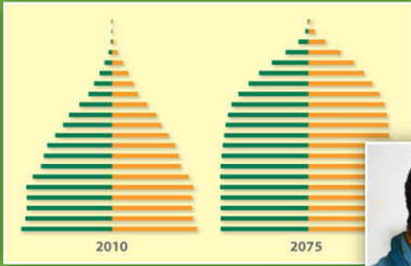


*Robert Holzmann, Edward Palmer,
and David Robalino, editors*



*Volume 2:
Gender, Politics, and
Financial Stability*

Nonfinancial Defined Contribution Pension Schemes in a Changing Pension World



THE WORLD BANK

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VOLUME 2 GENDER, POLITICS, AND FINANCIAL STABILITY

*Robert Holzmann, Edward Palmer,
and David Robalino, editors*



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Foreword

It takes time to discern the impact of reforms, especially those of a pioneering nature. Sweden was one of a handful of countries that developed and implemented a nonfinancial (notional) defined contribution (NDC) public pension scheme in the 1990s along with Italy, Latvia, and Poland.

One fundamental principle of our pension reform in Sweden was to honor the long-term commitment to Swedish pensioners and savers that the pension promise entails. With this in mind, we believed that small or gradual reforms would risk exacerbating the weaknesses of the system that was in place at the time. Sweden therefore embarked on a political journey entailing a significant systemic change to the pension system and the launching of an NDC scheme. The philosophy underpinning the reform was that the system should be financially stable in a changing demographic and economic climate and should, at the same time, create fairness between generations and income groups by diversifying economic, financial, and demographic risks.

Does this sound like a tall order? Yes, it was. But the systemic shift to an NDC scheme allowed us to embed these philosophies into the design of the Swedish pension system. We have a public, universal, and compulsory system that is based on the fundamental principles of socioeconomic fairness. A system where pensions are based on life-time earnings and correspond to the contributions paid into the system. The direct link between contributions and pensions has also created incentives to work, which are augmented by the actuarial structure of the system that has an annuity divisor based on remaining life expectancy at retirement. These features have, in hindsight, also been designed so as to create a structural gender balance, even if there is still a lot left to do to equalize the actual pension outcomes of men and women. The Swedish NDC scheme also allows for increased transparency, especially into the finances of the system. We have seen that this type of scheme puts greater decision-making demands on beneficiaries. As a consequence, policy makers and pension providers have a responsibility to provide understandable and comprehensive information to the public if the incentives and structures of the scheme are to work adequately.

Pension reforms are once again being triggered by the strained economic situation around the world. The economic crisis has highlighted weaknesses in pension systems across Europe, and reform has heavily influenced pension policy making over the past five years. Initially, the reforms in the wake of the crisis have been more reactionary and usually a part of government budget consolidation or stimulus packages. We now see a trend toward more structural reforms to ensure the long-term adequacy of pensions despite economic and demographic pressures.

Some other countries, such as Norway and the Arab Republic of Egypt, have recently chosen to move in the direction of NDC. The Swedish pension reform was implemented in 1999 and has, on the whole, been able to weather the stormy economic climate during the past 15 years. We do, however, recognize the need to review our pension reform to ensure that the structural shift we made is having the desired effects given changing labor market behavior and conditions, especially for women.

For this reason, the Swedish government was happy to co-fund a conference in Stockholm in 2009 jointly organized by the World Bank and the Swedish Social Insurance Agency. This meeting brought together a constellation of international experts who have examined the pros and cons of the designs of different NDC schemes. We have been able to draw policy lessons from other nations and revisit the founding ideas around our reforms and establish areas for further improvement. Those of us unable to attend the conference can still partake of the knowledge that was gathered then and is documented in this publication.

I would like to thank participating officials and experts from around the world for sharing their experiences and knowledge on this important subject as well as our colleagues at the World Bank and the Swedish Social Insurance Agency for their efforts in realizing a successful conference and this subsequent publication. I believe that due to these efforts we now have a good ground to review our reforms and pave the way for other countries interested in introducing NDC characteristics within their own pension policies.

Ulf Kristersson
Minister for Social Security
Stockholm, Sweden

Preface

The concept of nonfinancial (notional) defined contribution (NDC) was born in the early 1990s and implemented from the mid-1990s in a number of countries. This innovative unfunded individual account scheme emerged and created high hopes at a time when the world seemed to have been locked into a stalemate between making piecemeal reforms of ailing traditional pay-as-you-go defined benefit schemes and introducing pre-funded financial account schemes. Ten years after the first countries had implemented NDC, it had become a clear reform alternative for national pension schemes.

In a previous anthology (Holzmann and Palmer 2006), the emerging new idea of creating NDC pension schemes was scrutinized. That anthology documented the content of the conversation among leading academic and institutional experts. The first anthology emerged from the presentations and discussions originating at a conference held on the island of Sandhamn outside Stockholm in September 2003. It was a way to bring the fruits of this discussion of NDC innovation to a worldwide audience. The present anthology emerged from a second NDC conference, held in Stockholm in December 2009. The aims of the second conference and the present anthology, which emerged from it, are to offer a deeper and more comprehensive analysis and understanding of NDC, as it has progressed into its teens. This effort should ensure a successful adulthood and an even better start for its offspring.

The second anthology encompasses more than 50 contributions from about as many experts, and with this number of contributions it outgrew the reasonable limits of a single book. Consequently, the anthology has been published in two volumes. This is volume 2 of the two-volume series. Volume 1, titled *Progress, Lessons, and Implementation*, provides a detailed analysis of the experience and lessons in the pilot countries—Italy, Latvia, Poland, and Sweden; a presentation of the new legislated or implemented pilots following the NDC approach (the Arab Republic of Egypt and Norway); and general thoughts about the implementation of NDCs in other countries, including Chile (retrospectively), China, and Greece. One of the chapters also discusses whether selected NDC features can be “copied” in the context of defined benefit reforms, which has been the case in several countries of the Organisation for Economic Co-operation and Development. A main driver of all these reform efforts has been to move toward financial sustainability.

The importance of a solvent pension system came even more strongly into policy focus during the financial crisis of 2008–09 and the ensuing economic ripples in much of the world. The fiscal dilemmas of Greece, Italy, Portugal, Spain, some Eastern and Central European countries, and (potentially) other highly indebted countries have demonstrated how financially unsustainable pension systems can have undesirable repercussions. We are now seeing the market judging the creditworthiness of sovereign states, where a large

percentage of future commitments is the pension debt. Moreover, financial markets are likely to react increasingly to the level of uncertainty of pension liabilities and the resultant question of solvency. Public finance consolidation is unlikely to succeed without pension reform, particularly in the developed economies, where population aging has most progressed and where the survival rates of the retired population are increasing rapidly.

Developed countries are not alone in this picture. Fiscal concerns exist in middle- and low-income countries, where the United Nations demographic projections for the coming half century show considerable population aging. Many of these countries are already burdened by pension systems that are financially unsustainable despite their short histories. Others need to learn from the now considerable international experience in building national pension schemes.

A further challenge in middle- and low-income countries is the fragmentation and low coverage of current pension systems. Badly designed defined benefit schemes often operate in parallel with weak provisions for the portability of benefits that affect labor mobility and can create inequalities. On average, less than 30 percent of the workforce in middle- and low-income countries is covered by mandatory pensions; however, increasing coverage under the current regimes is proving difficult. Even where coverage is relatively high and increasing, no hope may exist for long-term fiscal sustainability without systemic change.

Against this background, NDC reform becomes attractive even in low- and middle-income countries. It brings to the table a pension scheme with fully transparent liabilities and a built-in approach to ensure solvency and financial sustainability. NDC is conceptually neutral in relation to individual labor supply decisions and has exactly the same potential to promote formality as financial (or prefunded) defined contribution (FDC) schemes, as opposed to typical defined benefit pay-as-you-go schemes. In addition, the design of NDC opens the door to integration, or at least harmonization, of parallel schemes and facilitates the portability of benefits. NDC schemes can also become the building block to design alternative arrangements that expand pension coverage to informal sector workers.

Another reason countries are taking an even closer look at NDC is that confidence in FDC, which many economists considered the preferred alternative for a national pension scheme, has been shaken by the repeated and severe financial crises of the 2000s. After this past decade of financial crises, FDC may be less attractive for many. In addition, quite a few experts now expect the financial market to deliver lower rates of return in the future, as populations age and move into the dissaving stage of their life cycles, with continued extreme fluctuations associated with phenomena other than economic fundamentals.

In addition, fiscal capacity and willingness to pay for transition costs to prefund schemes is likely to be reduced in view of a higher explicit public debt in many countries. Downplaying transition costs and ignoring the fiscal impacts of large economic shocks have proven deadly for reformed pensions systems in a number of countries in Latin America and Central and Eastern Europe. Against these constraints, an NDC reform offers an attractive alternative for emerging economies. Even in cases where the end goal is to have a fully funded pension system, NDC schemes can prepare the ground by setting an individual account system that is solvent but only partially funded by financial assets. As enabling conditions improve, the level of funding of the system can increase.

Volume 2 addresses these and other key issues under the title *Gender, Politics, and Financial Stability*. It includes in-depth analyses of these issues, most of which received little or no attention in the 2006 publication, nor for that matter anywhere else. The five

chapters in part III are about gender issues and may be the most complete discussion of the topic available—for NDC and well beyond. Part IV focuses on issues surrounding the political feasibility of NDC design, reform implementation, and communication to the participants. Part V consists of six chapters addressing issues of financial stability. These include critical micro- and macroeconomic aspects, such as the balancing mechanism, the use of a reserve fund, the handling of legacy costs, and technicalities related to the management of the longevity risk when designing annuities.

Although the two volumes of studies address many issues and in considerable depth, new questions nevertheless emerge from these discussions for which good answers are still not yet readily available. These issues are outlined and discussed in chapter 1 of volume 1 (Holzmann and Palmer 2012) and can be summarized here as follows:

- We need to focus even more on how the outcomes of NDC schemes measure up to the primary goals of pension systems compared to alternative scheme designs, in particular NDB and FDC alternatives, but also systems with components of matching defined contribution.
- Further work with measurement of assets and liabilities is called for with respect to the introduction, distribution of adjustments in liabilities, and overall sustainability of NDC schemes.
- We need to think more about how to best mix the pension portfolio to create optimal consumption smoothing and risk distribution for old age, which includes the roles of the other pension pillars, but also other benefits and taxes. Also, much more attention must be devoted to the details in creating the NDC annuity.
- What are the models for applying and implementing NDC in low- and middle-income countries and the issues associated with these? Here, as elsewhere, transition issues become key, but in this case with reference to the transition from household to market economies, the fact that large segments of the economy are informal, and so on.

In sum, the present volume moves the state of knowledge forward. It brings to the forefront and addresses in greater depth many issues that had only been skimmed previously. Importantly, it also brings to the forefront new issues. It is our hope that this volume, together with its companion volume 1, will contribute to more research and thinking about the design of pension schemes in general and NDC pension schemes in particular, and in addition, about how NDC schemes can be integrated with companion schemes and other components of social policy directed toward providing adequate old-age income within a sustainable financial framework.

Please read and enjoy.

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Robert Holzman, Edward Palmer, and David Robalino, editors

Abbreviations

ABM	automatic balancing mechanism
AFP	administradora de fondos de pensiones (pension fund administrator) (Chile)
AIME	average indexed monthly earnings
ALDA	advanced-life delayed annuity
APEX	Analysis of Pension Entitlements across Countries
APS	Aporte Previsional Solidario (Pension Solidarity Complement) (Chile)
ARIMA	autoregressive integrated moving average
ATP	Arbejdsmarkedet Tillaegspension (occupational pension scheme) (Denmark)
ATP	Allmän tilläggspension (defined benefit pension scheme) (Sweden)
BPS	Banco de Previsión (Social Insurance Bank) (Uruguay)
CASEN	Encuesta de Caracterización Socioeconómica Nacional (National Socioeconomic Characterization Survey)
CeRP	Center for Research on Pensions and Welfare Systems
CPP	Canada Pension Plan
DB	defined benefit
DC	defined contribution
DD	demographic divisor
DI	disability insurance
ED	economic divisor
EPI	Employees' Pension Insurance (Japan)
EPS	Encuesta de Protección Social (Social Protection Survey) (Chile)
EPV	expected present value
EU	European Union
EU-SILC	EU Statistics on Income and Living Conditions
FDB	financial defined benefit
FDC	financial defined contribution
GAD	Government Actuary's Department (United Kingdom)
GDP	gross domestic product
HPA	Historias Previsionales de Afiliados Activos, Pensionados y Fallecidos (Affiliates Pension Histories) (Chile)
ILB	inverse longevity bond
IMF	International Monetary Fund

IPD	implicit pension debt
IRR	internal rate of return
ITP	Industrins och handelns tilläggs pension (occupational pension scheme) (Sweden)
IZA	Institute for the Study of Labor
LB	longevity bond
MDA	les majorations de durée d'assurance (increases in the duration of insurance) (France)
MDC	matching defined contribution
MPG	minimum pension guarantee
NDB	nonfinancial defined benefit
NDC	nonfinancial (notional) defined contribution
NP	National Pension (Japan)
OASDI	Old-Age, Survivors, and Disability Insurance (United States)
OASI	old-age and survivors' insurance
OECD	Organisation for Economic Co-operation and Development
OLG	overlapping generations
OLS	ordinary least squares
OPZZ	Ogólnopolskie Porozumienie Związków Zawodowych (All-Poland Alliance of Trade Unions)
PAF	pooled annuity fund
PASIS	pensiones asistenciales (means-tested assistance pension) (Chile)
PAYG	pay-as-you-go (system)
PBS	Pensión Básica Solidaria (Basic Solidarity Pension) (Chile)
ppa	percent per annum
PPM	Premiepensionsmyndigheten (Premium Pension Authority) (Sweden)
PROST	Pension Reform Options Simulation Toolkit
PSU	public service unit
SERPS	State Earnings-Related Pension Scheme (United Kingdom)
SSA	Social Security Administration (United States)
TD	turnover duration
UISA	unemployment insurance savings account
VAT	value added tax
ZUS	Zakład Ubezpieczeń Społecznych (Social Insurance Institution) (Poland)

PART III

**The Gender Dimension of Pension
Reform with NDC**

Gender in the (Nonfinancial) Defined Contribution World: Issues and Options

Estelle James

Nonfinancial (notional) defined contribution (NDC) plans are designed to eliminate the work disincentives and nontransparent redistributions of defined benefit (DB) social security schemes without the transition costs and risk shifting that occur in the context of a switch to a funded defined contribution (DC) scheme. To a large extent, they sweep away the special privileges that, intentionally or inadvertently, accrue to various groups in traditional schemes and pay everyone in accordance with his or her own contributions. However, not surprisingly, these new provisions will have different effects on diverse population subgroups, including men and women. Most of the effects do not stem from explicit gender-specific provisions in the plans, but rather from the interaction of gender-free policies with differing demographic and employment characteristics of men and women. The same policies affect the two genders differently because of the more limited labor force attachment of women as a result of their childbearing and child-rearing roles, their lower earnings when they do work, their longer life expectancy, and the likelihood that they will eventually become widows and live alone in very old age. Although those differences were not at the forefront when NDC schemes were designed, they require a careful reevaluation in the fine-tuning process that is going on now.

From one vantage point, the same gender issues arise in all types of pension systems: decisions must be made about retirement age, earnings-related pension amounts, and safety net programs that have gender implications for the reasons already described. But certain gender-related issues are much more salient in DC plans than in DB plans, and others are easier to resolve in NDC plans than in financial defined contribution (FDC) plans. This chapter concentrates on those salient issues and differences.

Both FDC and NDC plans make certain design choices explicit that are implicit in DB plans. Although this feature allows for more informed decision making, it can also be politically sensitive and divisive. Policy makers must decide how to convert the retirement accumulation (whether notional or financial) into a stream of periodic payouts through decisions about pensionable age, annuitization, imputed interest rate, and indexation method, and those decisions affect men and women differently. Additionally, systems with dominant DC plans must make their redistributive goals explicit through the choice of safety nets, choice of survivor benefit programs, and use of unisex versus

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gender-specific mortality tables. Such choices generate redistributions between men and women and trade-offs among different subgroups of women in a way that is more transparent than in DB plans. Some policy choices that benefit women in DB plans (such as gender-differentiated retirement age) may hurt them in DC plans.

In some cases, the decision process is simpler for NDC plans than for FDC plans. NDC plans do not have individual investments and, therefore, do not have the problems that FDCs face and that stem from decentralized investment decisions. For example, some argue that women are more risk averse than men and that this aversion to risk will lead them to make investments that have a lower (and less volatile) expected rate of return. Therefore, women will have smaller pensions. This issue does not arise in NDC plans, where there are few, if any, assets. Any assets that do exist are in a buffer fund covering the overall system. Asset management is, therefore, done centrally, and imputed interest rates are uniform for all. Also, in the case of NDC plans, one need not worry about whether a competitive annuity market will function well at the payout stage or how private insurance companies will react if unisex mortality tables are required. Because the stream of payouts is not funded, private insurance companies are not involved, and payouts are simply made by the central authorities on a pay-as-you-go (PAYG) basis. In this sense, policy makers have greater discretion with respect to NDC plans than they do with FDC plans, which have multiple decentralized decision makers, each with his or her own preferences and information. This chapter throws light on how policy makers have used this discretion.

This chapter focuses on key choices with gender implications that must be made in NDC plans: retirement age, payout terms, safety net provisions, and arrangements for survivors and the very old. An earlier legal retirement age for women seems like a perk but contributes to their lower pensions. Because women tend to earn less than men do, safety net provisions are crucial to their welfare. If those provisions are not carefully crafted, however, they can induce behaviors that maintain women's dependent state. Because women live longer than men do, they face a greater risk of running out of money. Thus, rules regarding annuitization, indexation, survivors' benefits, and joint pensions determine their standard of living—and do not always protect the very old, who are disproportionately women. For each design feature, this chapter lays out some general analytic points and then describes the empirical situation. It tries to distinguish (a) between choices that tend to be made in NDC schemes and those that tend to be made in FDC schemes and (b) between effects that are inherent and those that are discretionary in NDC plans. Gender-related characteristics of current and projected NDC schemes in the Arab Republic of Egypt, Italy, Latvia, Norway, Poland, and Sweden are summarized in table 10.1. Table 10.2 shows the effect of joint annuities and unisex tables.

A basic tension becomes apparent between (a) the work incentive and fiscal discipline ethos of NDC pillars and (b) the more general poverty prevention and consumption-smoothing goals of the overall old-age and survivor systems in which they are embedded. Women tend to be at the core of those tensions. Safety net and survivor policies that are designed to protect the elderly from low incomes often discourage the incremental work that is needed for women to achieve financial independence. Policy changes that save money for the public treasury, such as reduced indexation and widow benefits, often come at the expense of the very old—a growing group, most of whom are women. The conclusion suggests steps that might produce better work incentives and protection for women without increasing the burden on others.

TABLE 10.1 **Gender-related characteristics of NDC plans**

	Egypt, Arab Rep.	Italy	Latvia	Norway	Poland	Sweden
<i>Retirement age in NDC pillar</i>						
1. Legal retirement age	60, men and women	65, men and women	62, men and women	67, men and women	65, men; 60, women	65, men and women
2. Early age reduces pension size	Yes	Yes	Yes	Yes	Yes	Yes
<i>Payouts from NDC pillar</i>						
3. Annuity required?	Yes	Yes	Yes	Yes	Yes	Yes
4. Public provision?	Yes	Yes	Yes	Yes	Yes	Yes
5. Actuarially fair? ^a	Yes	Yes	Yes	Yes	Yes	Yes
6. Payout dependent on life expectancy and retirement age?	Yes	Yes	Yes	Yes	Yes	Yes
7. Indexation method?	Price	75–100% of price, depending on pension size ^b	Price ^c	Nominal wage growth: –0.75%	80% price, 20% wage	Nominal wage growth: 1.6% ^d
8. Unisex tables used?	Yes	Yes	Yes	Yes	Yes	Yes
9. Imputed interest rate in annuity calculation	—	Expected real wage growth: 1.5%	0	Expected real wage growth: 1.5%	0	Expected real wage growth: 1.6%
<i>Safety nets accompanying NDC pillar</i>						
10. Minimum pension or income?	Yes if > 70 years old	Social assistance	Yes	Yes	Yes	Yes

(continued next page)

TABLE 10.1 **Gender-related characteristics of NDC plans (continued)**

	Egypt, Arab Rep.	Italy	Latvia	Norway	Poland	Sweden
11. Contributory requirement for minimum?	No	n.a.	10 years	No	25 years, men; 20 years, women	No
12. Is minimum indexed?	—	—	Price	Wage: 0.5% ^e	80% price, 20% wage	Price
13. Is couple's rate < 200% single's rate?	—	—	No	Yes	Yes	Yes
14. Phase-out rate (implicit tax)	30% against NDC pension	—	100% against NDC pension	80% against NDC pension	100% against NDC + FDC pension	100%, 48% against NDC pension
15. Share of retirees who get minimum top-up	—	—	60%, women; 40%, men	50%, women; 5% men ^f	n.a.	68%, women; 18%, men
16. Child-care credit	No	Yes	Yes	Yes	Yes	Yes
17. Credit reduced if retiree works	—	Yes	Yes	Yes	Yes	Yes
<i>Survivors' benefits and joint annuities in NDC schemes</i>						
18. Survivor benefits in working stage?	Yes, as DB ^g	Yes, as DB	For children only	Yes, as DB	For children, as DB	Temporary, if children
19. Survivor benefits in retirement stage?	Yes, joint annuity ^h	Yes, as DB	For children only	Yes, as DB	Yes, as DB	No

20. Offset against wages and own pension?	No	Yes	—	Yes	Yes	n.a.
21. Joint annuities allowed from NDC?	Yes ^h	No	No	No	No	No
22. NDC balance to widow or widower	No	No	No	No	No	No
23. Contribution splitting allowed?	No	No	No	No	Only FDC, at divorce	Yes

SOURCE: Author's calculations based on information provided by country informants.

NOTE: n.a. = not applicable; — = not available.

- a. "Yes" means expected present value of payouts = notional capital, given the person's retirement age and given the mortality table and discount rate stated in the rules (which may not be same as market rates).
- b. There is less than full-price indexation for large pensions.
- c. Between 2002 and 2008, partial wage indexation was used for small pensions. Indexation was frozen for 2009–10. Price indexation is expected to resume after 2010. Guaranteed part grows at the same rate as the full pension amount. However, because of fiscal pressures, old age pensions were decreased by 10 percent between July 1, 2009, and December 31, 2012.
- d. Nominal wage growth amounts to price indexation if real wage growth = 1.6 percent, as assumed in annuity calculation, and assets = imputed liabilities for the NDC scheme as a whole. If real wage growth is less than 1.6 percent, indexation is less than price, so real pension falls. If assets are less than imputed liabilities for the NDC scheme, the balancing formula reduces the real pension.
- e. This percentage is an estimate of the adjustment for increased life expectancy. Therefore, the minimum is not fully wage indexed.
- f. Of all minimum pensioners, 88 percent are women. This percentage is expected to fall over time.
- g. Benefits might be provided by the insurance company. Balance in the account would be transferred to the company, which would charge a premium to cover the risk.
- h. Joint annuity is mandatory if only one spouse has a pension; it is voluntary if both spouses have their own pension.

TABLE 10.2 **Simulated effect of joint annuities and unisex tables in Chile**

	Education				
	Incomplete primary	Incomplete secondary	Complete secondary	Up to 4 years postsecondary	5+ years postsecondary
<i>Males, retiring at 65 years (monthly payouts, 2002 US\$)</i>					
1. Individual: gender specific	217	314	467	651	1,501
2. Individual: unisex	200	290	431	601	1,385
3. Joint: gender specific	179	259	386	538	1,240
4. Joint: unisex	175	254	378	527	1,215
<i>Females, retiring at 60 years (monthly payouts, 2002 US\$)</i>					
5. Individual: gender specific	59	83	146	241	444
6. Individual: unisex	63	88	156	257	472
7. Widow's annuity	107	156	232	323	744
8. Widow's annuity + own annuity	167	238	378	564	1,188
<i>Ratios (%)</i>					
9. Widow's pensions as a share of husband's pension + wife's pension ^a	70	70	71	72	71
10. Widow's annuity as a share of widow's annuity + own annuity ^b	64	66	61	57	63
11. Percentage increase in wife's lifetime benefits stemming from joint annuity ^c	45	47	39	33	42

SOURCE: Author's calculations based on James, Edwards, and Wong 2008.

NOTE: Joint annuity assumes 60 percent to the survivor. The wife is assumed to be three years younger than the husband. Amounts are based on actual wages and employment rates for men and women by age and education in 1994, assuming a 5.0 percent rate of return during the accumulation stage, a 3.5 percent rate of return during the annuity stage, and real wage growth of 2.0 percent.

a. Pensions for widow as a percentage of the husband's pension plus the wife's pension = (own annuity of wife + widow's share of joint annuity after husband dies)/(own annuities of husband and wife while husband was alive).

b. Joint annuity for widow as a share of the widow's annuity plus own annuity = (widow's share of joint annuity after husband dies)/(own annuity of wife + widow's share of joint annuity after husband dies).

c. This figure is calculated as follows: (expected present value of widow's share of joint annuity)/(expected present value of own annuity + widow's share of joint annuity).

Retirement Age, the Retirement Decision, and Actuarial (Un)fairness

All three schemes—NDC, FDC, and DB—must make explicit decisions about the “standard” or “statutory” retirement age, preconditions for early retirement, and gender differences in any of these matters.¹ Most analysts would probably agree that women should not have an earlier allowable retirement age than men have, and monthly pension amounts should fall for workers who take early retirement. However, many DB plans contain the opposite provisions—earlier pension age for women and little or no penalty for earlier retirement. Such provisions lead workers to retire “too early” in the sense that their retirement imposes a heavy fiscal burden on the scheme’s financial pool, they stop work while still potentially productive, and they may end up with very low pensions in very old age. Indeed, such outcomes were one reason for the switch to DC plans, which build in an automatic actuarial connection between the benefit amount and workers’ contributions, their age when the pension starts, and their future expected life span. Close examination of these new constraints and incentives suggests that they affect men and women differently.

THE IMPACT ON WOMEN’S PENSIONS OF EARLIER STATUTORY RETIREMENT AGE IN DB VERSUS DC PLANS

The statutory (“standard”) retirement age is the age at which individuals can receive a full defined benefit or can start their DC pension without meeting any special preconditions. In many countries, the statutory retirement age of women is earlier than that of men. The reason sometimes given is that women who worked in the market also worked at home, so in compensation for having two jobs, they should be able to retire from one (their market job) earlier. Another possible explanation is that husbands, who are generally older, want their wives to retire at the same time they do. But this rationale ignores the fact that women work less and live longer than men; thus, if anything, a higher pensionable age could be justified. The earlier retirement age for women reduces the expected years of work and, therefore, the incentive for on-the-job training and the resulting wage growth, whether the scheme is DB or DC (James 2009b).

However, earlier retirement has different effects on monthly pensions in DB and DC schemes, because DC schemes are, in principle, actuarially fair, while DB schemes are not. In an actuarially fair pension schemes, (a) the expected present value (EPV) of lifetime contributions equals the EPV of lifetime benefits, (b) the EPV of incremental contributions equals the EPV of the incremental monthly benefits that accrue, (c) the postponement of the start of pension (holding everything else constant) raises monthly benefits enough to hold the lifetime EPV constant, and (d) a higher life expectancy results in a lower monthly pension because a given EPV spreads contributions over a longer lifetime (see Disney, Queisser, and Whitehouse 2006).² In an actuarially unfair scheme, those equivalences do not hold, thus creating a tax wedge between gross and net remuneration.

In actuarially unfair DB scheme, the incremental pension often becomes negligible beyond some point, and there is little or no reward for pension postponement. Consequently, an earlier statutory retirement age gives women additional years of leisure without diminishing their monthly benefits much. The financial cost of longer pensions is borne

by the scheme's pool. In contrast, in DC schemes (both FDC and NDC), the EPV of the lifetime benefit stream equals the EPV of total contributions, and any incremental contribution or pension postponement results in a commensurate increase in monthly benefits. In such cases, the women themselves bear most of the cost for an earlier retirement age by receiving a lower monthly pension. In a typical FDC scheme in Latin America, women's pensions would increase by 40 to 50 percent if the women deferred their pensions from age 60 to 65, and their pensions would increase even more if they worked during those extra years (James, Edwards, and Wong 2003, 2008; James 2009b). Norway has estimated an increase of 35 to 40 percent from five years of postponed pensioning in its new NDC scheme (Christensen et al. 2012). Thus, keeping the standard retirement age lower for women increases the gender differential in monthly benefits when a country shifts from DB to FDC or NDC.

Most high-income schemes in member countries of the Organisation for Economic Co-operation and Development (OECD)—both DB and DC—have moved in the direction of raising the statutory retirement age for women to that of men, although this issue remains politically contentious. An FDC country, Chile, was unable to equalize normal retirement ages for the genders, even as a trade-off for the large public benefits recently granted to women (James, Edwards, and Iglesias 2009). Among NDC countries, Latvia is equalizing the pension age for men and women, while Poland has been unable to achieve the political consensus till very recently.

EARLY RETIREMENT RULES AND THE ROLE OF INCENTIVES IN DC PLANS

More important than the standard retirement age is the earliest allowable retirement age, which is usually lower. In most DB plans, many individuals start their pensions as soon as they are allowed to do so and stop work at the same time (Gruber and Wise 1999, 2004). Under those plans, the earliest allowable pension age is the binding constraint; most workers never reach the “standard” age. One might expect that this scenario would be less true of DC plans, because actuarial fairness gives workers an incentive to work longer and start their pensions later. Indeed, one does observe that when DB plans become more actuarially fair or when DC plans are introduced, people work longer (Disney and Smith 2002; Lluberas 2007; Song and Manchester 2007). In Chile, workers postponed pensioning and stayed in the labor force when the scheme shifted from DB to FDC, and the response was greater among women than men (Edwards and James 2010, 2011).³

Nevertheless, some sources of actuarial unfairness persist in mandatory DC schemes because they impose parameters that constrain choice and that differ from the retirement preferences of heterogeneous individuals. For example:

- A worker may be forced to save more than he or she would voluntarily choose.
- The worker's time preference for choosing leisure over labor may dictate withdrawals sooner than permitted.
- The worker may wish to make riskier investments than are allowed.
- He or she may wish to use the savings to cover emergency needs during the working or early retirement stage.
- He or she may be in ill health and, hence, may not expect to live as long as indicated by the mortality tables used by the scheme to determine monthly payouts.

This disparity between plan regulations and individual preferences may be especially great in NDC schemes because the interest rate that accrues is uniform for all (and, hence, does not allow any adjustment for heterogeneous risk preferences) and because it depends on the growth rate of wages, which is usually lower than the market interest rate. Often the imputed real interest rate is zero at the annuity stage. This lower interest rate is not inevitable in NDC plans, but it is a common political decision that may be used to maintain the fiscal sustainability of the scheme in the face of payroll-based revenues and rising dependency rates. In contrast, the individual's subjective discount rate may be closer to the capital market rate. In fact, for nonsavers, it is greater than the capital market rate. With discounting at those higher rates, such individuals will find that the incremental mandatory contributions exceed the benefits from working longer and from postponed pensioning. The heterogeneity among worker preferences means that some workers will postpone retirement because of increased actuarial fairness when the scheme shifts from DB to NDC, whereas others will continue to retire at the earliest allowable age.⁴ The choice of earliest allowable age is, therefore, critical and has implications for gender differentials.

In some countries, early pensioning is constrained simply by age. For example, in Sweden, workers can start their NDC pension any time after age 61, although the income guarantee does not apply until age 65. But in other cases, workers are allowed to start their pension early only if the potential pension amount is above the minimum income guarantee that is found in most NDC countries. This rule is planned for the new NDC schemes in the Arab Republic of Egypt and Norway and has been implemented in some FDC schemes in Latin America. It is a more effective response to moral hazard stemming from the minimum income guarantee. Under the Swedish approach, a person could stop working and start using up his or her notional capital at age 61, even if the pension is below the minimum guarantee, thus leaving a bigger gap for the public subsidy to fill at age 65. In contrast, under the Norwegian approach, a person would not be able to start drawing down his or her notional capital before the standard retirement age. Such a person is, therefore, likely to continue working, unless his or her own pension exceeds the minimum.

Women are more likely than men to qualify for the subsidy, and they are less likely to meet this precondition for early retirement in DC plans because of their low wages and interrupted careers. That is, when the earliest allowable age is defined in terms of a threshold pension, it is a more binding constraint for women than for men—a matter of some concern in the Norwegian debate (Christensen et al. 2012). Women benefit the most from the guarantee, but early retirement rules that are designed to protect the public treasury also constrain their behavior the most. For similar reasons, in Chile's FDC schemes, early retirees (people who start their pension before the standard age) are mainly men; women are more likely to receive the minimum pension guarantee. So even when the same early retirement rules apply to both genders, their actual retirement ages may differ because of their differing labor market experiences.

In sum, women pay a higher price for an earlier gender-specific statutory retirement age under DC plans (both FDC and NDC) than under DB plans. If they continue to retire at the earlier statutory age, they will find their monthly pension falling further behind that of men who retire at the later male retirement age. Pro-work incentives in DC plans may induce some women to postpone retirement voluntarily, but incomplete

actuarial fairness means that many will cease work and will start their pension as soon as they can. Therefore, as a first step toward gender equality of pensions under DC plans, it is important to equalize the normal retirement age. As a second step, the same early retirement rules should apply to both genders. However, if this rule allows the pension to start early only when it is above society's minimum acceptable income, women who have worked intermittently will find it more difficult than men to satisfy that condition. Having worked less when young, they are constrained to work longer when old to meet this threshold.

Payout Issues

Both NDC and FDC schemes must decide whether annuitization is mandatory, what forms the annuitization should take, what interest rate should apply in determining monthly payouts, whether unisex tables must be used, and whether the annuities should be price or wage indexed.⁵ In general, mandatory annuitization protects women more than men, because women live longer and are, therefore, more likely to run out of money before death if annuitization is not required. But a low discount rate hurts women disproportionately for the same reason. Indexation—especially wage indexation—shifts retirement resources away from the young-old toward the old-old, who are predominantly women. The required use of unisex tables in benefit calculations redistributes from the average man to the average woman. This effect is enhanced by mandatory annuitization and indexation, because under unisex tables, women are not charged extra for the fact that they predominate in the older age groups that benefit the most from indexation, and men cannot legally escape the cost. Unlike safety net arrangements that deter women's market work as they redistribute to women (see the section titled "Safety Nets"), unisex requirements may encourage women's work by increasing their rate of return to contributions but may discourage men's work for the converse reason.

MANDATORY OR OPTIONAL ANNUITIES?

Public DB plans, in principle, pay a pension for life; the option of lump-sum payouts is usually not even given. This scenario is advantageous to women, who may live 30 or 40 years after retirement. In contrast, in a DC plan, workers build their retirement savings—which they consume during their retirement period—but they do not automatically receive a lifetime pension. If lump-sum or flexible withdrawals are permitted, short-sighted workers may use up their savings well before their death. Women are especially prone to outlive their savings, because of their greater longevity and smaller voluntary saving. This problem is accentuated in households where husbands have dominant decision-making power over family resources and place greater weight on consumption during their own shorter lifetimes. When the husband dies, the wife is left with the risk of inadequate savings. Moreover, expected lifetimes have been increasing by about one year per decade (i.e., an average person born a decade later will probably live a year longer). Workers may not take this fact into account in their calculations, instead basing their expectations on the experience of their parents, who had much lower expected life spans. Giving retirees discretion about the payout from their DC accounts produces the danger that very old women will find themselves without a means of support.

Annuities solve this problem by providing longevity insurance. With annuities, retiring workers turn over their retirement savings to a (public or private) insurance company, which takes on the longevity and investment risk and guarantees a monthly benefit for life. DC schemes can protect workers from uncertainty and short-sightedness by requiring or encouraging annuitization. Annuitization pushes some potential income flow and consumption into the distant future, thereby protecting society from the liability of supporting very old individuals—predominantly women—who have outlived their retirement saving. Thus, such rules are consistent with the dual objectives of avoiding poverty and controlling fiscal costs. However, individuals who prefer to spend their savings sooner, who are in ill health and expect to die young, or who want access to their money during emergencies will resist mandatory annuitization.

Countries with FDC schemes have reacted in very different ways to these pushes and pulls. Lump-sum withdrawals are allowed in Australia's mandatory DC plan, thus making the accounts less restrictive and more attractive. Australia is counting on its flat public benefit to provide a floor on old-age consumption. But if senior citizens use up their retirement savings quickly, this provision will put a big burden on the government's budget as the population ages. And older women may find that their standard of living falls dramatically when they are left with only the public benefit. At the opposite extreme, annuitization is mandated in Sweden's FDC plan to help ensure that everyone has a life-long income without imposing a cost on the public treasury. The FDC annuities are provided by the same organization that handles NDC annuities, but retirees have a choice between fixed and variable annuities and between individual and joint annuities.⁶

In Chile and in most other Latin American FDC countries, retirees can choose between annuitization, gradual withdrawals according to a schedule set by the regulator, and gradual withdrawals backed up by deferred annuities. Gradual withdrawals are permitted, in part because of the high degree of inequality that exists in those countries. Low-income workers have much shorter life spans than do high-income workers, so if both were put into the same mandatory annuity pool, the former would end up cross-subsidizing the latter—a perverse redistribution. Such redistributions (and monthly amounts) are further reduced by the prevalence of guaranteed payment periods of 10 to 20 years, which are chosen by individuals who expect to have a short life span. Chile, which requires joint pensions for married individuals, recently began allowing variable annuities and now permits the withdrawal of a lump sum after the annuity size has passed a high threshold. Private companies provide the annuities, and competition forces them to discount according to the interest rate they can earn when investing the premiums. Since 2008, retirees who choose gradual withdrawal have been required to set aside a special reserve fund to draw on when their account is exhausted. This requirement is intended to mitigate moral hazard. Two-thirds of all current pensioners have annuitized and receive the Chilean risk-free interest rate, which has been much higher than the rate of wage growth (James, Martinez, and Iglesias 2006). Poland has also recently mandated annuities in its FDC plan, which are to be provided privately. Some other countries in Eastern and Central Europe have not yet made a decision on this issue.

In contrast, there is much greater uniformity among NDC schemes and less choice to workers on payout mode: all schemes require annuitization, the annuities are provided by a public agency, and they must be individual (except for the projected plan in Egypt, which will be described later). NDC schemes are much like PAYG DB schemes in this

regard. Having no funds in their accounts, workers may have less sense of private ownership in an NDC plan than an FDC plan—and, therefore, less expectation that they will have some choice of payout mode. Central provision is necessary unless the public agency is prepared to prefund the lifetime pension at the point when the individual retires—but such a provision would run counter to the PAYG ethos of the NDC model.

The imputed interest rate used in the conversion of notional accumulation to annuity is low—zero in the case of Latvia and Poland, a real rate of 1.60 percent for Sweden, and a rate of 1.5 percent in Norway. Such rates are lower than the prevailing rate in Chile over the past three decades—and lower than the risk-free (treasury) rate in most countries. It is, of course, the rate chosen by a mandatory public monopoly, not by the competitive market, and it is consistent with the low notional return during the accumulation stage as well as the sustainable PAYG rate. The low interest rate produces a low initial payout and is one of the reasons many individuals conclude that these schemes are not actuarially fair to them personally. It also produces a lower lifetime income stream, especially for individuals who live long lives, who are predominantly women. Women benefit from mandatory annuitization in NDC scheme but lose from the low discount rate applied.

UNISEX TABLES

One of the most contentious issues in a DC social security scheme concerns which individual characteristics should be taken into account in selecting the appropriate mortality table for converting the individual's retirement accumulation into his or her annuity. The most salient characteristic in this regard is gender, because the life expectancy of women is generally about three years greater than that of men.

In DB schemes, community rating is implicitly used. That is, the same formula applies to all individuals regardless of gender, health, or other characteristics. In a DC regime, explicit rules are needed. The basic idea is that the EPV of lifetime payouts approximately equals the retirement balance in the DC account (Brown et al. 2001; James and Vitas 2001; James, Martinez, and Iglesias 2006). The question is, which mortality tables go into the EPV calculation? In an FDC scheme, if unconstrained competitive insurance companies provide the annuities, they may take into account many factors—such as health status, parental history, and race—to put people into different mortality risk categories that yield different monthly payouts from a given premium. Should they be allowed to put men and women into different categories (i.e., to use gender-specific mortality tables in calculating expected lifetimes), or should regulations require unisex tables?

If gender-specific mortality tables are used, women's monthly pensions will be smaller than those of men with similar retirement accumulations so those pensions compensate for the longer expected period of payment. In contrast, unisex tables assume a common (average) survival probability for men and women. Because both genders are treated as if they have the same expected lifetimes, the monthly pensions of women are raised, and those of men lowered, relative to gender-specific tables. This treatment implies a redistribution of income to women, who get back more over their lifetimes than they paid for. As discussed later, this redistribution is particularly large if wage indexation is used, thereby back-loading the annuity payouts. Besides the redistributive effects, the higher return on women's contributions may lead women to work longer than they would have otherwise—if they correctly calculate the payoffs. The opposite is true for men.

The chief argument in favor of the unisex requirement is that it tends to equalize the monthly benefits and, therefore, the standard of living of men and women. Those in favor also point out that the life expectancy distributions of men and women are wide and overlapping, so it is unfair to attribute a higher average lifetime to all women, which would penalize them because of an average characteristic of their gender.

The chief arguments against the unisex requirement are that it implies a lifetime redistribution from men to women that may not be equitable; in some cases, it redistributes from low-income men to high-income women. The unisex requirement poses implementation problems in FDC schemes, including adverse selection by individuals and cream skimming by insurance companies. When men do their own calculations, basing the figures on male mortality rates, they will find that the true EPV of their incremental contributions exceeds the EPV of their benefits. So they have an incentive to stop contributing and take their money out as soon as possible. For women, the unisex requirement has the opposite effect. If annuities are not required, men may avoid them, because under unisex tables, they will get poor terms. Such behavior is a form of adverse selection. Under that scenario, the market may end up dominated by the risky group—females—and their higher longevity rates.

In the opposite direction, insurance companies will use cream skimming. They will try to attract men, who are lower risk and, therefore, more profitable, and they will avoid female annuitants who will likely live longer. For those reasons, unisex tables should probably not be imposed unless annuitization is mandatory and exclusion is prohibited. Even if not legally permitted to exclude women, companies may concentrate their marketing or offer better rates in occupations and industries where men dominate. In competitive markets, companies that end up with a disproportionate number of women will make a loss and may become insolvent. To counter those effects, a risk-adjustment mechanism may be desirable in countries with a unisex requirement, but such mechanisms are themselves difficult to implement.⁷

The implementation arguments are not relevant in NDC schemes where annuitization is mandatory and provided centrally, but the equity arguments—pro and con—remain. Equity is in the eye of the beholder; there is no objective right and wrong. If one evaluates this issue, it may be relevant that the changes in monthly income and lifetime redistribution under the unisex requirement are surprisingly small—only 2 or 3 percent—in the context of joint annuities purchased by married couples. The reason is that the mortality rates of both spouses enter into the determination of payouts in joint annuities whether or not unisex tables are used. But joint annuities are not permitted in current NDC plans. The effect of the unisex requirement is more noticeable—7 or 8 percent—for individual annuities (see table 2 of James, Edwards, and Wong 2008). And it is still larger in the low-interest-rate context of NDC plans, which give relatively heavy weights to distant years in annuity calculations. Nevertheless, even in the latter case, unisex tables have a much smaller effect on women's living standards than joint annuities would have—or equal retirement ages in countries where they are now unequal. And they have a less beneficial effect on poverty than does the redistributive safety net, because most women who benefit are not poor, whereas some men who implicitly pay by getting lower pensions are poor. In this sense, the benefits (and costs) of unisex tables may be overstated.

What have countries done? All NDC countries require unisex tables, and European countries are also moving toward unisex tables in their FDC plans, but with a bit more

debate. Poland recently made this decision, adding a risk-adjustment mechanism. More generally, in the European Union, community mortality tables are required when accounts in the mandatory FDC or NDC pillar are annuitized.⁸

At the opposite end, most Latin American countries allow the use of gender-specific tables and other risk categorization by insurance companies issuing annuities for their FDC plans (see James, Martinez, and Iglesias 2006). The United States does not have a mandatory DC plan but does have voluntary employment-based DB and DC plans. Employment-based DB and DC plans that annuitize are legally required to pay equal monthly benefits to men and women, thus implying unisex tables, and a joint benefit is also required unless the spouse specifically waives that right. However, DC accumulations are typically paid out in a lump sum or are rolled over into retirement accounts that are not under the employer's control. If the worker later decides to annuitize, this annuitization takes place outside the employment relationship, and gender-specific tables may be used. The rules could be quite different if those or similar accounts became part of the mandatory system.

INDEXATION RULES AND THEIR INTERACTION WITH UNISEX TABLES

Future price changes and wage growth are uncertain. Who bears this risk in a pension scheme? Indexation policy deals with this issue. Pensions can be nominal, indexed to prices, or indexed to wage growth. The indexation method chosen plays a key role in determining the distribution of retirement resources between the young-old and old-old and between the two genders.

In the past, in traditional PAYG DB schemes, many countries simply promised nominal benefits—the dollar amount was unchanged regardless of what happened to prices or wages in the broader economy. Hence, in an inflationary context, the purchasing power of the benefit gradually eroded. Retirees were thus exposed to the risk that their pensions would eventually become worthless. This lack of indexation particularly hurt women because of their greater longevity. Their lifetime real pension was much less than it appeared initially.

Currently, many countries index the DB to inflation, so the real value remains constant as prices rise. The scheme's treasury bears the inflation risk. However, if wages are growing, the purchasing power of pensioners will decline relative to that of workers over the retirement period—which is part of the reason very old women are often relatively poor. Wage indexation maintains the relative position of workers and pensioners. Such indexation is especially valuable to retirees with long expected lifetimes—predominantly women. But it costs much more than price indexation and could result in transfers to older generations or fiscal unsustainability in PAYG DB schemes. Given this trade-off, some countries use a mix of wage and price indexation; the 50 percent mix in Switzerland is best known.

In decentralized FDC plans, options are more limited, because costs cannot be passed on to future generations. Instead, if risk classification is unconstrained in the annuity market, the EPV of each individual's lifetime annuity stream is set to equal his or her retirement accumulation—assuming a money's worth ratio of close to 100 percent, consistent with empirical analyses (see Brown et al. 2001; James and Vitas 2001). Subject to this constraint, annuities can be specified in nominal terms or price indexed. The latter is more costly to insurance companies, because they are bearing the risk of inflation. They

pass this cost on to retirees in the form of a risk premium that reduces the rate of return, which, in turn, depresses the payout stream.

In Chile, all annuities are price indexed, yet companies base their pricing on a relatively high rate of return because many price-indexed financial instruments are available for insurance company investments and hedging (James, Martinez, and Iglesias 2006). But those instruments are unavailable in most low- and middle-income countries (and even in some high-income countries). In view of such considerations, Poland has not yet decided how to index its FDC annuity and is considering tying it to investment return. Wage-indexed annuities are practically impossible for private insurance companies to provide in FDC plans because risk is high and hedging instruments are unavailable.

In principle, NDC plans with centralized annuity provisions have a wider range of options. Because there are no assets to invest and private insurance companies are not involved, the absence of hedging instruments is not an impediment to wage indexation. The plans can choose to index annuities to wage growth or price growth or to simply leave them unchanged in nominal terms. Those choices determine the time stream of payouts over an individual's lifetime, the types of redistributions that occur within a given cohort, and the likelihood of spillover costs across cohorts. The indexation practices observed are consistent with this wide latitude for choice, albeit closest to price indexation. Latvia indexes to prices, although indexation has temporarily been frozen and pensions have even been cut. Egypt plans to use price indexation. Italy indexes to price, but only to 75 percent of price for high earners. Poland is a bit more generous—80 percent to price but 20 percent to average earnings, which generally grow faster than prices.

Sweden's indexation is more complicated: An expected rate of real wage growth of 1.6 percent is used as the imputed interest rate in its initial pension calculation. In subsequent years, payouts are indexed by nominal wage growth minus 1.6 percent. If realized real wage growth turns out to be 1.6 percent, price indexation results: $\text{indexation} = \text{price} + \text{real wage growth} - 1.6 \text{ percent} = \text{price}$ if real wage growth = 1.6 percent. If actual wage growth is less than 1.6 percent, indexation is less than full price; it is more than price if—and only if—wage growth exceeds 1.6 percent.⁹

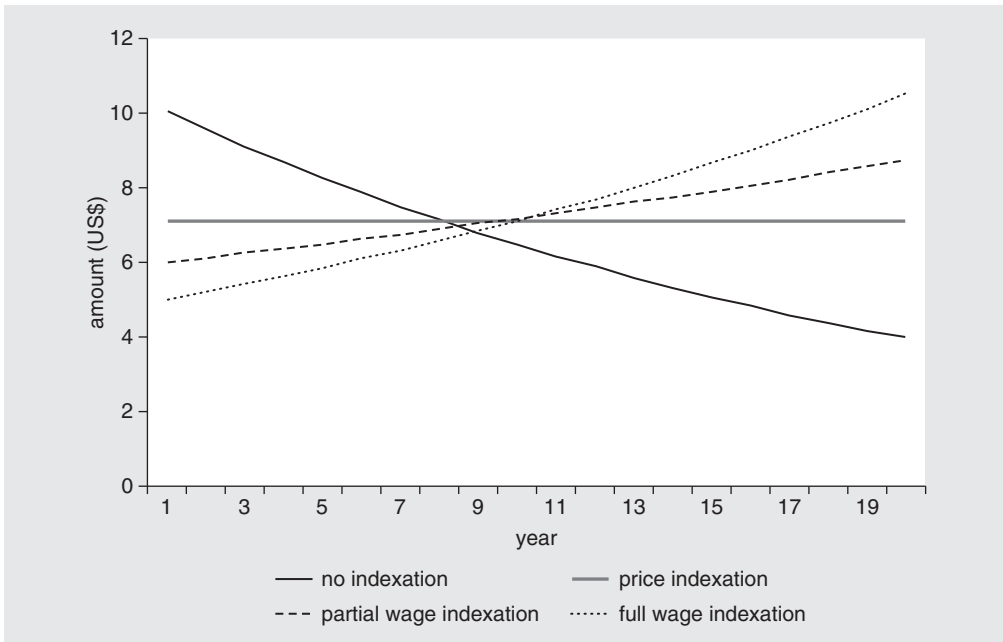
Norway is more likely to raise real pensions over the retirement period, because the initial pension is based on an expected wage growth of 1.50 percent, whereas future payouts are indexed by nominal wage growth of -0.75 percent. (If realized real wage growth is 0.75 percent or below, price indexation results, whereas if wage growth is faster than 0.75 percent, indexation is more than price level change.) The lower initial payout permits higher expected future payouts while staying within the constraint set by the individual's notional accumulation.

Basically, NDC schemes that strive to be actuarially fair and to pool mortality risk within a given cohort face a trade-off between the size of the initial pension and the size of the future pension, as determined by the imputed interest rate and the indexation method. Suppose that the scheme's imputed rate of return is the growth in wage rate or wage bill, and suppose that gender-specific mortality tables are used in the annuity calculation, which implies pooling risks separately for each gender. Then, if the EPV of the time stream of lifetime benefits is held constant at the notional accumulation, the choice of indexation method does not produce gains or losses for a given individual or gender-cohort group. It simply changes the time stream of ex ante benefits for the individual and the distribution of ex post benefits within each group. Full wage indexation requires that a

lower interest rate be used in the annuity conversion, so the initial pension is smaller than it would be for price indexation because the pension is expected to rise more in the future. Price indexation implies a lower interest rate and initial pension than no indexation. Wage indexation pushes more of the individual's benefits into the distant future (figure 10.1). People who live longer than expected gain ex post, whereas those who die unexpectedly early lose.¹⁰

However, use of unisex mortality tables implies pooling risks across both genders. In that scenario, a movement toward wage indexation implies an increase in the EPV of total benefits for the entire group of women in each cohort (i.e., a redistribution from men to women takes place), because women will disproportionately survive to collect the larger benefits in the end. Thus, women (and healthy and high-income people, who typically live longer) would have gained if Sweden had chosen a lower imputed interest rate in its annuity calculations. Such a rate would imply a smaller initial pension and a larger adjustment for wage growth subsequently. This situation would have increased the rate of return to women's contributions and would potentially have generated a positive incentive for women to work longer (the opposite would hold true for men). But the larger initial

FIGURE 10.1 Real annual payouts over lifetime: Using the imputed interest rate and indexation method to determine the time stream of real benefits for a given retirement accumulation



SOURCE: Author's calculations.

NOTE: The figure assumes the following: expected present value of lifetime benefits = notional accumulation at retirement; expected lifetime = 20 years after retirement; notional accumulation = 100; inflation rate = 5 percent yearly; real wage growth = 4 percent yearly = imputed real interest rate for scheme; nominal wage growth = 5 + 4 = 9 percent yearly; $K = 2$ percent yearly; imputed interest rate for initial payout in annuity conversion = expected nominal wage growth in "no indexation" case, expected real wage growth in "price indexation" case, expected real wage growth - K in "partial wage indexation" case, and 0 in "full wage indexation" case. Future nominal pensions are indexed up to nominal wage growth - imputed interest rate. Future real pensions are indexed up to real wage growth - imputed interest rate used in annuity conversion.

pension implied by the higher imputed interest rate probably made price indexation a more politically palatable goal, even among women.

Safety Nets

NDC plans tie benefits closely to contributions so they leave noncontributors and low contributors with little or no pension in old age.¹¹ From one point of view, this situation may not be a problem. Women who managed without wages when young may be able to manage without pensions when old. They may have some other source of income. From another vantage point, however, it may be a big problem. Some women did not work when they were young because they were caring for children and their husbands supported them. When they are old, their husbands may be dead or they may have divorced; hence, they may no longer have this alternative means of support. Some people who have not accumulated pension rights worked in the informal labor market when they were young. When they grow old, they are no longer able to do such work. Some low earners who barely subsisted on their wages when they were young will live in poverty if they do not have a similar amount when they are old, but their pensions may be much less because of their small contributions and the low rate of return in the NDC plan.

Several policy options exist for solving this problem. For example, the extended family may continue to support the wife or mother. Maternity and caring credits can be given to women who stay at home to perform nonmarket functions that society values. Survivors' benefits can be paid to those who depended on their spouses, or the spouse can be required to purchase a joint annuity (discussed further later). The family's retirement accumulation can be split continuously or upon divorce. Nevertheless, very old women who did not work regularly are a common poverty group. Many countries have chosen to use safety nets for noncontributors and low contributors to avoid this outcome.

In DB countries, the safety net is sometimes implicitly embedded in the DB formula. For example, the accrual rate may be higher for the first 10 years or for the first tranche of income. But in DC countries, the safety net arrangement must be explicit and separate from the DC pillar, which is itself largely nonredistributive. What kinds of safety net arrangements have been and should be chosen by NDC countries? Men and women are affected very differently, depending on whether the benefit is flat or phased out against other income or is simply a minimum pension guarantee; depending on whether it is for all residents or only for contributors; and, if the latter, depending on how many years of contributions are required for eligibility.¹²

UNIVERSAL FLAT BENEFIT

To keep the elderly out of poverty, some countries offer a flat (uniform) pension to all residents once they pass an age threshold such as 65. The Netherlands and New Zealand are the best-known examples. Norway and Sweden also had such pensions before their NDC reforms. Those arrangements set an income floor for each elderly person, regardless of whether that person has contributed. Typically, the flat benefit is financed from the government's general budget. It is redistributive because all elderly residents receive the same amount even if they had no market earnings, but those with high incomes pay more to finance it. In low- and middle-income countries with more limited fiscal capacities

(Botswana, Nepal, and South Africa), the flat benefit is smaller and usually starts at a very old age such as 70 (Palacios and Sluchynsky 2006). Egypt will have such a provision when it starts its projected NDC plan.

Women are major gainers from such universal uniform pensions—particularly older cohorts of women who did little or no market work. They get the same monthly pension as men, but because they live longer, they get a larger EPV of lifetime gross benefits. And their lower labor market earning implies a small tax payment toward financing the cost. Thus, as a group, they get an income redistribution from men. Those arrangements may, to some extent, discourage market work by women, because they provide additional lifetime income and pension wealth. Hence, they allow women to allocate more time to household work or leisure. However, the work disincentive or implicit tax cost attributable to the phase-out for high earners is absent. For any given pension floor, this method is the most costly but least distortionary way to achieve the income support objective. Currently, no NDC country uses such an arrangement.

PHASED-OUT FLAT BENEFITS, MINIMUM PENSIONS, AND THE IMPLICIT TAX ON LABOR

In an effort to cut costs, most countries phase out the noncontributory flat benefit as contributory pensions and other income grow. The phased-out flat benefit is even more redistributive from high earners to low earners than the pure flat benefit, because high earners get little or no benefit while paying most of the tax cost. This system sets a floor for those who have no other retirement income. If their contributory pension grows, their total pension also grows, but this growth is partially offset by the decline in their flat benefit.

The phased-out flat benefit is fiscally attractive, but it poses an efficiency cost: it is much more distortionary than the pure flat benefit, because the phase-out rate becomes an implicit tax on work. This phase-out rate varies widely across countries, from 15 percent to 50 percent. Some portion of the benefit is usually received by 25 to 75 percent of the population, and the implicit tax deters formal work by that same group. By now it is well established that workers respond to implicit taxes in the old-age security system, especially when making decisions about when to start the pension and stop working (Gruber and Wise 1999, 2004; Disney and Smith 2002; Song and Manchester 2007; Edwards and James 2010). Women are disproportionate recipients of phased-out flat benefits and the implicit tax that they generate. This safety net is the most common type used in NDC countries.

For example, when Sweden introduced its NDC plan in 1999, for fiscal reasons it converted its pure flat benefit to a benefit that phases out at a 100 percent rate for the first tranche and at a 48 percent rate subsequently. The switch from a pure flat benefit to a phased-out flat benefit reduced lifetime benefits for a large group of women who divided their adult lives between work in the market and work at home. Previously, the women received the entire flat benefit as a large proportionate addition to their own pension, but now their flat benefit has been partially phased out (Ståhlberg et al. 2006; Ståhlberg, Kruse, and Sundén 2006). Currently, almost half of all pensioners (68 percent of females and 18 percent of males) receive some top-up from the treasury. The Swedish pension authorities estimate that in the future, to exceed the phase-out range, average earners will have to work at least 20 to 24 years if real wage growth is 1.8 percent—longer, if wage growth is lower (Swedish Social Insurance Agency 2008). Thus, a high proportion of

women will continue to receive some part of the safety net benefit and will be subject to its high implicit tax. They will be largely immune to the work incentives that the NDC is supposed to pose.

Norway previously had a small, pure flat benefit for everyone, combined with a phased-out flat benefit above that level. Its new NDC scheme will simply include a modified flat benefit that phases out at an 80 percent rate throughout. Initially, the benefit for noncontributors will equal 33 percent of the average wage, and the phase-out range will continue until contributory pensions equal 70 percent of the average wage. Most recipients are projected to be women, and more than half of Norway's female pensioners fall within the phase-out range, are subject to an 80 percent implicit tax on contributory pensions, and are thus insulated from NDC incentives.¹³

In some countries, the phase-out rate is 100 percent. This phase-out rate is a pure minimum pension guarantee (MPG). That is, all seniors are guaranteed a minimum income, their contributory pension crowds out the public top-up dollar for dollar, and retained income does not rise above the minimum level until the public benefit is fully displaced. Such an MPG exists in Poland. This 100 percent implicit tax will strongly cut the incentive for marginal work in the formal market for individuals whose potential contributory pension is less than or close to the minimum.

The MPG level is usually in the vicinity of the relative poverty line—much lower than the maximum pension at which some top-up is typically paid with phased-out flat benefits.¹⁴ For example, in Chile, only individuals whose contributory pensions were less than 25 percent of the average wage received the MPG, while some part of the phased-out flat benefit that replaced it in 2008 is paid at up to 66 percent of the average wage. Many retirees will have pensions that lie between 25 and 66 percent of the average wage. Consequently, although the work disincentive facing each recipient in MPG schemes is greater than that associated with phased-out flat benefits, far fewer people are in that group of recipients. Once individuals get past the guaranteed floor, they are also past the implicit tax.

In most countries, the couple's rate for the phased-out flat or minimum pension is less than double the individual's—in recognition of joint consumption and household economies of scale. (This point will be explored further in the section discussing survivors' benefits.) Usually the phase-out takes into account all household income, although in some cases only the individual's wage or pension income counts. In Norway and Sweden, only the NDC pension counts against the phase-out, but in Poland, the sum of the NDC and FDC count. Assets are rarely considered (although in Australia they are). Thus, to a large extent, this approach taxes income from past or present labor.

Safety net recipients are granted higher income and pension wealth than they would have otherwise—which is their purpose. However, they (and younger workers who anticipate this situation) have a greater incentive to choose leisure over labor because of the income and wealth effects, the explicit tax cost of financing the noncontributory benefit, the contribution rate to their own pension (typically 15 to 20 percent in NDC countries), and the high implicit tax cost from the MPG or phased-out flat benefit. Such implicit and explicit taxes compose a big subtraction from actuarial fairness and are a deterrent to continued formal market work.

Women disproportionately receive the phased-out flat benefit or MPG and also are disproportionately subject to the disincentives that the phased-out flat benefit and MPG

generate for market work. As women approach retirement and make the calculations, those who think they will fall in or near the minimum pension or phase-out range will be discouraged from continuing to work and to contribute. Such a decision will reinforce their inferior income position when they become old and widowed. Although the NDC is supposed to provide an incentive for working, this incentive fails to reach about half of women, who expect to receive the safety net benefit.

CONTRIBUTORY REQUIREMENTS FOR FLAT AND MINIMUM PENSIONS

To reduce fiscal costs and to encourage formal market work, countries sometimes provide the safety net benefits only to contributors—not to all residents. The contribution requirement is supposed to give people an incentive to work. Thus, the careful setting of contributory requirements becomes crucial. If they are set too high, many individuals will fail to qualify and may end up below the poverty line, but if they are set too low, the fiscal cost may be great.

Women's pensions are especially sensitive to the eligibility conditions. For example, relatively few women meet the 30-year contribution requirement for Argentina's flat benefit or the 25-year requirement for Mexico's MPG, so most contributions by women to the safety net pillar are a pure tax. And those who have contributed long enough to become eligible probably have pensions of their own that exceed the pension floor.¹⁵ In response to low eligibility rates, Argentina changed its system to include a minimum pension with little or no contribution requirements, and Mexico is considering a noncontributory flat benefit. Among NDC countries, Poland requires 25 years of work for men and 20 years for women for MPG eligibility, which is probably not unrealistic in view of the high labor force participation rate of women in that region. But Norway and Sweden set an income minimum for all residents whether or not they have contributed, thereby shifting the balance further toward women.

Facing the tension between (a) the coverage and redistributive advantages of a residence-based scheme and (b) the cost and work incentive advantages of contribution requirements, some countries (e.g., Belgium, the Czech Republic, France, Ireland, Luxembourg, Portugal, Switzerland, and Turkey) have set up a two-tier minimum pension—a poverty-level floor for all senior residents and a higher minimum for contributors (see Whitehouse 2007). Among NDC countries, Latvia has a multitiered minimum pension, depending on whether the individual has 10, 20, 30, or more years of service. Women are more likely than men to cluster at the low tiers. Italy resolved this tension in another way when it adopted its NDC plan—by abolishing the minimum pension altogether and replacing it with a small, means-tested social assistance benefit for the elderly. This approach may be the best course in countries where residents have large unofficial sources of income.

INDEXATION OF THE SAFETY NET

Indexation of the noncontributory pension plays an important role in determining the welfare of women, just as it did in connection with the contributory pension. If the flat benefit or MPG is not indexed at all, it is quickly devalued in real as well as relative terms over the lifetime of a retiree and for later cohorts. A price-indexed noncontributory benefit maintains its absolute real value but falls over the lifetime of retirees and for successive

retiring cohorts relative to wages of workers. Over time, fewer retirees collect the benefit. If the object is to avoid absolute poverty, price indexation meets that purpose. But if poverty is defined in relative terms (income of pensioners relative to workers), wage indexation of the safety net is needed. Wage indexation, however, costs much more than price indexation. If wage growth is 2 percent per year, after 36 years a wage-indexed pension is double a price-indexed pension.

Because NDC schemes were adopted at a time of fiscal pressure, it is not surprising that price indexation is most common. For example, in Sweden, the income floor—which was rather generous to begin with—was price indexed in the new scheme as a politically acceptable way to gradually reduce old-age expenditures relative to tax revenues, which rise with wages. Eventually, fewer individuals will receive the noncontributory benefit, because NDC pensions (which are linked to wages) grow faster than the price-indexed minimum. This approach cuts costs as well as the scope for implicit taxes and work disincentives. It also leads to greater inequality, with the disparity increasing (a) between the income of workers and that of pensioners, (b) between the top and bottom quintiles of retirees, and (c) between men and women. For this reason, some analysts expect that the linking of noncontributory benefit to wages will eventually be resumed.

In Norway, the income floor is scheduled to rise with wage growth minus a 0.5 percent adjustment factor for increased life expectancy. Because contributory pensions rise with wages, the proportion of women immune to NDC incentives will gradually fall over time, but the fall will be slower than in Sweden. Norway (like Sweden) places a great emphasis on relative income equality, and this preference played an important role in its policy discussions. Also, Norway can afford this costlier scheme, in part because of its oil revenues. To counter the continued negative impact on work incentives, Norway takes the unusual step of increasing the minimum pension on an actuarial basis if withdrawn after age 67. This approach offsets the higher contributory pension from working longer and could encourage individuals who expect to receive a noncontributory top-up to postpone retirement. Poland's MPG indexation is in between that of Norway and Sweden: it rises 80 percent with prices and 20 percent with wages.

Because recipients of noncontributory benefits are disproportionately women, the decision about how to index those benefits largely shapes the retirement income of very old women and future cohorts of women.

SHOULD CREDITS FOR CHILD CARE BE OFFERED?

Most European countries grant pension credits for time spent in maternity and child care, and NDC countries are no exception. The presumption is that rearing children is a socially valuable function, and those who do it should not be penalized by loss of pension rights. Perhaps an underlying belief is that having children should be encouraged in a region where fertility is below replacement rates. Increasingly, the credits can be used by either husband or wife. The child-care credits vary from one to six years per child, but they have been reduced in some transition economies because of fiscal pressures and falling work propensities of women.

In DB countries, the benefits are usually financed on a PAYG basis. In most NDC countries, the public treasury actually shifts money to the pension fund at the moment that the obligation is incurred. (In Norway, there is no distinction between

the pension fund and the treasury.) In principle, this requirement that all obligations be financed *ex ante* increases transparency, imposes fiscal discipline, and prevents governments from invisibly shifting costs to future generations for benefits that current generations will receive.

Child-care credits, like the safety net, are a fiscal obligation, but they have quite different effects on work incentives. Usually they go only, or in larger amounts, to women who have reduced incomes during periods of childbearing and childrearing; to that extent, they discourage work during those periods. For example, in Italy, they go only to women who take child-care leave; in Sweden, they fill in the gap for women whose incomes have fallen because of child care, and if income does not drop, the pension credit is small. Thus, they discourage women with young children from working. However, the fact that they add to the notional accumulation means they may increase work later on for many women, because they make it less likely that women will become recipients of the minimum pension and subject to its implicit tax.

THE BASIC TRADE-OFF: POVERTY AVOIDANCE VERSUS WORK INCENTIVES

The NDC pillar is designed to reward work. The safety net is designed to avoid poverty by redistributing income to those who have low pensions because they have not worked or have worked at low wages—a direct conflict to the degree that the decision to work is volitional.

A universal flat benefit is most inclusive and neutral on work incentives, but it is also the most costly option. Phasing out the flat benefit as the contributory pension grows further targets the benefit toward women and other low earners and economizes on fiscal resources, but the implicit tax it imposes may discourage them from engaging in formal market work, which would help get them out of the low-income trap. A flat benefit with a high contributory requirement for eligibility is even cheaper, but it excludes most women (as well as many men who have worked in the informal market) and turns any contributions they have made into a pure tax.

In the past, strong social norms kept most women out of the labor market, so those incentives may not have mattered, but today's norms give women greater discretion about how much to participate. The safety net structure that increases the welfare of older women today, taking their past behavior as given (e.g., a universal flat benefit with a phase-out), may discourage market work and may slow behavioral change that will improve the welfare of younger women in the future. NDC countries are still grappling with this trade-off, and each country has chosen a different course. Perhaps the basic ingredients should be a modest flat pension for all senior residents, starting at a rather late age when other resources are most likely to be used up. If a phase-out is applied for fiscal reasons, the implicit tax should be applied against all income sources in the household to keep it low. If a contributory requirement is imposed, it should be low enough to include most women. If poverty problems are concentrated in the very old, then arrangements that push income to very old age, such as partial wage indexation and joint pensions for survivors, are important. For individuals who are in the phase-out or minimum pension range, it should be recognized that the NDC does not generate the positive work incentives that it claims as an advantage. Those individuals are mainly women.

Survivors' Benefits and Joint Pensions

Old-age security schemes are designed, in large part, to smooth consumption over the life cycle.¹⁶ Because women are usually younger than their husbands and have longer life expectancies, they are likely to outlive their husbands. Most women have an additional life stage that most men do not have: they eventually become widows, who often live alone, and this stage may last for many years. Therefore, a program that is designed to smooth consumption over the life cycle must include widowhood as one of the most vulnerable stages of life.¹⁷

THE ECONOMIC RATIONALE FOR SURVIVORS' BENEFITS

Because husbands have traditionally provided the bulk of the family income, some arrangements for survivors' benefits are crucial to wives' financial welfare. In the past, many wives did not work in the labor market, so their financial dependence was extreme. At present, most women work for some part of their adult lives, but they are likely to earn less and to accrue smaller pension rights than do their husbands because they may take time out for childbearing and childrearing, may work part time, and may take jobs that pay lower wages. They have some independent financial capacity, but when the husband dies, the family income is cut by more than 50 percent.

Even if women earned as much as men, they would suffer a sharp decline in standard of living when their husbands die because of joint consumption and household economies of scale. Owing to scale economies, household costs for a given living standard will typically fall by only 30 percent when they cover a single person rather than a couple.¹⁸ Yet in the absence of survivors' insurance, household income falls by 60 to 70 percent when the husband dies. The husband's death may come too late in life for the widow to recoup by embarking on a full-time, highly paid career. It is not surprising that very old widows are one of the poorest groups in many countries (Smeeding and Sandstrom 2004).

In principle, this problem could be solved through voluntary saving or the voluntary purchase of life insurance. However, if households are short sighted, or if the husband places greater weight on consumption during the period when he is alive, the household will not save or ensure a sufficient amount voluntarily (Bernheim et al. 2003; Friedberg and Webb 2006). High payroll taxes for mandatory old-age benefits in many countries make voluntary insurance purchases or long-term saving a low priority. Evidence from the United Kingdom suggests that, where the choice is voluntary, the vast majority of men use their retirement funds to purchase single life annuities rather than joint annuities (U.K. Pensions Commission 2004).

In traditional DB programs, generous survivor benefits were often provided—but at the same time, they introduced serious problems of their own, such as work disincentives for women, nontransparent redistributions from single individuals to married couples, and cross-subsidies from dual-career to single-wage-earner families. Those criticisms, combined with serious fiscal pressures, have led to major cuts in the programs, particularly in Eastern and Central Europe. At the same time, new FDC schemes in Latin America have developed ways of providing survivors' benefits that smooth consumption for widows without the deleterious side effects just described, by requiring husbands, on retirement, to purchase joint pensions that cover their widows. Rather than incorporating

survivors' benefits into the NDC pillar, NDC countries have continued to cover widows with a separate PAYG-funded DB—with the negative consequences listed previously—or they have simply eliminated those benefits, thereby exposing widows to a sharp drop in standard of living. It might be more consistent with the NDC philosophy to protect women in their final life state through a joint annuity option.

SURVIVORS' BENEFITS IN DB SCHEMES

Traditionally, in public DB plans, older widows received 50 to 80 percent of the primary benefit, starting at the point when the husband died. Those rules still prevail in some European countries (Austria, Italy, and Luxembourg), as well as parts of Asia and the Middle East. This benefit was financed by the common social security pool—a costly method. Rules regarding eligibility in such schemes typically reinforce traditional social roles. In almost all public earnings-related DB plans, survivors' benefits are considered a payment to widows who were dependent on their husbands. If they worked and have their own pension, they must give up all or most of that pension to get the widow's benefit. Because the husband's pension is usually much larger, they tend to take the widow's benefit, which increases their income. But doing so also means that any contributions made by working wives are a pure tax; the women get no incremental benefit in return (James 2009a).¹⁹

Some countries (e.g., Belgium, France, and Germany) phase out the benefit against wages as well. In Estonia, widows must choose between their own pension and the survivor's pension, which is also phased out against wages. The U.S. scheme pays an additional 50 percent of the husband's pension to wives while the husband is still alive and 100 percent to widows after his death—but those generous benefits are fully offset against the wife's own pension and also are reduced by wages prior to the normal retirement age. In all these cases, survivors can receive investment income or inherit money without losing their benefit—only labor income is penalized. Recent studies have found that, in the United States, married women reacted to those incentives by working less than single women and by retiring early (Munnell and Jivan 2005; Munnell and Soto 2005).

The rules also create perverse redistributions. The largest net benefits (gross benefits received minus payroll taxes paid) go to married women who never worked outside the home. Those wives often get larger pensions than single women who worked. Part of the contribution of single people, who do not qualify for such benefits, subsidizes married couples. Dual-career families, where the wife may take her own benefit instead of the widow's benefit, subsidize traditional families with a sole breadwinner, and low-earning couples subsidize high-earning couples, whose wives receive larger benefits. The survivor's benefit, in effect, forces working wives to contribute toward the pension of nonworking wives, thereby discouraging women's work. For a wife who has worked part of her adult life, the fact that she cannot keep her own pension and the survivor's benefit ignores household economies of scale and makes it almost inevitable that her standard of living will fall when her husband dies.

As women's labor force participation rates have risen and fertility has fallen, fiscal pressures have led to cutbacks in the survivor benefits, especially for young widows without children, who are now expected to work. For example, in most Eastern and Central European countries, the United Kingdom, and the United States, widows do not receive

benefits until they are close to retirement age, unless they are caring for dependent children. In Lithuania and Australia, new widows get virtually no survivor's benefit, regardless of their age (they are eligible for the contributory and noncontributory old-age benefits paid in those countries). In Western European countries that pay flat benefits to most elderly residents (as just discussed), special benefits to older widows are now considered unnecessary.

JOINT ANNUITIES IN FDC SCHEMES

Survivors' benefits are handled quite differently in the new FDC pillars in Latin America, and they suggest design features that could be built into NDC pillars as well. In Latin America, each spouse is required—on retirement—to purchase a joint annuity or other joint pension that covers the widow as well as the primary beneficiary. This requirement reduces the husband's pension by 15 to 20 percent, depending on the share of primary benefit that the survivor gets and the relative ages of the husband and wife (compare rows 1 and 2 of table 10.2 to rows 3 and 4; see also James, Edwards, and Wong 2008; Swedish Social Insurance Agency 2008). The theory behind this mandate is that wives have lower earnings and pensions because of the implicit contract they made with their husbands to allocate time toward household and child-care services in exchange for monetary income that he will provide. The joint pension requirement enforces the wife's entitlement after his death and prevents families from externalizing the cost of household services. The widow is protected, but the husband (rather than single individuals and dual-career families) pays. Therefore, this approach avoids inequitable redistributions and distortionary choices about marriage and work.²⁰

Most important, widows are allowed to keep the benefit from the joint annuity as well as their own benefit. Because the husband has paid for the joint annuity by taking a lower payout himself, it becomes his wife's property on his death, and there is no reason for her to pay twice by forgoing her own pension. This scheme ends the high taxation of married women who work in the market and enhances the incentive for them to work. Recent research indicates a strong positive response in the labor force participation rates of older married women (Edwards and James 2010).

In Chile, the joint annuity comprises more than 60 percent of the total monthly pension of the average widow and raises the EPV of total lifetime benefits for the average woman by more than 40 percent. The widow's benefit, together with her own benefit, maintains household purchasing power at about 70 percent of the previous level, so her standard of living is roughly unchanged (see table 10.2). The joint annuity requirement also extends scheme coverage to many women who have not worked in the formal market—without placing a burden on the public treasury or an implicit tax on working women. In countries that are considering unisex requirements, joint annuities reduce their cost and distortionary effects. Because widowers are treated symmetrically with widows in most countries, the joint annuity requirement also protects long-lived men. In effect, it provides family co-insurance against the financial loss of a key earner. It pushes some retirement resources toward the very old age of the last surviving spouse.

Despite those advantages, the joint annuity is not mandated in most FDC schemes in Eastern and Central Europe, nor is it mandated in Australia or Sweden. In Sweden's FDC scheme, joint annuities are permitted but not required. Contribution splitting is

also permitted while both partners are alive, but this approach does not shift the wife's retirement income to the widowhood stage.

NDC POLICIES TOWARD SURVIVORS AND JOINT ANNUITIES

In all current NDC schemes, joint annuities are not required or even allowed, nor is contribution splitting permitted while both partners are alive. (The one exception is the projected plan in Egypt, which as proposed would allow joint annuities and even require them if the spouse has no pension of his or her own.) This policy represents a decision that the surplus from the notional accounts of men who die young should be returned to the common pool and spent as a small enhancement to the return of everyone in the scheme, rather than in maintaining the living standard of their wives. Instead, survivors' pensions are provided in Italy, Norway, and Poland as a separate PAYG DB, with all the inherent problems described in this chapter.

In other countries, such pensions have simply been eliminated. In Poland, widows receive a survivor's benefit at age 50 that is 85 percent of the husband's pension, but this amount is partially offset against wages if they work and is entirely forgone at age 60 if their own (NDC and FDC) pension is larger. In other NDC countries, the separate widow's benefit has been dropped completely. In Sweden, survivor's benefits are paid to young widows with children on a temporary basis; they are not paid to older widows. In Latvia, survivor's benefits are paid to children but not to widows. Smoothing consumption over the life stage of widowhood is disappearing as an NDC objective. This trend may be one reason for the growth in term-annuity purchases for women in Sweden, but such purchases are unlikely to be large enough to fill in the gap (Palmer 2008).

This attitude toward survivors is inconsistent with provisions in flat and minimum pension safety nets in those same countries, which give couples less than double the individual rate. Such provisions stem from recognition of household economies of scale, yet the absence of joint annuities in NDC plans ignores this phenomenon. It is also inconsistent with the NDC ethos of work incentives and fiscal responsibility. In countries that still have a separate survivor's benefit that is phased out against one's own pension, work by women is discouraged. In countries that have eliminated survivors' benefits, widows may be eligible for a larger noncontributory benefit owing to their lower income. This provision imposes a fiscal burden on the public treasury while at the same time causing widows who are just above the threshold to experience a fall in their standard of living. Making joint pensions mandatory in NDC schemes and allowing widows and widowers to keep their own annuity as well as the joint annuity would maintain their living standards, remove a disincentive for formal labor market work, and co-insure both partners without increasing the fiscal burden. Such an approach would be more consistent with the NDC philosophy.

Conclusion

What is the effect on gender of NDC plans? Except for the earlier retirement age permitted for women in Poland that is now scheduled for phase-out by 2040, practically no gender-specific provisions remain in NDC countries. However, many provisions still have subtly different effects on men and women. On the one hand, compulsory annuitization and the required use of unisex tables in the NDC pillar, along with minimum pensions or phased-out flat benefits in the safety net pillar, have implicit or explicit distributional effects that

favor women. On the other hand, the likely absence of an increase in real NDC pensions over the retirement period, the move toward price indexation of the safety net benefit, the shift from pure to phased-out flat pensions, and reductions in survivors' benefits without a replacement in the form of joint annuities will have negative consequences for women. Fiscal sustainability was achieved in NDC schemes largely by cutbacks on the benefits that were least connected to contributions—disproportionately benefits for women. Fine tuning may be in order at this point to ensure that some of the cuts did not hit the wrong subgroups and that the new benefit structure does not perpetuate inefficient behaviors.

Two effects are worth particular attention: the remnants of work disincentives for women and the likely deteriorating position of very old women in some NDC countries. Although the NDC pillar was designed to encourage work, disincentives remain (and in some cases are increased) through the earlier legal retirement age for women till 2040 (in Poland), the high implicit tax in schemes with minimum pensions or phased-out flat benefits, and the arrangements that force widows to choose between their own contributory pensions and survivor's pensions. The deteriorating position of very old women is a consequence of (a) their earlier retirement in the face of a longer life expectancy, (b) a time stream of real benefits in the NDC pillar that is likely to remain stable (or even to fall) rather than rising over the retirement period, (c) little or no link to wages in most safety nets, and (d) cuts in survivor's benefits. As a result, the growing numbers of very old women are likely to find themselves at the bottom of the income ladder. Particularly affected will be those with relatively little education and labor force attachment who respond to the work disincentives when they are young-old and find themselves in trouble when they are old-old. Ways exist to remove such disincentives and to better protect very old women without imposing a cost on others. They include the following:

- Equalizing retirement ages for men and women in countries that have not yet done so and gradually raising the standard pension age for both genders
- Shifting some retirement resources to very old age by using a low imputed interest rate in initial NDC payout calculations and by allowing benefits to rise if actual wage growth is higher
- Reconfiguring safety net arrangements so their implicit tax affects a small group and their benefits rise with age (e.g., through a pure flat benefit or minimum pension that starts low and rises for the very old, whose private resources are likely to be used up)
- Requiring each spouse to provide from his or her NDC accumulation a joint pension that covers the widow or widower as an add-on to the widow's own contributory pension

Notes

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1. This section refers to table 10.1, rows 1–2.
2. “Actuarially fair” schemes do not necessarily produce “equitable” pension distributions. The latter is a value judgment that depends on one’s concept of equity. But such schemes do provide a neutral starting point from which deliberate transparent redistributions may take place to achieve equity. Conversely, actuarially unfair schemes produce redistributions that are not transparent, that might not be considered equitable, and that distort retirement incentives.
3. The author is not aware of any studies that test this hypothesis rigorously for NDC plans.
4. This observation may help to explain the greater range of retirement ages observed, for example, in Sweden under the NDC than under its previous DB scheme. Women may regard NDC schemes as more actuarially fair than men do, all other things being equal. Some evidence suggests that women are more risk averse than men are. If women regard the NDC as safer than capital markets, they are more likely to be more satisfied with its lower return and to place a higher value on its insurance benefits. Moreover, their expected lifetime is understated by the plan’s projections if unisex mortality tables are used. Therefore, the deviation from actuarial fairness may be smaller for women than for men, and the positive work incentive may be larger.
5. This section refers to table 10.1, rows 3–9.
6. The fixed annuity in Sweden guarantees a fixed nominal amount per month and may pay an additional rebate if the fund is profitable. The variable annuity does not guarantee any amount; instead, the monthly payout changes each year depending on investment returns and mortality rates. An individual annuity is paid only during the lifetime of the primary purchaser, whereas a joint annuity continues to be paid to the spouse after the primary purchaser’s death.
7. Under a risk-adjustment mechanism, companies with a disproportionate number of men would pay a premium to a central authority to absorb the profit they make because of the unisex requirement. This premium would be used to compensate companies with disproportionate females for their losses. Such a mechanism would allow all companies to charge consumers the national unisex rate while remaining indifferent to the gender of their annuitants; hence, it would avoid the cream-skimming and insolvency issues discussed earlier. However, such risk-adjustment procedures require good mortality data and considerable technical skills—both of which are in short supply in low- and middle-income countries. Alternatively, a competitive bidding process might be applied to concentrate the entire annuity business in one company for a specified period, thereby minimizing selection.
8. This requirement also means that healthy and sick individuals, rich and poor people, are treated as if they have the same life expectancies, even though that assumption is false. The lifetime redistribution from poor to rich in DC plans offsets some of the opposite redistribution in the safety net.
9. If assets and liabilities are out of balance, this indexing mechanism can be downsized, and pensions can fall—even after retirement. Indeed, all NDC countries have changed their indexing rules at least once in the few years that the rules have existed. Such practices raise questions about whether automatic indexing really exists. In Sweden, payouts were cut by 3 percent in 2010 and are expected to fall another 3 percent in 2011 because of the financial crisis of 2008–09.
10. This statement assumes that all sources of differences in expected lifetime are captured by cohort and gender. If the longer or shorter lifetimes stem from factors such as education or family history that are known *ex ante* but are not taken into account in the annuity calculation, those changes in total benefits are *ex ante* redistributions that are due to pooling people with different expected lifetimes. If, as occurs in Latvia, a zero interest rate at annuity conversion is

combined with price indexation or no indexation at all, this scenario implies that the scheme overall is giving a rate of return much lower than the growth in wages, perhaps to generate a surplus to pay off the legacy debt.

11. This section refers to table 10.1, rows 10–17.
12. Flat, phased-out flat, and minimum benefits all take the form $B = F - aP$ or 0, whichever is greater. In this equation, B = the noncontributory benefit, P = the exogenous contributory pension, a = the rate at which B is phased out as P increases, and the total pension benefit is $TOTP = B + P$. For a pure flat benefit, F = the fixed noncontributory benefit, $a = 0$, and $B = F$. For a pure minimum pension guarantee, F = retirement income floor, $a = 1$, and $B = F - P$ or 0, whichever is larger. For countries with phased-out flat benefits, F = the largest contributory pension at which some noncontributory benefit is paid, $a > 0$ but < 1 , and $B = F - aP$ or 0, whichever is larger. In all three cases, B sets the floor on retirement income. F sets the ceiling on the contributory pension that qualifies individuals for B in a phased-out flat or minimum pension guarantee scheme. Retirees with a contributory pension higher than F get B only in a pure flat benefit scheme. The fiscal cost and proportion of retirees who receive B depend on the level of F and a . If F is held constant, expenditures on B will be highest in countries with pure flat benefits. They will be lowest in countries with minimum pension guarantees. However, F may vary with the scheme because of political economy pressures. F is likely to be relatively low in minimum pension guarantee countries and is designed to set an income floor in the vicinity of the poverty line, and B may reach only the near-poor at small fiscal cost. In countries with pure flat benefits, F may also be low, enabling it to reach all elderly residents but at a higher total cost. In schemes with phased-out flat benefits, F is usually well above the poverty line and is designed so that some B reaches a fairly broad group, at higher fiscal cost than in minimum pension guarantee countries.
13. See the tables at <http://www.nav.no/212375.cms>.
14. See the discussion in note 12.
15. An on-off switch for eligibility also creates strange patterns of work incentives—a 100 percent implicit tax on own pensions for those receiving the safety net benefit, but a high marginal rate of return to work and incremental contributions for those slightly below the cutoff point.
16. This section refers to table 10.1, rows 18–23.
17. The term *widowhood* applies to formal marriages as well as to unmarried cohabitation and civil partnerships, and the term *husband* applies to the male partner in all those cases.
18. The relative expenditure needed to maintain a given standard of living for families of different sizes is estimated using equivalence scales. The scales give an adjusted number of equivalent full-cost family members by attributing different marginal costs to incremental members, depending on their age and family size. Because the “right” adjustment is far from clear, several alternative scales exist. The previous OECD scale weights the first adult as 1.0, additional adults as 0.5 each, and children as 0.3 each. The square root scale, commonly used by the OECD at present, takes the square root of the number of family members as the divisor (OECD 1982; Hagenaaers, De Vos, and Zaidi 1994). Based on the previous OECD scale, the cost of maintaining a given living standard is 100/150, or 67 percent, as much for a single-person household as for a couple, whereas the square root scale implies that it is 1.0/1.4, or 71 percent, as much. In both cases, it costs a couple only 40 to 50 percent more than an individual to maintain a given living standard. For a single person plus two children, compared to a couple plus two children, the previous scale yields a relative cost of 1.6/2.1, or 76 percent, whereas the square root scale yields a relative cost of 87 percent. Much of those economies of scale will stem from similar housing needs for an individual and a couple.

19. Remarriage also eliminates access to the widow's benefit because the widow now has another husband to support her.
20. Survivors' benefits are handled differently during the working stage in Latin America. In Chile, each pension fund purchases a group disability and survivors' insurance policy for all its members. Survivors' benefits for widows are financed by the balance in the husband's account, topped up by the policy in an amount sufficient to purchase a defined benefit for the widow (60 percent of the husband's wage). The insurance fee is an equal percentage of wages for all workers, so cross-subsidies are created. Chile has recently required a rebate into women's accounts to reflect their lower risk cost.

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CHAPTER 10

COMMENT

Ann-Charlotte Ståhlberg

Responses to challenges of an aging society demonstrate change in the philosophy of how to organize support in old age. The defined contribution (DC) feature means that each individual bears her or his costs, and one generation cannot impose a burden on future generations. The design includes strong incentives to increase labor force participation and hours of paid work, which is one way of lessening the burden of aging. Benefits based on DCs will probably result in unequal outcomes for men and women as long as real differences remain in the paid and unpaid employment of men and women. Consequently, risk of poverty in old age is generally higher for women than for men. But the current nonfinancial (notional) defined contribution (NDC) plans have retained special redistributive features—for example, use of unisex life tables to calculate annuities and minimum pension guarantees. Those features compensate indirectly for unpaid domestic work by redistributing income to women. Estelle James suggests changes that might bring about work incentives and protection for women without increasing the burden for others. In her chapter, she focuses on pension age, annuities, indexing, safety nets, and survivors' protection.

In defined benefit (DB) plans, women are often permitted to retire earlier than men. James finds that it might be rational for women—also in DC plans (NDC and financial defined contribution)—to not postpone retirement voluntarily because of a high subjective discount rate and continued actuarial unfairness. But a higher retirement age that is the same for men and women would add to the supply of older workers and yield a fiscal saving. For example, the annual pension for women in Argentina and Chile would be increased by nearly 50 percent if the normal retirement age were raised from 60 to 65 years. Old women would be better off, and the burden of others would not increase as a result.

Some countries allow lump-sum withdrawals (e.g., Australia), whereas annuitization is mandated in others (e.g., Sweden). With voluntary annuities, pensioners might spend their retirement savings long before they were dead. Very old women, in particular, might become destitute, which in many countries means that taxpayers would have to support them. This scenario is one reason for mandatory annuities; another might be that in many welfare states, care services for the elderly are subsidized and benefits are means tested (e.g., Sweden). Women use those services to a much greater extent than men. When husbands grow old, their (often younger) spouses usually take care of them in their homes. So it might be rational for the female spouse not to select annuities—if the option is provided—but to prefer lump-sum withdrawals or phased withdrawals during, for example, the first 10 to 15 years of her retirement. Then she can count on free elderly care. With an annuity, she would pay for it herself. From the point of view of society, such a scenario is another reason for mandatory annuities in addition to those mentioned in James's paper.

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All NDC plans use unisex life tables to calculate annuities. Use of unisex life tables favors women and discriminates against men because of gender differences in actual longevity. However, gender is not the only discriminating factor. A complex mixture of education, employment, income, and lifestyle determine life expectancy. For example, there is empirical evidence from many countries that wealthy people and people with higher education are likely to live longer than poor people do.

So unisex life tables might be a disadvantage for the average man and for women who have a low life expectancy because of their socioeconomic status. A DC pension allows joint life annuities with spouses. James would prefer these joint annuities to unisex tables. They can ensure a degree of redistribution within the family and do not burden others. In comparison, single mothers and cohabiting and divorced women would be worse off without unisex tables—and those categories are continuously increasing. An alternative to joint annuities is the sharing of pension rights between spouses. Preretirement transfers of pension rights, either continuously or on divorce, can be thought of as an enforcement of the implicit contract between husband and wife.

Some social security schemes have kept the survivor pension scheme. When the state funds survivors' pensions, the result is redistribution from the unmarried to the married and from two-career families to one-career families, which get the same benefit for only one contributive member. The survivor pension scheme gives incentives to wives to stay at home or to work in the informal sector. In certain social security systems, women who have worked in the labor market must give up their own pension when they receive a widow's pension. This situation greatly affects women's incentive to work in the labor market.

In Sweden, tax-financed widow's pensions were abolished in 1990 for all women born in 1945 and later.¹ In Latin America, they were replaced by joint annuities, which are a crucial feature of new pension systems in those countries. The guiding principle of the Swedish economic policy is that all people should support themselves through paid work. The Swedish female labor force participation rate is high by international standards, and almost as many women work as men do. To facilitate participation in the labor market, Swedish family policy provides subsidized child and elderly care. Joint annuities ensure that family income is redistributed to support a partner who carries the burden of unpaid domestic work when the main breadwinner passes away. The couple themselves—not the state—becomes responsible for the surviving spouse's pension. But benefits depend on marriage and offer no support for the rising number of divorcees and single parents. James's chapter did not mention that derived rights may, nevertheless, act as work disincentives by encouraging reliance on family income.

Many DB pay-as-you-go (PAYG) schemes suffer from serious financing problems that are the result of aging populations. In some countries, fertility has fallen below the replacement level, which implies that returns on contributions to the public pension will be very low or even negative. The PAYG scheme may be blamed for this problem. Because the return on social security contributions depends on average fertility in the economy—and not on individual fertility—there is a positive externality for members of society to have children. Children are necessary for a sustainable pension system but raise the return to their parents' contributions by only a negligible fraction. The social security system might drive down the number of children (Cigno and Rosati 1996; Cigno, Casolaro, and Rosati 2000). So in NDC plans, one can argue that parents should be entitled to some support

for giving birth to and raising children, regardless of their income. Provisions for direct compensation for parenting work—through a system of pension credits—target people who take time out of the paid labor market. But subsidies create disincentives to work, which James criticizes. The disincentives are fewer, however, when there is no requirement to give up paid work to receive the subsidy. This approach is used in the Swedish NDC pension. Credits for child care are provided until the youngest child is four years old (with a maximum of four years per child), irrespective of previous income and with no requirement to give up work. The credits can be apportioned to either the mother or the father.

The provision of basic pensions—*independent of previous income*—ensures a social safety net for the old, particularly those with low lifetime income. To provide for income security, the benefit formula could be flat and means tested or could provide a minimum pension guarantee. James prefers the flat pension because it is the least distortionary safety net. But it is also the most costly. Means-tested benefits can be more directly targeted toward those in need, but then women are more exposed to marginal effects and would get only a low, if any, rate of return on additional effort in the labor market. The minimum pension guarantee (top-up to a main benefit) is a version of a means-tested benefit in which only the individual's own pension counts as "means." A minimum pension guarantee does not discourage voluntary personal savings when an individual is young and transfers from members of the extended family when the individual is old, in contrast to a traditional means test. But it could have the effect of excluding some women from the labor market.

James questions the Swedish guaranteed minimum pension: why not keep the old flat benefit (paid to all irrespective of previous labor market experience)? I think this question is based on a misunderstanding. Even in the old Swedish system, a universal flat basic pension of reasonable standard for the very poor was considered to be too costly. And so the basic pension consisted of a portion independent of income *and* a portion that was a special pension-tested supplement for those with a low or no income-related public pension—the old ATP (Allmän tilläggspension, or general supplementary pension) benefit. If the ATP became less than the maximal special pension supplement, then the pension was topped up so that the ATP and the special supplement together amounted to the maximal pension supplement. Thus, the income-related ATP was reduced by an amount equal to the pension supplement that a person missed out on. This plan created negative incentives for labor supply in the lower part of the income distribution (mostly women) (Ståhlberg et al. 2006).

If the growth rate is positive, it is especially important for women to have a scheme with some form of wage indexation. Because women have a longer retirement period, price indexation makes them fall behind the working generation's standard of living to a greater extent than men do. Benign thinking would suggest that pensioners should enjoy a higher standard of living as a result of ongoing productivity increases. In reality, such a policy may turn out to be excessively costly in a situation with an aging (and even declining) population. James sets out certain indexation designs to provide for the oldest old—designs that do not change the expected present value of total benefits but only the time stream of expected benefits. James claims that women in Sweden would have gained if Sweden had chosen a lower imputed interest rate in its annuity calculations, which implies a smaller initial pension and a subsequently larger adjustment for wage growth. But this approach might not have increased the rate of return to women's contributions.

In addition, in Sweden, with means-tested care for the elderly, the old women's gain from wage indexation would result in increased contributions for elderly care.

Finally, I would suggest a different measure: enable women to build their own adequate standard pensions. Countries could introduce policy reforms that make it easier for women to acquire education and paid work. Publicly subsidized parental leave and good-quality child care can facilitate participation in pension plans and access to resources in later life. Such policies can also provide a measure of support for single parents.

Note

1. This change to the NDC scheme has not generally meant that widows have suffered. What is unusual about the situation in Sweden is that practically all employees are covered by collective agreement insurance schemes in which the mandate is not a legal requirement imposed by the state but is the result of contractual agreements between labor unions and employers' association. *All* people working for an employer that signed a collective agreement—not just union members—automatically have the coverage that was agreed on. The collective agreement schemes contain widows' and widowers' pensions and bear a substantial part of total income security. But there are big differences in survivors' pensions among various sectors (Ståhlberg 2006).

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To Share or Not to Share: That Is the Question

Anna Klerby, Bo Larsson, and Edward Palmer

One of the main models now considered by countries contemplating pension reform is nonfinancial (notional) defined contribution (NDC). NDC is an individual account scheme that combines pay-as-you-go financing with an individual lifetime account structure. Individuals or employers on their behalf pay a fixed percentage of the individual's income as contributions. Contributions are noted on individual accounts, but the contributions are actually used to pay the benefits of current pensioners. The balance on the individual's account and the life expectancy of the individual's cohort at retirement determine the value of his or her lifetime benefit.

The fundamental purpose of a public mandatory pension system is to prevent poverty in old age. Beyond that goal, many countries aspire to structure their mandatory system to provide an adequate standard of living in old age, at least for the average worker. Many systems aspire to go beyond this objective and provide the main earnings-related benefit for all workers. This chapter focuses on two issues inherent in achieving these results.

The first issue is structural labor market barriers for women in comparison with men, which can result in women not earning sufficient market income to receive an adequate pension in their own right. Because they typically earn less market income and on average outlive their husbands by many years, women are more likely than men to suffer poverty in old age. The second issue is the loss of economies of scale in consumption when one of the partners dies. In principle, either the female or male partner can be the insured survivor, but in practice, females are much more likely to end up in this situation.

In the traditional defined benefit (DB) context of pay-as-you-go national pension schemes, the surviving spouse's loss of income because of the death of the other spouse has typically been covered by a survivor benefit. This is also largely true of a number of prefunded financial schemes (James, Cox Edwards, and Wong 2003; Jefferson 2009; see also chapter 10 in this volume). As it usually takes form in pay-as-you-go DB schemes, which are the traditional national pension schemes, this mechanism has two principal drawbacks. First, the public mandate taxes singles to subsidize couples. Second, if the mechanism is designed to provide long-term coverage of the survivor before the normal retirement age, it can reduce the incentive for the survivor to retain or seek work after the death of a spouse. For a younger survivor, a lifelong survivor benefit can become the entrance into lifelong poverty.

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Therefore, one needs to think beyond the construction of the traditional survivor benefit in pension design. This chapter argues that the alternative lies in sharing pension rights; the rationale for sharing accounts is fundamentally related to (a) the structural implications of the gender distribution of labor between market and nonmarket work and (b) gender differences in remuneration for market work. The underlying structural characteristics of both developing and developed economies are typically such that women are less likely to have market employment to the same extent as men and that the remuneration for the market work they perform will be lower. The difference between developed and developing economies is merely a difference in degree. The overall picture is that women contribute less than men to an earnings-related pension scheme during their working-age years and, as a result, receive a lower pension. This is, in fact, a systematic risk. This chapter begins by citing clear evidence in support of the hypothesis that this systematic risk is a result of reigning social institutions.¹ Because the risk is systematic, individual women should not be responsible for rectifying this situation on their own. Instead, this risk provides one of two strong reasons for partners to share individual pension rights.

A second important reason for sharing is that spouses or partners used to sharing consumption before old age may prefer to retain the same level of per capita consumption in old age even after the death of their spouse. This rationale underlies joint annuities. Joint annuities make possible the sharing of accounts at or after retirement. Moreover, from the societal point of view, joint annuities have the advantage that they do not involve third-party transfers, unlike the usual convention of using survivor benefits in mandatory pay-as-you-go schemes. NDC accounts are particularly suited for both sharing of pension rights during working years and formation of joint annuities with retirement.

This chapter begins with an overview of worldwide data to set the stage. Then, using data from Sweden, it analyzes how structurally based differences between women's and men's pensions can be eliminated through pension system design. The relevant mechanisms to achieve a more equitable distribution of rights are sharing of pension rights, contracting joint annuities, or both. The chapter presents strong support in favor of the claim that policy makers should consider mandating shared pension rights and joint annuities on the basis of the conclusion that the overall poorer outcomes for women result largely from systematic cultural factors and not individual behavior.

The next section presents the structural and economies-of-scale arguments for sharing accounts between partners and basic structure of joint annuities. Thereafter, the chapter takes up the question of why joint annuities, even in a country like Sweden, with near economic gender equality, can be preferable for partners concerned about the consumption standard of the surviving partner in old age. The empirical analysis shows how joint annuities would reduce the money paid on guarantee benefits, which arguably is an acceptable outcome, because with a constant budget, it frees some pension money for other uses, including other uses within the pension system, such as financing more extensive child-care credits.

Structural Issues and the Economics of Pensions

The following sections discuss how the structural characteristics of societies influence the outcomes of the pension system. They focus on education, workforce participation,

distribution and valuation of formal and informal work, earnings differences for market work, and consequences for couples when a spouse or cohabitant dies.

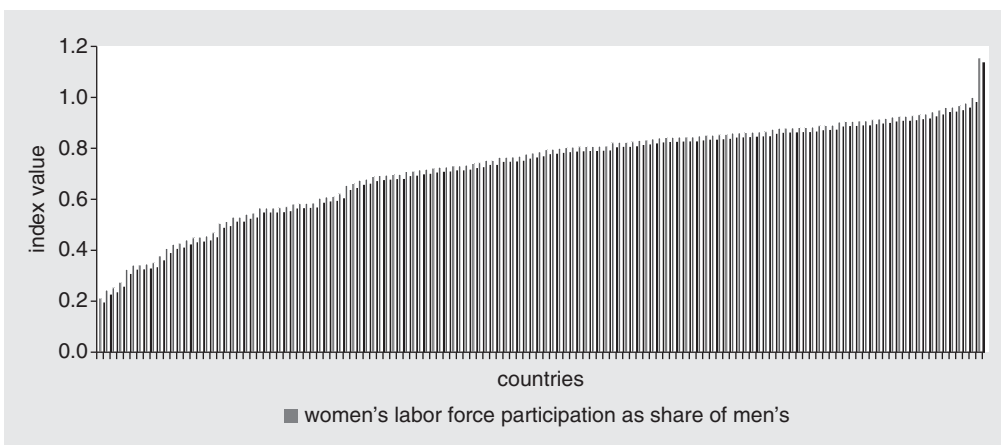
SOCIAL STRUCTURES AND PENSION OUTCOMES

Probably the greatest misinterpretation of the unequal pension outcomes between women and men is the belief that the result reflects a lack of work incentives for women. In fact, women work as much as or more than men; however, only a share of all production in society takes place in the paid, formal labor force, where it can be valued and provide a basis for pension rights. For example, in Sweden, one of the leading countries in gender equality, time-use surveys show that men and women work the same number of hours, but women devote half their time to unpaid work, whereas men devote one-third of their time to unpaid and two-thirds to paid work (Statistics Sweden 2010). This general pattern results in gender differences in the level of contributions and affects the relative size of men's and women's pensions in all countries.

According to Hausmann, Tyson, and Zahidi's (2009) *Global Gender Gap Report*, women participate in the official labor force to a lesser extent than men in almost all countries (figure 11.1). In a significant number of countries, women's participation is well below 50 percent of men's. Note that these figures say nothing about the difference in hours worked per person between men and women; they only address the number of women and men in formal work at least sometime during a year. If data on hours worked per year were available, they would undoubtedly show an even more skewed distribution.

The relative position of countries in figure 11.1 reflects in part where a country is in the transition from an informal to a formal market economy. Small-scale agriculture and trade activities account for a considerable portion of the informal work of both genders, but men in the rural setting are more likely to have market work than are women because women are "bound" to the home during a large portion of their working years to provide

FIGURE 11.1 **Global gender gap in labor force participation, 2009**



SOURCE: Hausmann, Tyson, and Zahidi 2009.

NOTE: The index covers 134 countries. Index value = 1.0 indicates gender equality in participation; the index value measures women's labor force participation as a share of men's.

care services (child care, care of the elderly, and so on). This situation provides one of the important explanations of why the informal sector is a large sector in any developing economy and why women are by far the largest suppliers of labor in this sector. In more developed countries, welfare services are provided to a larger extent as a market activity, and in these countries, women's labor force participation is considerably higher. More generally, workforce participation is determined by structural opportunities and only thereafter by individual choices.

Access to education is the primary determinant of opportunity; it is also an important determinant of whether people seek market work and of what wage they can command when they do have work. In a large number of countries, boys receive more years of schooling than girls do; however, in increasingly more countries, the trend is toward providing both boys and girls at least primary education (Hausmann, Tyson, and Zahidi 2009). The main barriers to access to education for girls derive from cultural and religious traditions, other value systems, and lack of family resources. Because of high costs of schooling and scarce family resources, families give priority to a son's rather than a daughter's education. But even practical factors, such as lack of functional sanitation, lack of access to clean water, or an unsafe journey to school, will prevent girls from attending school when boys likely still will attend. In addition to increasing market work equality, access to schooling leads to lower fertility and increased survival of both mothers and children, because educated women tend more often to focus on the well-being of the family and children's education than do equally educated fathers (Hausmann, Tyson, and Zahidi 2009). All of these structural factors lie behind the differences in opportunities for boys and girls and their economic outcomes later in life.

Although access to education is an important precondition, it is necessary but not sufficient in itself to reduce workforce participation differences or to eradicate the lower lifetime earnings of women compared to men. This conclusion is confirmed by the finding that women's educational attainment has surpassed that of men in 20 of the 30 member states of the Organisation for Economic Co-operation and Development (OECD), yet the gender wage gap appears to increase with the education level (OECD 2011). The development of earnings over the life cycle reflects the structural differences in education, labor market participation, and career opportunities. In a market economy, one expects to find idiosyncratic differences attributable to different human capital endowments, such as genetic human capital, education, and individual health. However, for example, the Human Development Index shows that women's estimated earned income as a share of men's reaches a maximum of 77 percent in the country with the most gender equality, which is Norway (UNDP 2007).

The literature abounds, however, with examples of gender differences that are not related to educational attainment, working experience, or any measurable factor other than gender.² Welfare systems in some OECD countries attempt to compensate for the uneven share of child care in the home with transfers directly in conjunction with both childbirth and child care in the early years, and a number of countries give pension credits for this time (see chapter 12 in this volume). Career earnings differences between men and women that arise from the birth of a first child are nevertheless significant even in countries where gender equality is highest (Sigle-Rushton and Waldfogel 2007).

Finally, differences in gender longevity constitute a systematic, in addition to an idiosyncratic, effect. As a group, women live longer than men in practically all countries

(UN 2007), which is why women are the most likely survivors in a partnership. This fact combined with the structural fact that partnerships usually consist of a woman and an older man means that a wife can be expected to outlive her husband beyond the difference attributable to gender-specific longevity.

In sum, one must distinguish between (a) inequalities with their roots in social structural institutions or systematic differences and (b) inequalities with idiosyncratic origin, such as individual differences because of choice, for example, regarding the content or level of education. For the very same reasons that one can justify state intervention in the area of pensions—short-sighted individual behavior and, more generally, failure to act on the need to make provision for one's old age—one can argue that the state should intervene with policy designed to compensate for the effect of structural deficiencies.

ECONOMIES OF SCALE

Because of economies of scale, two adults can live together less expensively than each can live alone. This feature is reflected in national income equivalence scales that are constructed on the basis of typical consumption baskets for households with different compositions of adults and children. Whereas the first adult in a household has a weight of one (100 percent, or 100 units of a currency for a given standard of living), the second and all additional adults (and children) benefit from economies of scale in sharing consumption expenses. This weight may vary between countries. If a weight of 60 percent is used for the second adult, two adults living together need only 160 units of a currency rather than the 200 units for the corresponding two consumption baskets if the two lived separately.

If two adults are identical with regard to income (i.e., each contributes to household income with 100 units), then the equivalence-scale weighted income of each is $100/160$ or 0.625. To retain the per capita living standard they had as partners, if one of the partners were to die, each on his or her own would require an income equivalent to 62.5 percent of their joint income, based on a weight of 0.6 for the second adult. As utility-maximizing consumers governed by the life-cycle model of consumption and saving, these individuals would attempt to arrange their joint economic lives to achieve a constant stream of consumption in the event of the partner's death, which then would require at least 62.5 percent, rather than 50 percent, of joint income. Because spouses die on different occasions, even if they are identical in all other respects—including life expectancy at retirement—room exists for insurance against the risk of losing the economies of scale of living as a couple.

In sum, regardless of one's opinion on gender issues, economies of scale are reason enough to argue for joint annuities in pension systems.

Tackling the Structural Problems

Together with providing pension rights to people (mainly women) in conjunction with childbirth and care of relatives with disabilities, the most significant tool available to policy makers to offset the structural imbalances discussed here is account sharing. The point of departure is that the burden of offsetting the structural imbalances in society should not be made the responsibility of the groups whose individual choices and outcomes are restricted by structural factors. Instead, such structural problems constitute a

legitimate reason for the state to intervene with a rule that redistributes pension rights within partnerships with the aim of compensating for the effects of structural restrictions on outcomes.

THE THEORETICAL UNDERPINNINGS OF SHARING

Partners may want to share accounts for many reasons. To begin with, adults who live together, as spouses or cohabitants, and who share their earnings on a daily basis for many years prior to retirement may want to share their claims on future retirement income as well. This motive can govern behavior, irrespective of age. In addition, spouses may have an altruistic concern for the consumption of the surviving partner in old age (Becker 1973, 1974, 1981). If partners have similar preferences and attitudes toward risk, but one of them has higher earnings, it follows that if the partner with higher income is altruistic, he or she will want to transfer lifetime resources to the partner with lower resources.

However, no clear evidence exists that altruism is a dominant characteristic of real-world families (e.g., Pollak 1985; Bergmann 1995; Woolley 1996; Ferber 2003). In fact, much of the literature in this area stresses the role of conflicting interests and bargaining. If altruism prevails, why is it that a large percentage of very elderly, widowed, or formerly married women in developed countries live in relative poverty (e.g., Zaidi 2010)? This finding clearly originates from an uneven sharing of lifetime income between spouses.

Absence of altruism is not the only reason couples do not make private provisions for a surviving spouse. How people discount the future also affects economic outcomes. Sharing of family income in general and pension rights in particular must be seen in the context of both the short run and the long run. In the short run, short-sightedness may reign sovereign over rational long-term economic decisions. This possibility raises the question of whether the paternalistic policy maker should consider mandatory rather than voluntary sharing of pension rights to secure a better long-term outcome for the partner working less in the formal sector—generally, the woman. Finally, even where women's supply of labor is approaching that of men, the traditional model is being challenged as other family constellations, such as partnerships without marriage, emerge and as divorce becomes more frequent.

The latter is an argument for sharing pension rights. By sharing pension rights during working years, individuals not only share their current consumption but also their claims on future consumption. In a pay-as-you-go setting, such as NDC, this wealth becomes liquid in the form of a future stream of yearly pension payments. If partners were identical in terms of earnings, contributions, and life expectancy at retirement, both would get the same benefit amount per year in an (N)DC scheme. Because of economies of scale enjoyed when both were alive, this amount is not sufficient for a single person to maintain the same per capita standard of living when living alone as he or she enjoyed while living as a couple. With a joint annuity, consumption can be reshuffled from years when both spouses are alive and live together to the remaining years of the surviving spouse. The financial consequences of this situation are explained in greater detail in a separate section later in this chapter.

The major alternative to (a) account sharing and (b) accounts or a joint annuity is a spousal or survivor benefit. The survivor benefit originated in DB schemes in times when the household economy in developed countries was based on the work of

a single (male) family breadwinner. However, as people born in the mid-1940s reached workforce entry age in the late 1960s, women's labor force participation began to closely resemble that of men. For example, the U.S. survivor benefit has been the object of criticism from the 1970s, when a critical report from the U.S. Department of Health, Education, and Welfare (1979) was published. Since then, critics have focused on the deficiencies of the U.S. spousal and survivor benefits with respect to equity, adequacy, and efficiency (e.g., Burkhauser and Holden 1982; Favreault, Sanmartino, and Steuerle 2002; Favreault and Steuerle 2007). To begin with, traditional DB survivor benefits can be strongly questioned on the basis of equity. With respect to the structure of the U.S. system, it is far from obvious why men and women who were never married or had only a short marriage career should transfer money to couples or single (but previously married) persons with a marriage career of at least X (in the United States, 10) years. The options are (a) sharing accounts prior to retirement, which creates an annuity based on shared income during the individuals' working lives, *and* subscribing to an annuity at retirement, or (b) simply retaining individual accounts until retirement and, at that time, converting those accounts into a joint annuity. These options can be either mandatory or voluntary, the relative advantages and disadvantages of which are discussed later in this chapter.

Second, as argued in a preceding section, the typical survivor benefit may not be adequate to keep the survivor out of poverty, especially for low-income partners, because a single person cannot enjoy the economies of scale enjoyed by couples. Joint annuities can be designed specifically to accommodate the need to leave more than half of joint income to the survivor.

Third, the traditional DB survivor benefit may reduce the incentive for working-age women to work. Using this reasoning, one can argue to reform the U.S. system, first by replacing spousal benefits available before retirement with child-care credits in conjunction with childbirth credits for *all* parents, and second by replacing survivor benefits with account sharing (Ferber, Simpson, and Rouillon 2006). Alternatively, one can argue that sharing gives the surviving spouse, usually a woman, a higher incentive to reduce labor force participation or completely exit the labor market if she receives a payout during working years. Favreault and Steuerle (2007) have recently run simulations using microdata from the U.S. social security database and found that sharing earnings reduces female poverty only when combined with a self-financed survivor benefit, similar to the joint annuity discussed here and examined in the next section for Sweden.

Finally, in addition to the structural factors already discussed, a time-consistency aspect of decision making is important to bring into the picture. Lindh and Lundberg (2008) argue that time inconsistency may cause individuals to make decisions today that they will later regret, although they made these decisions with awareness of the future outcome. This theory may explain why a large percentage of women choose professions and occupations with lower earnings despite knowing that the lifetime outcome is lower earnings and pensions. Both changing institutions over generations and time inconsistency in decision making may thus together explain today's large difference in the pension levels of women and men observed all over the world. The outcome is, in either case, a structural problem, and the pension system should be designed to accommodate these realities. To this end, governments can use child-care credits, account sharing, and joint annuities to counteract how structural factors affect pensions.

ACCOUNT SHARING

The structure of NDC schemes is especially amenable to account sharing because account sharing simply entails reallocating the values of two individual accounts between account holders. Individual accounts can be shared at any time up to or even during retirement. Even if one or both partners already have an annuity, it can be converted back to its capital value, for example, to compute a joint annuity. In principle, partners can share accounts or contract a joint annuity even after both have claimed their individual annuities.

In a voluntary system and in a society where the divorce rate is high, one would not expect to find that people opt to share during their working careers. For the person with higher earnings and earnings-related pension rights, the likelihood of losing considerable future consumption is certain, because the person loses his or her own command over consumption rights through sharing and even more by combining sharing with divorce. This situation argues for mandatory sharing—but only from the viewpoint of the partner who is the loser because of the structural factors discussed in the preceding sections. If the structural argument presented here is used as the guiding welfare norm, mandatory sharing of rights earned during a partnership would be the ideal system. In addition, because of partners' loss of economies of scale, mandatory sharing should in principle be supplemented with at least a voluntary option to enter into a joint annuity contract at or sometime after retirement.

In Europe, Switzerland seems to have gone furthest in creating gender equality in pensions. Since 1997, women have been compensated with child-care credits amounting to about 70 percent of the median wage for women in full-time employment *and* sharing of earnings between spouses is mandatory (Ferber, Simpson, and Rouillon 2006). This combination addresses the negative structural effects of pensions as well as the consequences of divorce.

A potential advantage of sharing accounts on an annual basis throughout the working career is that it sheds light on the consequences of the unpaid work between the spouses and creates a basis for informed negotiation within the family. One can also argue that bringing the value of informal work to the table creates a stronger incentive for both spouses to work in the formal sector and share more equally household and market activities. Sharing smaller amounts continuously may also present a less dramatic alternative than combining wealth at a single moment in time.

Critics of pension rights sharing argue that sharing strengthens the incentive for women to remain outside market work, providing less incentive to work toward their own pension. This criticism could be seen in terms of the push-pull incentive framework suggested by Ås (1962). Sharing can be seen as a force that contributes to “pushing” the individuals into the formal labor market by making transparent the true opportunity cost to the partner who has to share his or her pension rights when the other partner remains outside the formal market. This mechanism that pushes people out would be even stronger if shared pension rights were counterbalanced by a loss of a social pension or guarantee that is tested against other pension income or other income in general.

For some individuals, there will be a trade-off at the margin between more market work and the guarantee. Such a trade-off is especially likely for older workers with weak formal work histories. For younger workers, the potential increments in pension rights deriving from a full working career will surpass considerably the potential loss of the

guarantee because of the longer forward-looking planning horizon. In addition, if work itself creates social satisfaction, the “pulling” effect into the labor market may outweigh the possible negative incentive of losing the guarantee.

Finally, it is worth mentioning that one reason one does not observe examples of mandatory sharing on a wide scale may be that creating transitional rules for a country that already has a mandatory nonsharing scheme may be difficult. In doing so, the policy maker must consider whether—and, if so, how—to mandate sharing across the board. For example, one can share retroactively for people who are spouses at the time of the mandate. In principle, if the data exist, one can require retroactive sharing for people already divorced at the time sharing is introduced, but this strategy may meet with some opposition. In this respect, the paternalistic state that wishes to change norms will find introducing mandatory sharing of rights much easier in a setting where no mandatory public scheme has previously existed, such as cohort-based changes.

WELFARE ASPECTS OF SHARING

An elaborate analysis with weighting schemes for how individuals may perceive family utility and how individual utility may adjust to reach some kind of optimal total utility is outside the scope of this chapter. For purposes of discussion and the analysis to be performed in the next section, a theoretical approach is adopted that assumes a simple weighting scheme of the partners’ individual utility functions. The choice of a simple weighting scheme reflects the current state of the art, which lacks an empirical foundation on which to formulate an assumption; therefore, the choice is a simple function.

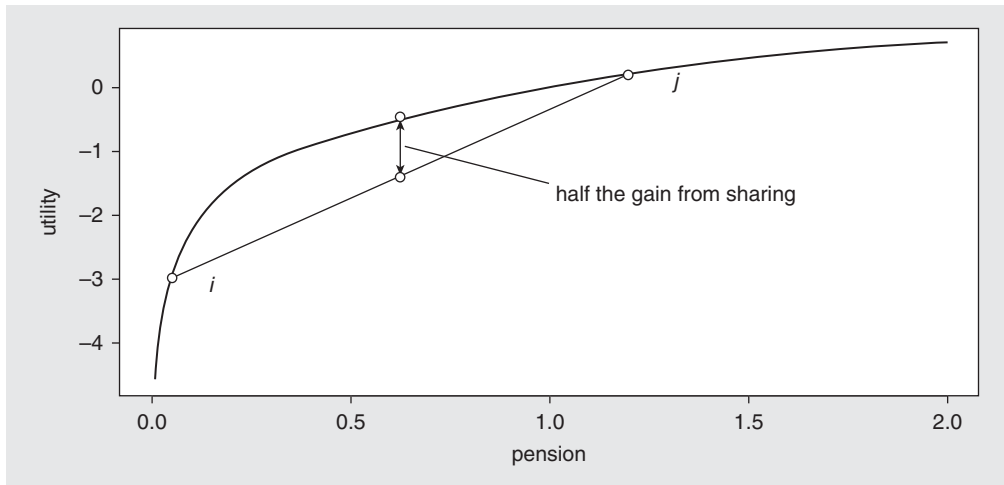
Utility, U_i , is assumed to be a function of consumption derived from one’s own and one’s spouse’s pension rights. The weighting scheme is as follows:

$$U_i(w_i, w_j) \equiv U(w_i) + \frac{1}{\gamma} U(w_j),$$

where γ weights the utility from spouse pension wealth—that is, the discounted expected flow of pension (annuity) payments. The expected value of payments is known for any given discount factor or, in an NDC scheme, internal rate of return and life expectancy factor used in computing the two annuities. For simplicity, the individuals in question are assumed to have no other form of wealth or income, and they have similar preferences and risk aversion, which justifies using the same utility function for each. Unless an agent is experiencing extreme levels of satisfaction from altruistic acts, γ should typically be a number larger than 1. If individuals are indifferent vis-à-vis the other partner’s utility, then $\gamma = 1$.

The result of sharing pensions between individuals i and j is the sum of utilities—that is, a family utility average, illustrated in figure 11.2, where the log of the average is multiplied by 2. Thus, the utility of each is half the *total* gain from sharing (i.e., half the outer boundary).

Inspection of figure 11.2 shows that the couple’s utility measured using those assumptions clearly favors sharing. Even if each partner in the couple enters into the contract with the same level of resources at the outset, is from the same birth cohort (with the same unisex life expectancy), and converts her or his NDC pension capital into a joint annuity at exactly the same time, one of the individuals will inevitably die before the other. The surviving partner receives more income and consumption and, hence, higher

FIGURE 11.2 The effect of sharing pensions between individuals *i* and *j*

SOURCE: Author's representation.

utility by sharing. However, in practice, one individual's capital balance will be greater on entering into the contract, and if the lower-income individual, usually the female, is the survivor, the individual gain is even greater.

Inevitably, the total resources of one of the partners in the couple are lowered by sharing, which means a Pareto improvement in two-person welfare, or consequently in total welfare, will not occur. This is so despite the relatively small utility loss for the "wealthier" or higher-income partner and the relatively large utility gain for the "poorer" or lower-income partner. In a country with a progressive or relatively high marginal tax starting at a fairly low level, an after-tax income gain may even occur for a couple if the higher-income partner's taxes decrease by more than the increase in the lower-income partner's taxes.³ However, even in this special case, in terms of individual utility, there is no Pareto improvement because one of the partners will, in fact, still receive a lower amount with sharing.

JOINT ANNUITIES

What might shared pension rights through a joint annuity look like in practice? Table 11.1 illustrates this situation, showing the computation of joint annuities with varying assumptions about the relative ages, income (account balances), and, hence, pensions of two partners entering into an annuity agreement. Life expectancy estimates have been used from the actuarial tables for Sweden provided by the Swedish Association of Insurers (Sveriges Försäkringsförbund 2008). The annuity divisors are all computed using life expectancy estimates from these tables and an assumed discount rate of 2 percent, which, in fact, is close to the NDC front-loading rates of return of 1.5 and 1.6 percent used in Italy and Sweden, respectively. Table 11.1 provides a simple example of what sharing of account balances through joint annuities could look like in practice.

Table 11.1 indicates the effect of contracting a joint annuity on the income of partners (a) during the time both are alive and (b) after the death of a partner. In the simple

TABLE 11.1 **Illustration of annuity payments with a joint annuity**

	Unisex life expectancy			Single-sex life expectancy		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Both partners are 65 years old</i>						
Age: P1 (years)	65	65	65	65	65	65
Age: P2 (years)	65	65	65	65	65	65
Capital balance P1 + P2	2,000,000	1,500,000	1,200,000	2,000,000	1,500,000	1,200,000
P1's individual capital	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
P2's individual capital	1,000,000	500,000	200,000	1,000,000	500,000	200,000
Account balance ratio: P1/(P1 + P2)	0.5	0.67	0.83	0.5	0.67	0.83
Joint annuity P1 + P2	99,341	74,506	59,605	99,188	74,391	59,513
P1's individual pension	59,565	59,565	59,565	63,550	63,550	63,550
P2's individual pension	59,565	29,783	11,913	56,207	28,103	11,241
Pension for P1 + P2	119,130	89,348	71,478	119,757	91,653	74,791
Divisor P1	16.79	16.79	16.79	15.74	15.74	15.74
Divisor P2	16.79	16.79	16.79	17.79	17.79	17.79
Divisor for first death	13.44	13.44	13.44	13.36	13.36	13.36
Divisor for second death	20.13	20.13	20.13	20.16	20.16	20.16
Remaining life expectancy P1 (years)	21.24	21.24	21.24	19.61	19.61	19.61
Remaining life expectancy P2 (years)	21.24	21.24	21.24	22.79	22.79	22.79
Years to first death	16.25	16.25	16.25	16.13	16.13	16.13
Years to second death	26.23	26.23	26.23	26.27	26.27	26.27

(continued next page)

TABLE 11.1 **Illustration of annuity payments with a joint annuity (continued)**

	Unisex life expectancy			Single-sex life expectancy		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Male is 69 and female is 61 years old</i>						
Age: P1 (years)	69	69	69	69	69	69
Age: P2 (years)	61	61	61	61	61	61
Capital balance P1 + P2	2,000,000	1,500,000	1,200,000	2,000,000	1,500,000	1,200,000
P1's individual capital	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
P2's individual capital	1,000,000	500,000	200,000	1,000,000	500,000	200,000
Account balance ratio: P1/(P1 + P2)	0.5	0.67	0.83	0.5	0.67	0.83
Joint annuity P1 + P2	97, 191	72,893	58,314	95,169	71,377	57,102
P1's individual pension	52, 863	52,863	52,863	73,678	73,678	73,678
P2's individual pension	68, 410	34,205	13,682	50,199	25,099	10,040
Pension for P1 + P2	121, 272	87,067	66,545	123,877	98,777	83,718
Divisor P1	18.92	18.92	18.92	13.57	13.57	13.57
Divisor P2	14.62	14.62	14.62	19.92	19.92	19.92
Divisor for first death	12.96	12.96	12.96	12.48	12.48	12.48
Divisor for second death	20.58	20.58	20.58	21.02	21.02	21.02
Remaining life expectancy P1 (years)	24.67	24.67	24.67	16.43	16.43	16.43
Remaining life expectancy P2 (years)	17.95	17.95	17.95	26.32	26.32	26.32
Years to first death	15.56	15.56	15.56	14.89	14.89	14.89
Years to second death	27.06	27.06	27.06	27.86	27.86	27.86

SOURCE: Authors' calculations based on life expectancy data from Sveriges Försäkringsförbund 2008.

NOTE: P1 = Person 1, a man; P2 = person 2, a woman. Individual capital on account and annuity values are expressed in Swedish kronor.

case of two people born in the same year who share their capital balances, each consisting of 1 million currency units, the couple will, at the age of 65, live on a joint income of 99,341 currency units per year with the joint annuity, compared with 119,130 if they retain their individual benefits. The surviving spouse continues to receive 99,341 units after the death of his or her partner. Of course, a factor can be introduced into the model to reduce the scale of the joint benefit for the survivor and increase the amount available to both during the years both are alive, or vice versa.

The example in table 11.1 illustrates the effect of using unisex life expectancy in addition to the effect of sharing. In examples where both partners are the same age, using unisex life expectancy transfers on average about 6 percent of total resources from a male to a female partner, assuming men's average higher contributions and the Swedish life expectancy estimates used here. (The remaining life expectancy of men and women at age 65 is 19.61 years and 22.79 years, respectively.)

The examples with a large spread between the account balances of the partners indicate the power of the joint annuity to maintain a high standard of living for the surviving partner relative to what the couple enjoyed together. If there is a large age difference in the retirement ages of the spouses, but the capital balance is the same, the overall effect is similar to the example in which the spouses are the same age. The reason for this outcome is clear: in defined contribution schemes, for given values of life expectancy, the individual's and, hence, the couple's capital balance determine the final outcome.

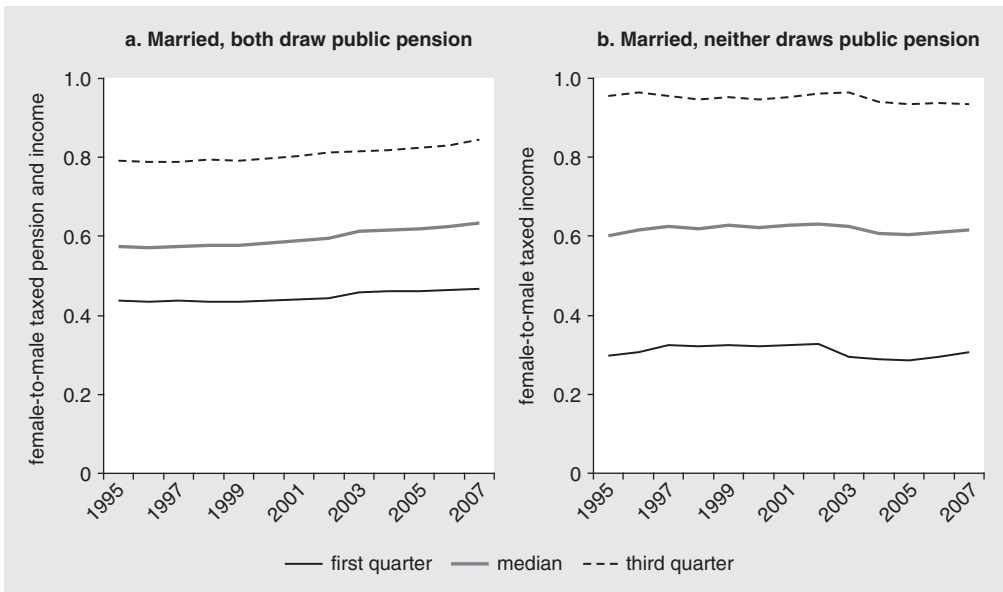
A Picture of Sharing, Using Sweden as the Example

This section attempts to quantify the potential effects from sharing in NDC schemes using Sweden, which has no sharing, as the example. Sweden is particularly interesting because it has a guarantee that tapers off gradually up to relatively high earning and pension levels (Chłóń-Domińczak, Franco, and Palmer 2012), which is a unique situation that does not characterize other NDC countries. Using Sweden as the example also gives an indication of what the outcome of sharing might look like even for a country with near equality in the labor force participation of men and women and with a very compact income distribution.⁴ The results are given without the guarantee, and the effect of the guarantee is then estimated.

The database used is Statistics Sweden's LISA database.⁵ The version of LISA used contains annual data on all Swedes older than 16 years of age from 1990 to 2007. The LISA database does not have the NDC account values of individuals, however. Instead, in this study, account values are imputed by using the actual cohort pension divisor and multiplying it by the yearly flow of pension. For this study, account values have been created for pensioners to recompute pensions as joint annuities, by creating the present capital value of the expected lifetime stream of benefits using official life expectancy estimates. The accounts of spouses and partners are then combined and converted to joint annuities. This analysis first looks at the income of females relative to males.

INCOME AND PENSION INEQUALITY AMONG SWEDISH SPOUSES

Figure 11.3 shows the ratio of female-to-male partner's income between 1995 and 2007⁶ for two groups of couples, both consisting of married people and cohabitants with or

FIGURE 11.3 **Comparison of male and female income, 1995–2007**

SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

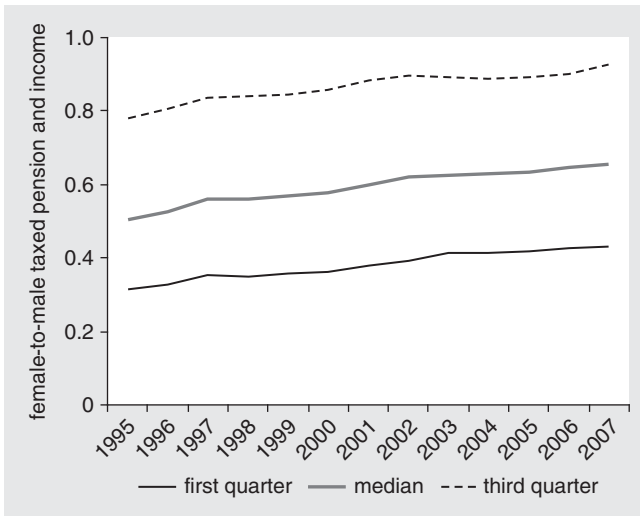
NOTE: Panel a shows the ratio of female-to-male income from pensions and other sources for couples when both draw a public pension. Panel b shows the ratio of female-to-male spouse income given that neither draws on a public pension. The earliest possible age to draw on a public pension is 61 years (60 years until 2001).

without children. The first group is people of retirement age, defined as people who draw a public pension. The earliest possible age at which an individual can claim a public pension in Sweden is 61, with no upper bound on how long one can wait to claim a pension. The second group is people of preretirement age, defined as those who do not draw a public pension. Figure 11.3 shows that gender-based income differences for couples who have not retired is greater than for the group that has. To a large extent, this difference can be attributed to the high level of the guaranteed pension and the child-care credits that parents in Sweden receive for four years in combination with a childbirth credit (however, in practice, mothers account for 80 percent of the credits and fathers 20 percent). Interestingly, the ratio of female-to-male income for retired couples shows an upward trend, but not in preretirement income. As already mentioned, the Swedish time-use survey implies that this difference can be attributed to women's average larger responsibility for unpaid work in the household.

Figure 11.4 shows the ratio of female-to-male income—pensions and other income—for couples when the oldest person in the couple is 70 years of age. For the majority of couples in this group, the second partner in the couple is above 65 years of age and draws a public pension. The situation for couples in which the oldest spouse is 70 years old, shown in figure 11.4, is similar to that of figure 11.3 for all couples if both draw pensions.

Income inequality is greater in the first quartile for couples when the oldest is 70 years of age. In figure 11.4, the ratio of women's to men's income in the bottom quartile

FIGURE 11.4 Ratio of female-to-male pension and income for couples when the oldest person is 70 years of age, 1995–2007



SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

third-quartile couples, women's share of pension and income rises from less than 0.8 to 0.9 between 1995 and 2007. In the 12-year period depicted in figure 11.4, the share of women with long careers increases, which in turn lowers the income inequality within couples.

The distribution of the men and women in a couple in which the oldest partner is 70 years old is shown in figure 11.5. Panel a shows the women's ages when the husband is 70, and panel b shows the men's ages when the wife is 70. More than two-thirds of the 70-year-old men have a partner who is between 65 and 70 years of age. The share of 70-year-old men with partners older than 64 has also been increasing over the years. The usual age difference is still relatively substantial, which means a large percentage of women are at risk of losing economies of scale as a single survivor in old age not only because they live longer but also because they are younger than their spouse.

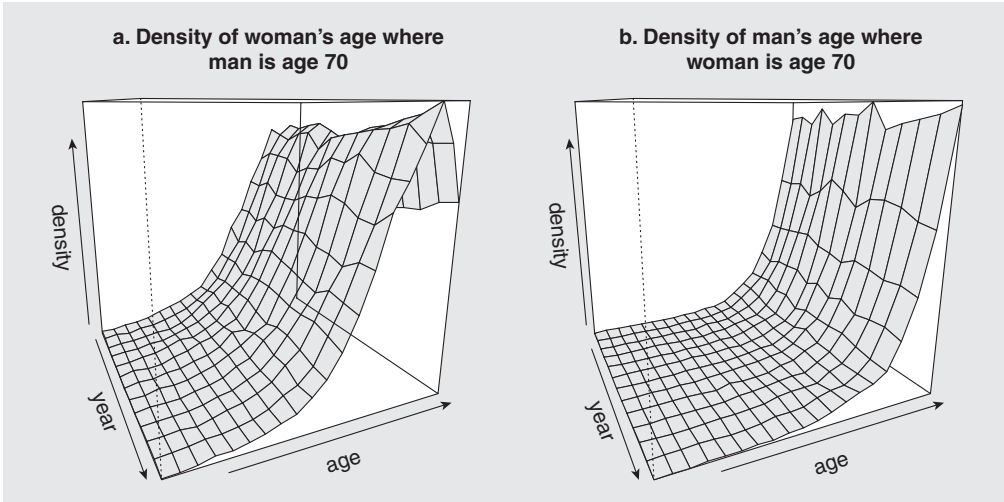
DIVORCED OR WIDOWED SPOUSES

In the theoretical "Beckerian world," one would assume that even divorce is covered by altruism. However, in the real world, where people do divorce, the concept of one altruistic family earner can be even more strongly questioned, as already discussed. Moreover, practically no public pension system currently allows a division of pension rights. This situation increases the likelihood that the burden of caring for widows and low-pension divorcees in old age will become an issue for national social policy. This section examines the frequency of divorces and death of a spouse in the Swedish data. The divorce rates during the period from 1997 to 2007 for those who were married in 1995 are displayed in panel a of figure 11.6. In panel b of figure 11.6, the ratio of women's to men's pensions and possible other income is computed for retired couples.

is around 45 percent. (The slight increase from 2003 is a result of the conversion from a nontaxed to a taxed guarantee—the final bolt in the Swedish pension reform quiver—using a conversion factor that worked to the advantage of guarantee recipients in low-tax municipalities.) In figure 11.4, women among the first-quartile couples have 30 to 35 percent of men's pension and income.

The trend toward less income inequality is slightly stronger for couples when the oldest is 70 years of age than for the overall group in figure 11.3. In

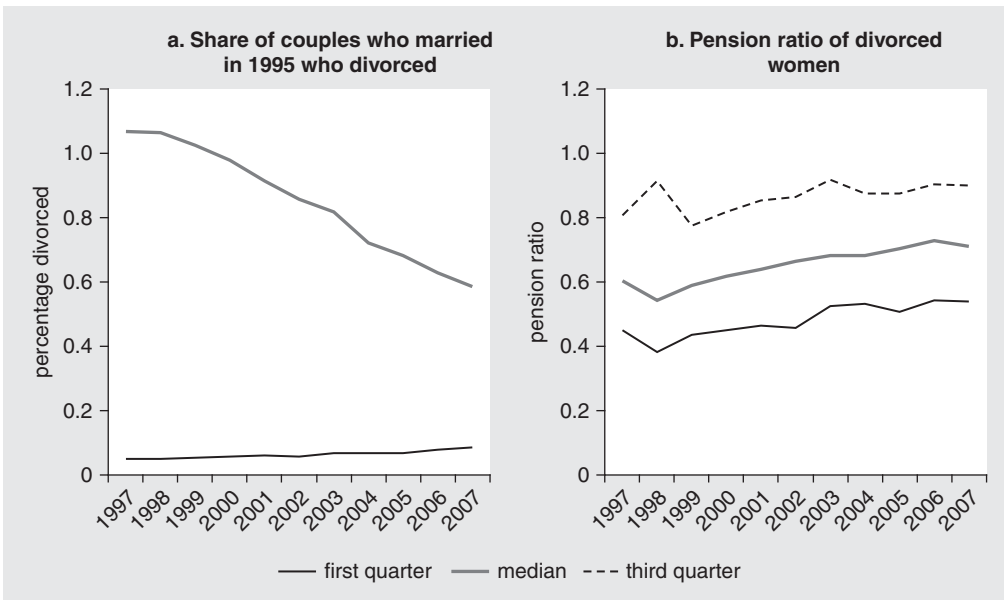
FIGURE 11.5 Age distribution of men and women in a couple when the oldest partner is 70 years, 1995–2007



SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

NOTE: Panel a shows the distribution of female spouses' ages where the male spouse is 70 years old. Panel b shows the distribution of the male spouses' ages where the female spouse is 70 years old. The data are for the years 1995 to 2007 and for ages 51 to 70. Note that panel b has fewer persons because women marry or cohabit with younger men much less commonly.

FIGURE 11.6 Effect of divorce on pension income, 1997–2007



SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

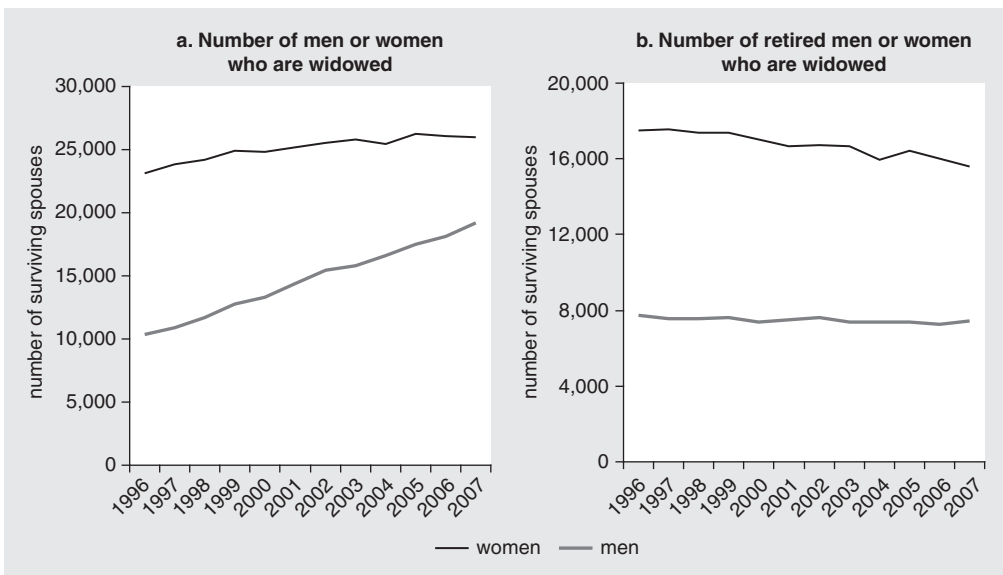
NOTE: Panel a shows divorce rates during 1997–2007 for married couples in 1995. Panel b shows the ratio of women's to men's pensions in the cohort of divorced couples.

One of the more striking observations for the purposes of this chapter is that the retired divorce at a much lower rate than the nonretired. Several explanations are plausible. For example, the people who are together as they retire are those who seriously plan to be together thereafter; also, older cohorts might be more likely than younger cohorts to see a divorce as a personal failure. However, one cannot dismiss the possibility that those who are retired may divorce less frequently because of the threat of financial distress: this possibility can be seen as an economic trap for the lower-income partner—generally, the woman. A woman’s desire to divorce from an unhealthy relationship may be prevented by the risk of lowering her standard of living close to the subsistence level. Not shown in figure 11.6 is that almost all retired people who divorce remarry—in fact, about the same number as those who get divorced. People who are not retired are less likely to remarry; roughly 5 percent of them remarry within the time span studied.

The ratio of women’s to men’s pensions in panel b of figure 11.6 reveals that divorced women were about as poorly off in the early years as their married peers in figures 11.3 (panel a) and 11.4. Surviving women partners trend toward less inequality for the first quartile and median, suggesting the relative preretirement earnings of women have been increasing.

Figure 11.7 shows the total number of couples per year in which a spouse becomes a survivor. In total, more than 30,000 persons became single every year in the period examined because of the death of their spouse if they were married in 1995. More important, panel a shows the number of retired people who became survivors, which is the majority. Annually, more than 7 percent of retired people have a spouse who dies. Panel b of figure 11.7 also makes clear that the majority of the widowed who are retired are women.

FIGURE 11.7 **Number of spouses who outlive their partners each year in Sweden, 1996–2007**



SOURCE: Authors’ calculations based on data from LISA, Statistics Sweden’s longitudinal integration database for health insurance and labor market studies.

NOTE: Panel a shows all survivors. Panel b shows those couples who were retired when one partner died.

In panel a of figure 11.3, it was shown that, among retired couples, the median pension of a woman is roughly 60 percent of her spouse's.

Earlier, the concept of economies of scale for couples was presented and its potential effect examined. The data show that even in a country such as Sweden, in which a high share of women are gainfully employed, a woman has a substantially lower level of income (pension) than her spouse. Even with equal pensions, the survivor will need 62.5 percent—not 50 percent—of the total pension income to be as well off as before the spouse's death, simply owing to loss of economies of scale. Unless women who are widowed have private solutions for their financial status or a spouse who has an occupational scheme with a survivorship benefit, they are at risk of becoming worse off than before the death because of the loss of the economies of scale described earlier.

This analysis clearly shows that there is a strong case for either sharing pension rights or contracting joint annuities to counteract both the structural differences between men's and women's earnings-based pensions and the loss of economies of scale after the death of a spouse.

WHAT IF SWEDES SHARED?

This section investigates what would happen if all Swedish couples were required to share their pensions with their partners. It uses data on all couples in which both partners drew a public pension between 1995 and 2007. The analysis assumes that only the public pension is shared, leaving all private pension savings and occupational pensions untouched.

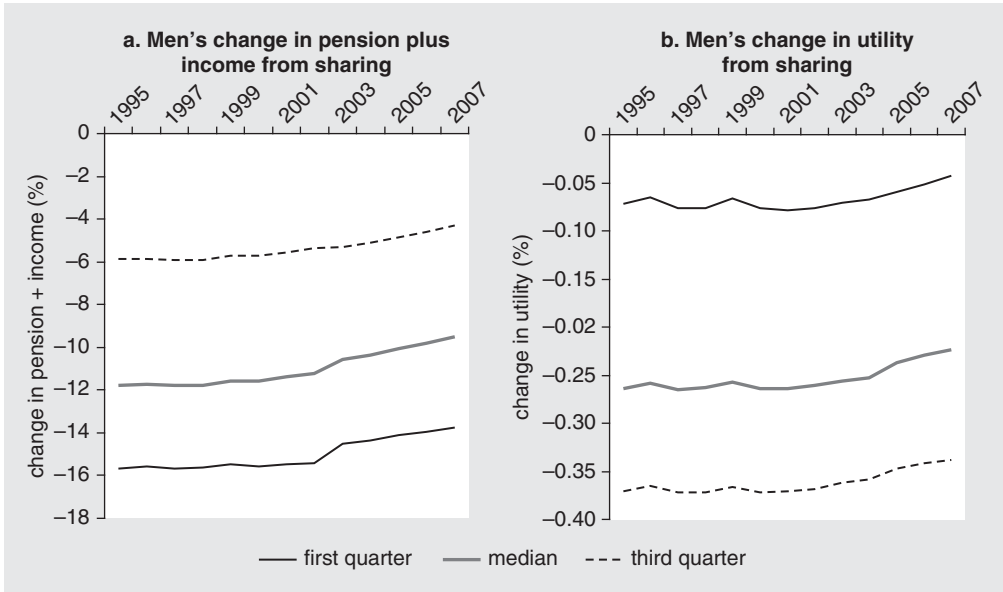
A simple tax rule, based on the approximate average rate of income taxation for 2009, is used to compute after-tax benefits. The rule is that everyone pays a tax of 30 percent. Thereafter, a marginal tax of 20 percent starts at the level of SKr 380,200 annually, with an additional marginal tax of 5 percent for income above SKr 538,800. It is also assumed that no tax is paid on income below SKr 42,400. This tax rule is used for all years for which calculations are performed, regardless of the actual tax rule. Several different deductions can be made before taxes are calculated, but they are ignored because the purpose of this exercise is to look at the relative effects from a change of policy, not the actual level of new policy.

The outcomes of sharing of public pensions are shown in figures 11.8 through 11.10, where the utilities are calculated with the naive function described previously, using a value for gamma of 2. Because part of the public pension was tax free prior to 2003, this part has been increased by the average tax between 1995 and 2002 to compensate for this difference. Hence, there is a jump in the curves for those whose public pension was lowered the most because of sharing.

As expected, sharing negatively affects most of the men's pension income. The majority of men will also see a negative effect on their utility even if they value the spouse's income in the personal utility according to the naive utility function. The picture for women is just the opposite. As already seen, on average, retired women have a lower public pension than their spouses. Hence, with sharing, they receive more income on average and see a gain in utility.

Women with the lowest pensions receive the largest relative transfers of income when sharing is imposed. Note that before the introduction of the NDC scheme, women accounted for the largest share of the prereform "tax-free" public pension. After the reform, their gross guarantee benefit was increased and then taxed down to a level that was, in

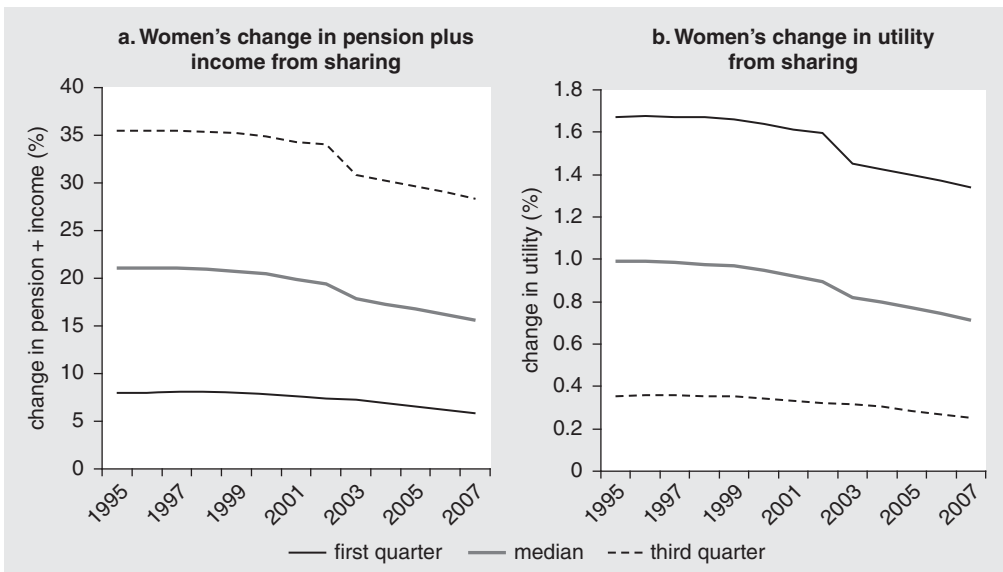
FIGURE 11.8 Men’s change in pension plus income and change in utility when sharing is imposed, 1995–2007



SOURCE: Authors’ calculations based on data from LISA, Statistics Sweden’s longitudinal integration database for health insurance and labor market studies.

NOTE: Only the public pension is shared; occupational pensions and all other income are not shared.

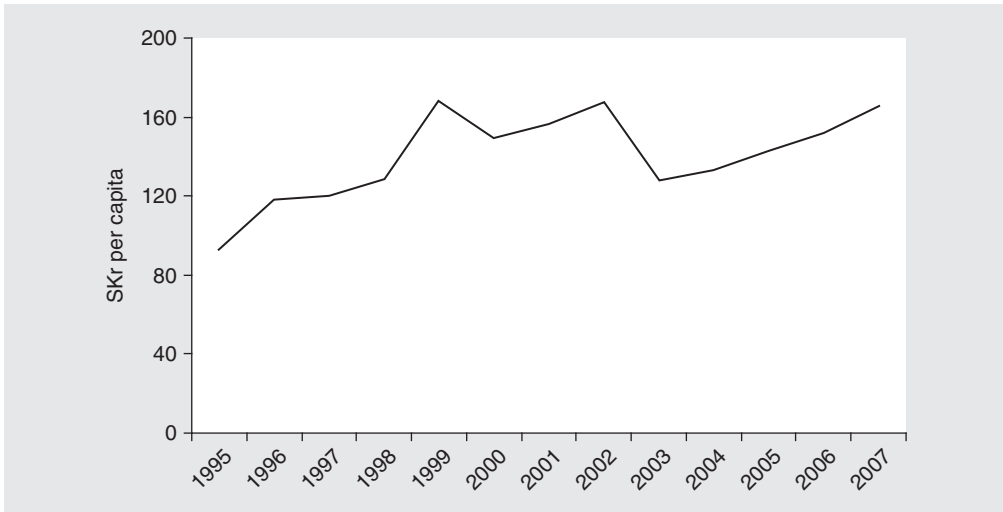
FIGURE 11.9 Women’s change in pension plus income and change in utility when sharing is imposed, 1995–2007



SOURCE: Authors’ calculations based on data from LISA, Statistics Sweden’s longitudinal integration database for health insurance and labor market studies.

NOTE: Only the public pension is shared; occupational pensions and all other income are not shared.

FIGURE 11.10 Tax revenues lost per person because of the decrease in men's taxable pension income to a lower tax bracket under sharing, 1995–2007



SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

principle, neutral compared with before the reform, thus explaining why the break in the series occurs in the quartile *receiving* the most, whereas for men the break was for those *giving* the most.

Figure 11.9 shows that women's pensions increase considerably with sharing but that the effect declines slightly with time. First-quartile men lose roughly 15 percent of their income, whereas first-quartile women gain roughly 50 percent from sharing. Note also that the female quartile gaining the least in utility still gains more than the men lose. Figures 11.8 and 11.9 also show that gender inequality in the Swedish public pension is diminishing over time, reflecting an increase in the equality of career earnings.

Some of the cushioning of the negative effect for those who are forced to give through this mandatory sharing experiment is attributable to the marginal taxation rules. Sharing results in some men falling from the 50 percent tax bracket to the 30 percent tax bracket because of the income transfer to their spouses; hence, the government funds part of the sharing scheme through a loss of tax revenues. Therefore, the actual result is not purely a within-couple transfer. Of course, this effect can be offset by including the amount by which sharing increases the pensions of low-income spouses above the level making them eligible for a full or partial guarantee top-up. This factor decreases the cost of the guarantee pension for the government.

Figure 11.10 shows the government's cost per retired person, assuming that the transfer does not decrease the recipient's guaranteed pension. Between 1995 and 2007, the tax loss per participant is SKr 180. If the transfer to the low-income spouse was also subject to tax, which is likely, a substantial reduction would occur in government expenditures on the guaranteed pension.⁷ With Swedish tax rules, the introduction of mandatory sharing could be expected not to significantly affect government revenues, whereas it would increase the welfare of older, widowed women considerably.

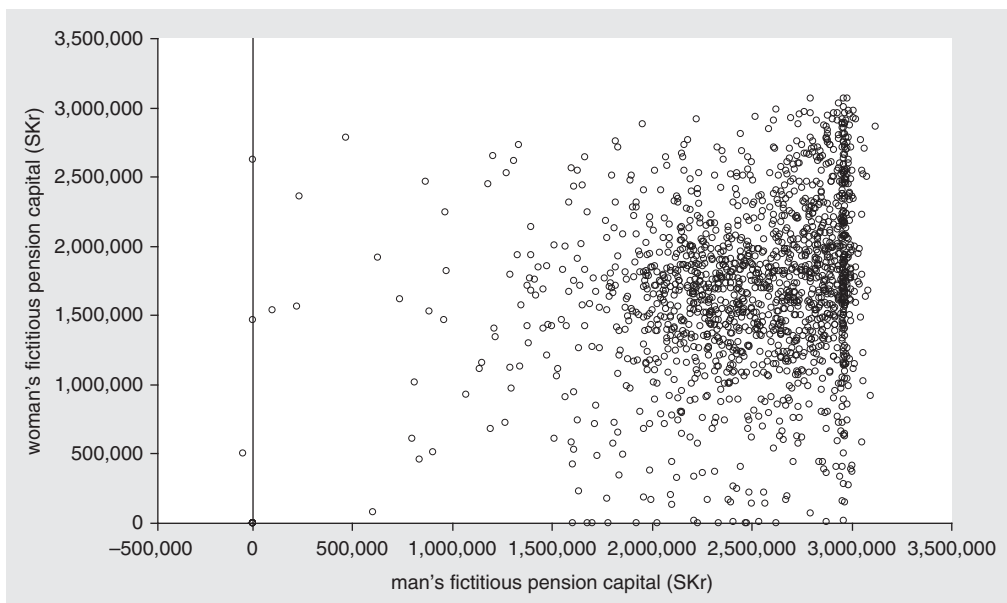
JOINT ANNUITIES USING SWEDISH DATA

To show the idea of joint annuities in a practical way, the analysis in this section uses microdata from Sweden. The pensions of the retired couples are converted to their underlying capital (account) values, using actual pension divisors for Sweden for the specified cohorts. Roughly 1,600 couples form a constellation in which both partners were 65 years old and both retired in 2006. Figure 11.11 presents a scatter plot of female and male pension capital. Generally, men have more pension capital than their wives have.

Couples' total capital is shown in figure 11.12. The majority of couples have total pension capital of between SKr 4 million and SKr 4.5 million. The distribution is rather symmetric around the center but has a short right tail because of the ceiling on covered earnings. The median share of men's capital in relation to the couples' total capital is 0.69. This group is roughly equal to the second column of the first example in table 11.1 but with considerably more joint capital than the 1.5 million currency units used in the example there, assuming the currency unit is Swedish kronor.

Earlier discussion indicated how a surviving spouse would receive a lower standard of living even if both in the couple had identical amounts of pension credits. In the Swedish case, the surviving party would need 62.5 percent of the combined pension to be economically as well off as before becoming a survivor. Were the couples to form joint annuities in the spirit of table 11.1, the surviving spouse would be economically much better off because the pension flow would be unchanged but would need to cover only one individual's consumption.

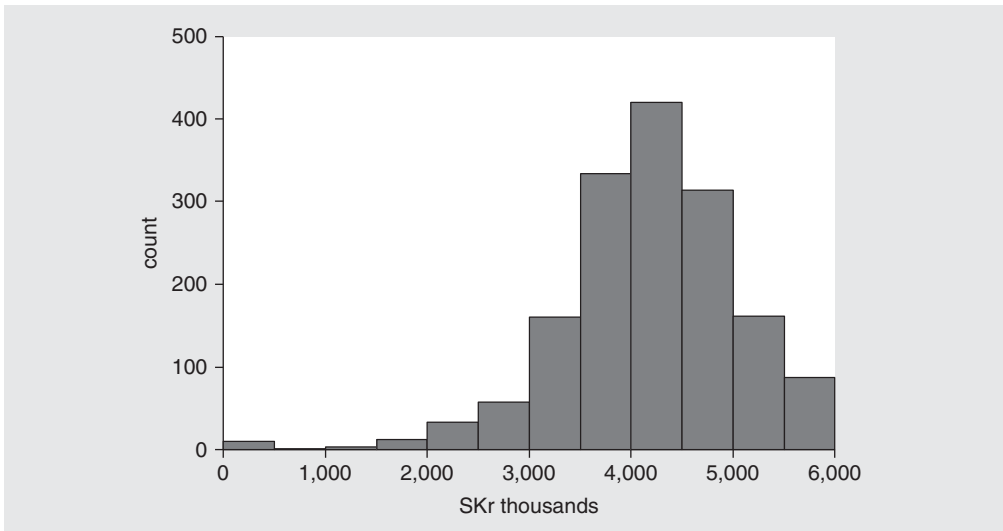
FIGURE 11.11 **Notional capital for 1,600 Swedish spouses, both born in 1941 and retired at age 65 in 2006**



SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

NOTE: Capital is derived from the amount of individual public pension payments (excluding the guarantee) and the actual unisex life expectancy divisor for this birth cohort.

FIGURE 11.12 **Distribution of notional pension capital for Swedish spouses, born in 1941 and retired at age 65 in 2006**



SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

Table 11.2 presents calculations of joint annuities. The calculations are based on unisex life expectancy and assume that the benefit for the surviving spouse needs to be 62.5 percent of the income enjoyed by the couple when both were alive. To eliminate extreme instances in which one partner in a couple has all the capital, the numbers are actually the average of the five couples below and above each point that is presented. For this reason, the male and female capital does not add up to the couples' capital; the couples' total capital is the actual number, and the gender numbers are the averages.

The total capital of the median couple is SKr 4.2 million. The woman's average share of total median capital was 41 percent, that is, the average of the median couple and the 10 couples around them. The unisex divisor is 16.79 (table 11.1), which yields an individual pension of SKr 148,000 for the men and SKr 102,000 for the women. If one assumes that the survivor needs 62.5 percent of the combined pension to maintain the per capita consumption each enjoyed when both were alive, the median survivor will need to have SKr 157,000.

A total joint annuity would reduce the per person share of the total pension from SKr 125,000 to SKr 104,500 while a couple. Moreover, if the spouse is widowed, the economic standard would not be the benchmark SKr 157,000 but still SKr 209,000. Thus, the spouse is economically much better off after being widowed than before. If one were to use the 62.5 percent benchmark required to maintain economic status quo and only "insure" away the economic risk of the person with lowest individual pension, a whole new picture would emerge.

To ensure that the party with the lower pension will, if the spouse dies, obtain a pension that is equivalent to 62.5 percent of the total pension, the average median couple needs to buy a joint annuity for roughly half their capital. The individual pension will

TABLE 11.2 **Joint annuities for Swedish couples: Case 1**

	1st quartile	Median	Mean	3rd quartile
Capital balance P1 + P2	3,720,093	4,210,203	4,178,127	4,741,419
P1's individual capital	2,296,187	2,489,788	2,520,258	2,843,932
P2's individual capital	1,423,187	1,719,409	1,656,744	1,899,500
Account balance ratio: P1/(P1 + P2)	0.617	0.592	0.603	0.600
Joint annuity P1 + P2	184,779	209,123	207,530	235,509
P1's individual pension	136,820	148,338	150,178	169,324
P2's individual pension	84,768	102,444	98,693	113,099
Even split of individual pensions	110,794	125,391	124,435	141,212
62.5 percent of combined pension	138,492	156,738	155,544	176,515
Share of joint annuity	0.537	0.509	0.522	0.518
Man's individual pension	63,323	72,841	71,732	81,605
Woman's individual pension	39,232	50,305	47,140	54,507
Joint annuity amount	99,260	106,433	108,404	122,007

SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

NOTE: P1 = person 1, a man; P2 = person 2, a woman. Both spouses were born in 1941, and both retired at age 65 in 2006. Individual capital on account and annuity values are expressed in Swedish kronor.

fall to SKr 50,000 for the lower-pension spouse (in the empirical data, a woman), but the joint annuity will be SKr 106,000, which together yield SKr 157,000, or 62.5 percent of the total combined pension. For the individual with higher income, the individual pension would be SKr 179,000, which results in an economic "overcompensation" of close to SKr 22,000. Note that this scenario is considerably closer to the target than both full annuitization (SKr 209,000) and doing nothing (SKr 102,000). Compared to no annuity, the consumption level is lowered by SKr 23,000 when the lowest pension is secured for widowhood with a joint annuity. In contrast, it is lowered by SKr 42,000 in the case of a joint annuity with all the capital.

Consider now a couple in which the man is 69 years old and the woman is 65. If the man retired at 65, some of his capital will be used before the time to buy a joint annuity. In this situation, the partners differ much less economically when they purchase their joint annuity. Table 11.3 provides the same information as table 11.2 for this case. The main difference compared to the example in which both spouses retired at 65 years of age in 2006 is that because pension capital is almost equal, less joint annuity is needed to insure the standard of living for the surviving spouse. Instead of needing a share of joint annuity in excess of 50 percent, the share needed when men have used up four years of capital is about 30 percent for the couples, regardless of where they are in the distribution.

TABLE 11.3 **Joint annuities for Swedish couples: Case 2**

	1st quartile	Median	Mean	3rd quartile
Capital balance P1 + P2	2,834,132	3,236,509	3,201,867	3,685,461
P1's individual capital	1,379,676	1,623,148	1,589,967	1,756,138
P2's individual capital	1,454,233	1,613,482	1,611,614	1,928,676
Account balance ratio: P1/(P1 + P2)	0.487	0.502	0.497	0.477
Joint annuity P1 + P2	148,037	169,054	167,245	192,504
P1's individual pension	82,184	96,681	94,714	104,619
P2's individual pension	86,632	96,102	96,006	114,906
Even split of individual pensions	84,408	96,392	95,360	109,763
62.5 percent of combined pension	105,510	120,490	119,200	137,203
Share of joint annuity	0.307	0.334	0.326	0.287
Man's individual pension	56,918	64,361	63,877	74,558
Woman's individual pension	59,998	63,975	64,749	81,889
Joint annuity amount	45,512	56,514	54,451	55,314

SOURCE: Authors' calculations based on data from LISA, Statistics Sweden's longitudinal integration database for health insurance and labor market studies.

NOTE: P1 = person 1, a man; P2 = person 2, a woman. The man is 69 years old; his wife is 65 years old. He has been retired from age 65 when they contracted the joint annuity. Values are expressed in Swedish kronor.

Summary, Discussion, and Conclusions

This chapter describes why it is important for countries, in formulating their national pension systems, to think beyond the construction of the traditional survivor benefit in pension design. It argues that traditional pay-as-you-go survivor benefits are flawed because they involve third-party transfers and, as designed by many countries, may provide a disincentive for older working women to remain in the labor force following the death of a spouse.

The chapter argues that the alternative lies in sharing pension rights and that the NDC structure is especially amenable to sharing. The chapter began by developing a rationale for sharing. The first reason is embedded in the structural implications of the gender distribution of labor between market and nonmarket work and gender differences in remuneration for market work. The overall picture is that women contribute less than men to an earnings-related pension scheme during their working-age years and as a result receive a lower pension. This is a systematic risk that can be addressed through formation of, for example, a pension policy. The important point is that this problem should not be dealt with as an idiosyncratic risk and left to individual women to fix themselves. By sharing pension rights during their working years, individuals share not only their current consumption but also their claims on future consumption.

The second reason for sharing is that spouses or partners used to sharing consumption may prefer to retain the same level of per capita consumption even after the death of their

spouse. This is the rationale behind joint annuities, which allow couples to share accounts at or after retirement. Both sharing and joint annuities have the great advantage that they do not involve third-party transfers, compared to the usual convention of using survivor benefits in mandatory pay-as-you-go schemes. In addition, sharing of pension rights compensates women for nonmarket work in the home through an intrafamilial transfer.

This chapter illustrates empirically the economic effects of sharing of pension rights and mandating joint annuities, using Swedish data. Generally, as is true all over the world, men are older than their wives in Sweden, thus adding to the expected length of survivorship of women, which is already significant because of the higher average longevity of women. Sweden is among the top countries in terms of gender equality, as is reflected in high female labor force participation and near equality of earnings in the same occupations. Nevertheless, as in other countries, Swedish women characteristically work fewer hours and in lower-paid service professions. As a result, the male partner's lifetime earnings and, hence, NDC capital are much higher than his female partner's. In the cohort studied in this chapter, men's NDC capital is almost 45 percent higher than women's. The result of this discrepancy is that many women will see their income in old age fall dramatically with the death of their male spouse. This fact is one of the main reasons for relative poverty in old age among women.

Using Sweden as an example, the chapter shows that sharing in the form of a joint annuity that takes economies of scale in consumption into account would improve the median pension of Swedish women who are born in 1941 and whose spouses are the same age and retire at age 65, by over 50 percent on the death of their spouses. Hence, good reason exists for Sweden to consider introducing sharing of pension rights and joint annuities at retirement into its public NDC scheme.

Finally, the chapter considered the trade-off between the guarantees and the fiscal effects of sharing. Generally, sharing will decrease expenditures on the general revenue-financed guarantee benefit for pensioners. However, if a country has progressive income tax rates, as Sweden does, the government will likely lose some tax revenues because sharing decreases the taxable income of the spouse with the highest income—usually the male. In the example from Sweden, this effect was not large, however. Generally, the effects on the revenues of the government of (a) lowering guarantee expenditures and (b) decreasing tax revenues will depend on country-specific features.

The argument for instituting voluntary sharing of pension rights through the creation of a joint annuity in conjunction with retirement has strong support from the analyses of issues and empirical results for Sweden presented in this chapter. Sweden has an especially compact earnings distribution compared with most countries, which implies that sharing could be an even greater advantage for women in just about every other country.

The general conclusion of this chapter, illustrated with the empirical analysis of Sweden, is that a strong case exists for introducing mandatory sharing of pension rights in conjunction with retirement, because such a system provides substantially improved welfare for older women as they become widows without involving third-person transfers. The case for sharing before retirement is founded on the premise that women are more likely than men to spend their time performing nonmarket work for family purposes and that sharing provides monetary compensation for this work in the form of enhanced consumption during retirement.

Notes

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1. The term *social institutions* refers to traditions, social norms, and informal laws.
2. In Sweden, earnings of men and women with the same qualifications performing the same work show an unexplained difference of approximately 6 percent (National Mediation Office 2011).
3. For example, in Sweden, a marginal tax rate of 20 percent is paid on income above SKr 380,200 and an additional 5 percent on income above SKr 538,800 (in 2009). So for some constellations of income, the couple's total after-tax income could increase.
4. Note, however, that the distribution among Swedish pensioners has been broadening, reflecting a similar trend among workers (Gustafsson, Johansson, and Palmer 2009).
5. Statistics Sweden's longitudinal integration database for health insurance and labor market studies is known as LISA for its Swedish acronym.
6. Note that starting in 2003, previously nontaxed guarantee benefits became taxable and the benefits were increased by enough to neutralize the effect. This change in the data is corrected by increasing the level of the guarantee in the years 1995 through 2002 by the compensation for taxes that began in 2003 (34 percent).
7. In the Swedish fully funded financial defined contribution personal account scheme, sharing is, in fact, already possible, because couples are allowed to give account values to their spouse. To account for the likelihood of adverse selection, 8 percent of the rights are deducted when given to the spouse. In 2006, only 0.25 percent of people, mainly men, chose to give away their pension rights. Men predominantly give to their female spouse.

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CHAPTER 11

COMMENT

Elsa Fornero

Klerby, Larsson, and Palmer propose that in nonfinancial (notional) defined contribution (NDC) schemes, couples should share pension accounts and stipulate, at retirement, a joint annuity to be enjoyed in its entirety as long as one member of the couple is alive. Furthermore, they recommend that these provisions be mandatory rather than voluntary.

The authors give the following rationales for their proposals:

- They rightly assume that family life brings about economies of scale, that these economies of scale disappear at the death of one spouse (typically, the husband), and that the survivor (usually, the wife) finds herself facing higher per capita expenditures with a diminished income that is insufficient to maintain the lifestyle the couple was used to.
- They consider women's inequality a systematic risk and argue that the burden should not be carried by women alone.

To correct this situation, they do not suggest a change in the pension formula to make it more favorable to women or allowances of new pension credits or ad hoc increases in benefits, which would amount to direct state redistribution of pension income in favor of women. On the contrary, they advocate enhancing the insurance properties of the NDC scheme within couples and consider risk sharing, not spousal benevolence, to be the appropriate solution. They argue that pension account sharing and joint annuities would increase household welfare measured in terms of the average pension rights thus accorded to the couple. Finally, they consider their proposal perfectly suitable also to present-day societies in which marriage breakups and cohabitations are becoming more and more frequent.

I will certainly not dispute the general aim of this proposal, with which I am in broad agreement. I will, however, put forth some caveats, particularly in regard to making sharing of pension accounts and joint annuity compulsory features of NDC schemes. First, however, a very brief description of the underlying motivation is in order (Fornero and Monticone 2010).

In most countries, the economic well-being of elderly women still depends on their role as spouses. Although the primary cause of this situation can be traced back to their disadvantaged position in the labor market—typically characterized, as compared to that of men, by lower participation rates, shorter working lives, and lower compensation levels—a deeper motivation lies in the roles traditionally attributed to men and women in society, with the latter regarded as the main providers of unpaid caring activities. Although more evident in developing and emerging countries, significant differences persist in rich countries, notwithstanding substantial cultural and legislative actions favoring greater equality of opportunities.

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Two different concerns arise in this respect: on the one hand, the recognition that these activities should be more equally distributed between men and women and that the right incentives for this purpose should be put in place poses a question of equal opportunities; on the other hand, the social relevance of these activities, irrespective of who carries them out, should be a sufficient motivation for acknowledging them (possibly through contribution credits) in the accumulation of pension rights.

Whether pension systems should aim at redistributing income within cohorts, from high- to low-income citizens, men and women alike, or whether—for concerns about efficiency—they should leave the task to the fiscal system is somewhat controversial. Certainly, if a pension system is conceived as an institution to prevent poverty in old age (as clearly stated by Klerby, Larsson, and Palmer), some redistribution is not only inevitable but also desirable and should thus be properly designed (to avoid the not infrequent, unjust situations of the past, with transfers from the poor to the rich).

Since their creation, pension systems have adopted a view of the family centered on the man's role as breadwinner and on the woman's as homemaker for the very reason that women would, more likely than men, find themselves in poverty at an advanced age, whether single or widowed, because they had spent all or most of their working years performing unpaid activities that gave them no right to pension entitlements of their own. The focus on the family had the advantage of providing insurance to family members who had little or no command of income sources; thus, it functioned as a poverty prevention mechanism.

At the core of family-based insurance mechanisms are derived rights—specifically survivors' benefits and benefits from pension sharing—awarded to women on the grounds that they live longer than their spouses and do not have enough resources of their own to finance their consumer needs. Even though quite effective in alleviating poverty among elderly women, this kind of measure, by reducing incentives for women to work and to invest in human capital and training, had the major drawback of reinforcing, or at least of freezing, traditional gender roles within the family. Pension systems centered on the family tend thus to reinforce the traditional gender roles.

The pension reforms of recent decades have pursued financial stability and have tried to adjust to a situation in which men and women have begun to share tasks more equally. The strengthening of financial sustainability has called for greater actuarial fairness in the pension formulas, to be reached through a closer link between the benefit, on the one hand, and the capitalized value of contributions and retirement age (and thus expected longevity), on the other. This structure, in turn, has meant placing more emphasis on the insurance role of pension systems and on the individual, rather than the family, as a unit of reference. The NDC scheme is the archetype of such transformations of social security systems.

In a pure NDC scheme, based on individual pension accounts, redistribution is practically nonexistent, so that each retiree receives the actuarial equivalent of the contributions he or she paid during working life. Of course, poor working lives translate into poor or inadequate pension levels to be dealt with outside the pension system, typically through subsidies financed out of general taxation.

The emphasis on the individual as a single person, rather than as an entity in a family context, stresses women's role in the work market more than as wives or widows and

avoids the paternalistic approach inherent in traditional defined benefit schemes. Clearly, however, this reform has been enacted somewhat ahead of the necessary changes in the labor market (as well as in society's cultural attitudes) that should have accompanied it. Indeed, although ultimately reducing women's dependence on their spouse, the departure from a form of insurance that relied on the family to one centered on the individual exposes women to a riskier proposition. Transitional issues, moreover, are very important in this context. Not all women of the younger generations will be able to build careers supporting an adequate pension level, given the family and social tasks they will still be expected to perform, and older cohorts are likely to suffer most from reforms if not adequately provided for.

As a consequence of increasing female participation in the labor market and of the shift in the tenets of pension regulations from the "state plus family" model to a more individualistic and market-oriented approach, retirement risks falling on women have intensified.

The risks related to interruptions in a working career can be, and actually are, mitigated in defined contribution schemes by provisions that acknowledge pension rights for the periods women spend out of the labor force for maternity or care of children and other family members. Such measures include the crediting of *notional contributions* that close the gaps caused by caring responsibilities in the individual's social security records. These credits usually help in the achievement of higher benefit levels, the completion of a minimum contributory period needed for eligibility, or both.

As to the longevity risk, in schemes oriented to actuarial fairness and neutrality, women's higher longevity implies, all else being equal, reduced benefits. In many schemes, however, mortality rates are calculated across genders, which corresponds to an implicit subsidy from men to women and from single persons to couples. The provision of this additional benefit, bestowed on the spouse with the longest life expectancy, can still be considered a sort of *ex post* compensation for women.

Changes in pension schemes and in gender division of labor have been accompanied by parallel changes in the family as an institution. The model of the dependent wife has been challenged by higher divorce rates, declining marriage rates, and an increase in the number of one-parent families. Moreover, new styles of relationships, such as civil unions and simple cohabitation, are being adopted by growing segments of the population. Regulations concerning survivors' benefits have, on the contrary, made only slight adjustments to the trend toward nontraditional families. In the few countries where same-sex marriages are possible, the provision for derived rights applies to homosexuals in the same way it does to heterosexuals. However, the legal acknowledgment of civil unions (or registered partnerships) and cohabitation agreements (*de facto* couples) has not always resulted in a corresponding enlargement of pension rights. In many countries, the issue is still open, if only for budgetary reasons. A further adaptation of derived rights to changing family patterns would thus require action through the recognition of same-sex marriages, with all the pertaining rights, or at least action toward the increase of pension rights within civil unions.

Turning back to Klerby, Larsson, and Palmer's proposal, my reservations are the following. First, as already stressed, I think the authors overlook the fact that treating women's inferior performance in the labor market as a systematic risk implies its perpetuation, not only because women would have fewer incentives to build up their own

pensions, but also because it would crystallize those cultural attitudes that tend to see women's work as complementary to men's. Although rightly recognizing that the inferior position of women in rich countries' labor markets is mainly a result of cultural factors, the authors fail to consider that cultural factors can change—are, indeed, changing—and this tendency would be nipped in the bud. Making compulsory provisions for women's inferiority merely perpetuates the discrepancy.

Second, the economies-of-scale argument is not really convincing. In the collective use of resources, encouraging elderly people to live alone as survivors may create a distortion: typically, the elderly live in a house that is much larger than their needs and absorbs a significant proportion of their pensions. This distortion can be remedied through the development of financial products that allow the extraction of cash from housing wealth, such as reverse mortgages or similar products, or through the encouragement of cohabitation of elderly people. These solutions might be more effective than compulsory pension sharing, and some attention should be devoted to them.

Third, and conversely, if systematic risks are to be taken into account in defined contribution schemes, why stop at gender differences? One should consider that special categories of workers, not unlike women, run a systematic poverty risk in their old age. Such categories include workers with low educational levels and workers born in poor families or in poor districts. Unfortunately, the emphasis on actuarial fairness is at odds with measures that tend to compensate, at the pension level, inequalities originating from the labor market. A crucial trade-off occurs between a view that advocates actuarial fairness without any kind of redistribution and another that incorporates principles of social justice into the system, thus attributing to pension systems a role in poverty reduction and resource reallocation.

The usefulness of the contribution method rests precisely in its ability to adapt to personal choices. So, although compulsory joint pension accounts would probably create more problems than they would solve, the possibility of such accounts as voluntary provisions would be very important. They might even be considered as the default option. Their compulsory nature, in contrast, would introduce serious social distortions. It could, among other things, become a further disincentive to marriage.

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CHAPTER 11

COMMENT

Ann-Charlotte Ståhlberg

Klerby, Larsson, and Palmer's study in chapter 11 illustrates the effects from sharing of pension rights and mandating joint annuities, using Sweden, where sharing does not at present occur, as an empirical example.

Pension systems and their reforms may have varying effects on men and women because of their varying employment histories and demographic characteristics. Women and men live different lives. Women typically participate less in the labor market, have lower earnings, and often experience interrupted careers. They have longer life expectancy and are more likely to become widows than men are likely to become widowers. In most countries, poverty in old age is more common among women, especially widows and divorcees. Even if two spouses are the same age and have identical earning histories and identical pension benefits, the death of one may lower the living standard of the other. A single survivor of a couple needs more than half the couple's income to maintain a constant standard of living because of loss of the economies of scale they enjoyed as a couple. Studies reveal that the single survivor usually needs 65 to 70 percent of the couple's income (Barr and Diamond 2010; see also chapter 11 of this volume).

Considering differences between men and women, how can we provide adequate pensions for women?

- Should social insurance be responsible for *survivors'* pensions? Typically, defined benefit pension schemes organized on a pay-as-you-go basis do so. These schemes, however, do not constitute redistribution in favor of women but rather redistribution in favor of couples. Single men and women subsidize families. In addition, two-earner families subsidize one-earner families that get the same benefit for only one contributive member. Survivors' pensions are derived rights that act as work disincentives by encouraging reliance on family income. Such pensions give wives incentives to stay at home or to work in the informal sector—especially in the case of older workers with weak formal work histories.
- Should the husband help finance a widow's benefit? Should social policy be designed so that it reinforces family responsibility? In either a funded defined contribution or a nonfinancial (notional) defined contribution (NDC) pension, the accumulation could be used to buy a joint annuity. For a two-earner couple, both earners could purchase one. Another approach is to allow annual preretirement transfers of pension rights, during the marriage, to individual accounts. These accounts belong to the individual and would be retained even through a divorce. Women's work at home raises men's market income. Sharing can be thought of as an enforcement of the implicit contract between husband and wife. But even joint annuities and sharing annually reduce incentives for women to work toward their own pensions.

If households are myopic about the future or if the husband places greater weight on consumption when he is alive, the widow may not have an equivalent amount with

voluntary sharing. This outcome is likely to be the case. In the United States, for example, employer-sponsored default pension plans were changed to joint annuities specifically to deal with this problem. To get the benefit as a single annuity, both spouses must grant their permission (Ståhlberg et al. 2006). Couples who think that one spouse will live considerably longer than the other are more likely to contract joint annuities (adverse selection). And in a society in which the divorce rate is high (for example, Sweden), people will not likely opt voluntarily to share during their working careers. These factors speak against voluntary sharing.

When the public pension is means tested against other pensions and incomes alongside income-tested care services for the elderly, income-tested housing allowances, and special allowances for pensioners with very low incomes, then possibly many people would opt not to share—not as long as part of the costs to support the elderly involve third-party transfers. In Sweden, the earnings-related benefit in the national scheme offsets the Swedish guaranteed minimum pension; at low earnings-related benefit levels, the offset is one for one and then declines. Individuals without an earnings-related benefit are eligible for the full guaranteed pension. Sweden also has income-tested care services for the elderly, income-tested housing allowances for pensioners, plus special allowances for pensioners with very low incomes.

Sharing is possible in the funded portion of the Swedish public pension system (but not the NDC portion, which is the focus of Klerby, Larsson, and Palmer). The voluntary transfer is stopped at the request of either spouse or automatically on divorce. But sharing has not turned out to be very popular. So far, very few have done so. In 2009, only 7,769 men and 169 women chose to transfer their pension rights.¹

Differences in traditions and cultures significantly affect female labor market participation—and so do economic conditions. Should public policy encourage women to engage in paid work to build their own adequate standard pensions? Tax and pension systems and other policies create incentives that affect decisions about market work, care activities, and leisure. Individual taxation and subsidized child care encourage continuous participation by women in the labor market. A pension system with positive work incentives leads to higher female labor force participation, higher pensions for women, and thus increased economic independence.

Klerby, Larsson, and Palmer favor sharing or joint annuities. Using Sweden as the example, they study how this outcome might look in practice by simulating sharing or joint annuities in NDC pension systems.

James, Edwards, and Wong (2008) studied the new defined contribution pension systems in Latin America, where married men must pay for a joint annuity; their study demonstrated that the reform reduced the pension gap between men and women partly because of these intrahousehold transfers from husband to wife.

Klerby, Larsson, and Palmer use actual data on all couples in Sweden, where both drew public pension between 1995 and 2007; their study investigates what would happen if all couples were required to share their public pensions with their partners, and they demonstrate that women, on average, gain through sharing, whereas sharing affects the pension income of most men negatively. Their chapter supports the claim that policy makers should consider mandatory sharing. The conclusion is that mandatory sharing in conjunction with retirement substantially improves welfare for older women as they become widows—without burdening a third party.

Sweden has developed from a society with family pensions to a society in which pensions are organized on an individual basis with women (and men) having pensions only in their own right. Entitlement to a widow's pension through the social insurance scheme was introduced in Sweden in the mid-1940s, and the benefits were tested against income and wealth. A more extensive widow's pension came into effect in 1960 with introduction of the national supplementary pension scheme. The supplementary pension benefits for widows were linked to the deceased husband's previous earnings and were payable alongside the widow's old-age pension.

In 1988, Sweden's parliament passed a government proposal for reform of family pensions; the new regulations went into effect in 1990. From 1990, the widow's pension was replaced by a temporary (one year) readjustment benefit for both men and women under age 65 and born 1944 or later; however, a survivor benefit children of the deceased, based on an imputation (to age 64) was retained. Why this vast structural change in pension schemes for survivors? The aim was twofold: partly to adapt the schemes to changes in family and income patterns and partly to reduce skyrocketing costs of earnings-related pensions in the future. The former reflected the fact that the proportion of gainfully employed women had greatly increased since the 1960s, and growing demand for equality between men and women required a gender-neutral survivors' pension. Together these factors led to the demise of the widow's pension. Although reduction of rapidly growing future costs was probably the most important factor, the major argument stressed at the time was the importance for women to stand on their own feet economically and that a survivor benefit for both spouses would still *de facto* be a survivor benefit mainly for women, with possible disincentive effects for labor participation. Nevertheless, the change was of fundamental significance, because it meant the ultimate break in a trend. The family was no longer considered the primary economic unit (Ståhlberg 2006).

Retrenchments might be a reason to advocate sharing or joint annuities even today in Sweden—and to again break a trend: the individual would no longer be considered the primary economic unit. Forty percent of Swedish pensioners receive a guaranteed top-up. With sharing, fewer persons would be able to qualify for the top-up, and tax-financed expenditures would be reduced. Income transfers to spouses, however, would result in some men falling from a high to a low tax bracket, which is why the state's tax revenues would fall. But because of means testing, sharing is accompanied by lower public expenditures for care services for the elderly and income-tested housing allowances and special allowances for very poor pensioners.

Finally, provisions for survivors can be organized in many ways. Governments that replace survivors' pensions by sharing or joint annuities may count on considerable reductions in expenditures. Sweden's government does not provide survivors' pensions. Nevertheless, by introducing sharing or joint annuities it may count on lower expenditures for income-tested benefits to pensioners.

By international standards, female labor force participation is high in Sweden; almost as many women as men work. But women with young children often work part-time. Furthermore, Sweden's labor market is segregated, and women's wages are about 92 percent of men's—after accounting for variations in education and work experience. As a result, men have more pension capital than their wives. But it is not obvious why spouses, who already receive their own adequate pensions, should retain the same level of per capita consumption in old age even after their partners die. So an alternative

could be joint annuities that allow the benefit as a single annuity—if both partners give their permission.

Note

1. These data for 2011 are from the Pensionsmyndigheten website, <http://www.pensionsmyndigheten.se>.

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Pension Entitlements of Women with Children: The Role of Credits within Pension Systems in OECD and EU Countries

Anna Cristina D'Addio

Retirement income today is a product of past events: it depends on the pension rules in place at the time entitlements were built up as well as on the pensioner's job and earnings history. Women's broken or incomplete work histories strongly affect pension entitlements in many countries.

The improvement in women's economic opportunities over the past few decades has varied in scale and pace across countries. However, the direction of change in women's labor market situation has been the same: thanks to greater opportunities and their rising educational attainment, successive generations of women have been spending more of their lives in paid work. Also, antidiscrimination legislation has contributed to the narrowing of the gap between the earnings of women and men. This trend implies that a growing number of women are building larger pension entitlements on their own rather than relying on benefits derived from their husband's pension contributions. However, achieving greater gender equality in pension entitlements between women and men is still a challenge in many countries.

Gender differences in pension systems originate mainly in the rules underlying (a) the access to pension benefits and the accumulation of entitlements and (b) the provision of benefits and the conversion of pension savings into benefits. Although the gender gap in retirement is expected to lessen in the future, not least because of increasing labor market participation rates of women during working life, today wide gender differences in pension outcomes exist across countries of the Organisation for Economic Co-operation and Development (OECD) and the European Union (EU). In fact, many of these countries report substantial gender gaps among current pensioners in terms of replacement rates—and therefore exposure to old-age poverty. These income gaps arise mainly because women are overrepresented in less well-paid occupations and because they are more likely to have part-time jobs and long career breaks, notably because of care obligations for

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children and close elderly relatives. In addition, pension ages for women in many OECD countries used to be lower than those for men, thereby giving earlier generations fewer years of contributions to the pension system and so lower benefits in their own right.¹ As a result of these fragmented career histories, women's ability to save for retirement is often adversely affected. Finally, some changes in the structure of the pension systems over time—such as the shift from defined benefit (DB) to defined contribution (DC) plans, where benefits depend on contributions made, interest received, and life expectancy—have also disproportionately affected the ability of women to prepare for retirement.

Of the broad reasons for different pension outcomes, labor market differences may be partly offset by increases in women's educational attainment and skill levels and by policies that seek to remove gender discrimination in the workplace. Indeed, creating a level playing field in the labor market would deal with this dimension of gender inequality in pension entitlements through the individual herself, rather than by addressing the disparity through an offsetting reward in pension schemes. However, in the presence of ongoing earnings inequality, the redistributive features of pension systems, such as those of residence-based basic schemes and generous minimum pensions, would assist in bridging the pension benefit gap between genders.

The other dimension for differing pension outcomes is based on qualifying conditions related to care. Women who spend periods of time out of the labor market caring for children or other relatives receive lower pensions in earnings-related pension systems. Many OECD countries award credits in the pension system to women with children and for time spent out of paid employment to care for children or sick relatives.

This chapter takes a detailed look at how these credits affect pension entitlements of mothers with an interrupted career. The chapter aims to explore to what extent caring credits offset the difference in pension outcomes of someone with an interrupted career compared to someone with a full work history in OECD and selected EU countries. It also reviews aspects of pension systems other than pension credits that affect the pension entitlements of mothers with interrupted careers.

The study begins with an overview of the main characteristics of pension systems and the factors that can affect pension entitlements (such as lower pension ages for women). The different kinds of child-care credit mechanisms in OECD and EU countries are then presented in terms of main recipients, applicable periods, credit calculation methods, funding sources, and objectives pursued. The chapter then presents OECD estimates of gross pension replacement rates for individuals with child-care breaks and for full career individuals with different earnings levels. This analysis is followed by simulations that look at (a) how replacement rates would be affected by the removal of compensation schemes and (b) how replacement rates vary across countries with credits and with no credits. The final section describes some policy implications.

Pension System Characteristics and Rules That Matter for Women with Interrupted Careers

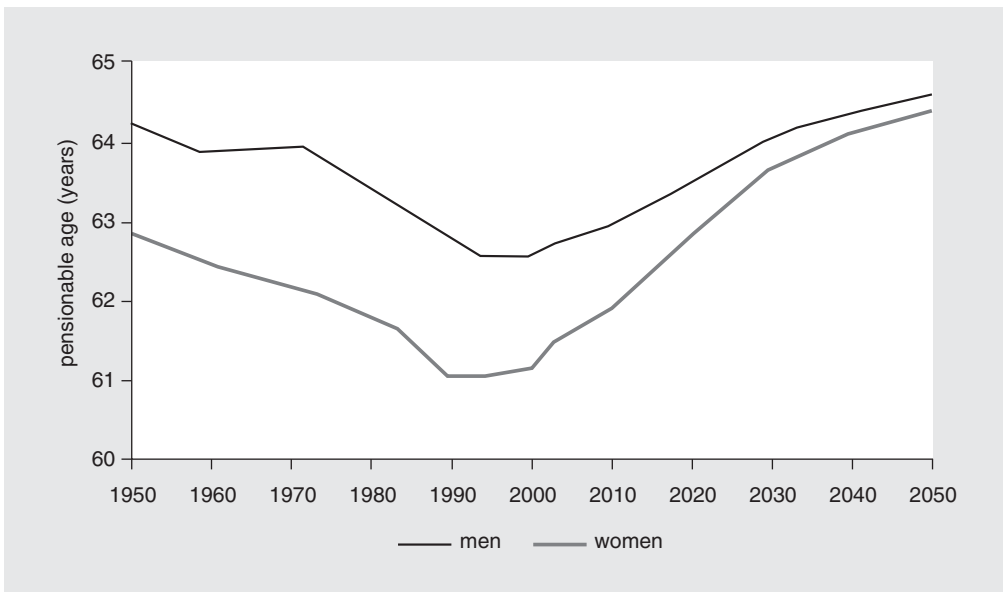
The characteristics and the design of pension systems have a large influence on the degree of coverage of women with interrupted careers when they retire. The OECD framework for classifying retirement income schemes consists of two mandatory tiers: a redistributive part

and a savings part (OECD 2004, 2005, 2007, 2009). Voluntary contributions, whether individual or employer provided, make up a third tier.

OECD countries' retirement income regimes are diverse and often involve a number of different programs. Nearly all countries have programs aimed to prevent poverty in old age, here called *first-tier redistributive schemes*. These schemes are of particular importance for women who, as shown in a background document (see D'Addio 2009), make up the majority of the poor at old age (see OECD 2009, chap. 2). In fact, guaranteed income schemes act as a safety net for women with an incomplete career or low earnings. Programs within the second tier play the role of savings in that they aim to provide retirees with an adequate income relative to their previous earnings, not just a poverty-preventing absolute standard of living. Even though mandatory pay-as-you-go systems are more suited to considering periods of unpaid work, in some cases occupational pension funds contain similar provisions. In Germany, for example, since 2005 individuals have been able to continue paying voluntary contributions into occupational pension schemes during periods of child care to avoid gaps in pension provision stemming from interruptions in wage earnings. The schemes considered here are, like those in the first tier, mandatory, whether public or private.

Another characteristic that matters when discussing pension entitlements of women who have children, interrupted careers, or both is the age at which the pension can be claimed. Normal and early retirement pension ages for women in many countries used to be below those for men, thus giving earlier generations fewer years of contributions to the pension system and so lower benefits in their own right.² Nowadays these two ages are converging because of reforms that aim both to increase minimum retirement age and to speed the process of increase for women (figure 12.1). Data show that women retire earlier than both the pensionable age and the age at which men retire. Average effective ages of exit

FIGURE 12.1 OECD average pensionable ages by gender, 1950–2050



SOURCES: Chomik and Whitehouse 2010; OECD 2011.

from the labor market are 63.5 and 62.3 years for men and women, respectively, whereas the average pensionable ages are 62.7 and 62.0 years for men and women, respectively, in OECD countries over the period 2002–05 (see Chomik and Whitehouse 2010).

Childbirth is one of the most important factors affecting the labor market outcomes of women (both participation and wages) and their working histories. Following childbirth, women in paid employment very often take some leave to care for the child. However, pension systems in many countries have compensation mechanisms related to childrearing aimed to mitigate the effects of interrupted careers. The next section looks into this issue.

Child-Care Credits

The evidence suggests that having a child can negatively affect the earnings used to compute the pension entitlements of women, the duration of the career, or both (see D’Addio 2009, forthcoming a). To offset part of this “penalty,” some mechanisms, either implicit or explicit, exist in the pension systems of most OECD countries (Queisser 2003). They are supposed to reward invaluable social activities—giving birth to and caring for children is vital for the survival of a society—or to achieve gender equity. Minimizing poverty of elderly women and ensuring women a decent income when old are also important reasons behind child-care credits.

Child-care credits available in OECD countries take various forms. Their design obviously depends on the structure of an individual country’s pension system. Explicit child-care credits are possible only in pension schemes that are contribution based and have some type of earned eligibility rules. Where pensions are universal (based, for example, on residency), credits are implicit in the system. The majority of countries with earnings-related schemes have child-care credit systems. DB schemes usually have built-in redistributive mechanisms that give more benefits to low-income earners than they would receive based on their contribution history. In contrast, in DC schemes, pension entitlements and pension levels heavily depend on individuals’ contribution records. Even though in theory credits can be given through government subsidies, DC-type private or occupational pension schemes rarely provide insured individuals with child-care credits. The Swedish occupational scheme, the ITP (*Industrins och handelns tilläggspension*), and the Danish occupational scheme, the ATP (*Arbejdsmarkedet Tillaegspension*), are the only examples of such a system. As table 12.1 shows, five countries—Malta, Portugal, Slovenia, Turkey, and the United States—among those countries with earnings-related schemes do not provide explicit child-care credits. Among the mandatory occupational pension plans, only the French one provides child-care credits to its members, but these credits only apply to parents with at least three children.

TYPES OF CREDIT-REWARDING ARRANGEMENTS

Many OECD and EU countries have pension systems granting various kinds of credit-rewarding arrangements (figure 12A.1 in the annex).

Maternal credits without stopping work. Some countries grant credits to mothers by increasing the duration of insurance, the amount of pension entitlements, or both without the mother having to stop work (e.g., France, Germany, and Italy). To qualify for

TABLE 12.1 Pension schemes in countries without explicit child-care credits for full-time workers

Country	Public	Private
Australia	Targeted (means tested)	Defined contribution
Iceland	Basic (residence based), targeted (means tested)	Mandatory occupational
Malta	Earnings related	n.a.
Mexico	Targeted (means tested)	Funded
Netherlands	Basic (residence based)	Quasi-mandatory occupational
New Zealand	Basic (residence based)	n.a.
Portugal	Targeted (means tested), minimum, earnings related	n.a.
Slovenia	Targeted, minimum, earnings related	n.a.
Turkey	Targeted (means tested), earnings related	n.a.
United States	Targeted (means tested), earnings related	n.a.

SOURCE: OECD, Global Pension Statistics database.

NOTE: The table lists the countries that do not grant explicit credits for child-care absences. However, components of the pension systems in Iceland, the Netherlands, and New Zealand grant implicit credits, thereby implying that the fact of being a resident in Iceland, the Netherlands, or New Zealand covers de facto periods out of the labor market. n.a. = not applicable.

Credits given to paid maternity leave are excluded because they are actually considered as employment.

these credits, a mother must have at least one dependent child. For example, in France as of January 1, 2004, the public pension system (*régime général*) awards mothers a quarter of insurance after the birth or adoption of a child. An additional quarter is awarded during the years following the birth or the adoption at the birthday of the child up to a maximum of eight quarters per child. In practical terms, a maximum of two years are credited for each child younger than 16 years of age.³ In Germany, following the birth of a child, a point, calculated on the basis of average income, is credited. The point equals one year of earnings at the economywide average in the pension formula. In Italy, the credit is granted as a more favorable conversion factor (which is the factor that transforms the notional capital into the pension payment).

Parental credits for interrupted work. This form of credit is granted to either the father or the mother if either interrupts work to care for the child. This credit is granted in most OECD and EU countries. Nevertheless, the forms under which the credit is awarded vary:

- In some countries, the periods devoted to child care increase the pension entitlement (e.g., in Luxembourg, people who cannot claim “baby years” because of an insufficient contribution period have the right to get a special monthly allowance during retirement).
- In other countries, the periods devoted to child care are taken into account in assessing the number of years necessary to be eligible for the pension, so they are formally considered as employment.

- In yet other countries, the periods devoted to child care are ignored in determining the calculation of earnings for pension purposes so that these absences do not reduce the assessment base (e.g., in Canada and the Czech Republic). In fact, in countries where pension entitlements are based on the average earnings over certain periods (e.g., lifetime or best 25 years), inclusion of unpaid caring periods may substantially reduce the total amount of pension benefits.
- In some countries, child-care periods count as qualifying years and are not used for the calculation of benefits. Most pension schemes set minimum qualifying periods to obtain pension entitlements. Examples are found in schemes that apply a limited number of best or final years' salaries to measure earnings for calculating benefits (e.g., Greece). In Luxembourg, as noncontributory periods, time spent caring for children under six years of age is counted for both an early retirement pension and the minimum pension.

Implicit mechanisms. The architecture of the pension system can implicitly take into account the interruption of activity in the paid labor market to care for children. In a number of countries, the pension is not linked to contributions paid into the system but depends only on the conditions of residence (e.g., the Netherlands and New Zealand). In that case, no rewarding mechanism for interruptions in work history is needed, because the eligibility conditions are met by residence records. In other cases, the number of contribution years required to receive a full pension is relatively low with respect to a full career lasting, for example, from the age of 20 until the age of 67 (e.g., in the United States, 35 years of contribution are needed). For these countries, career breaks, including child care, are therefore offset almost implicitly.

Credits depending on the number of children. A number of countries grant favorable treatment to mothers by allowing them to retire earlier.⁴ For example, in Italy, mothers covered by the new nonfinancial (notional) defined contribution (NDC) scheme can choose either to retire earlier (4 months for each child, with a limit of 12 months) or to get a higher pension. Retirement ages for women in some other countries (e.g., the Czech Republic and the Slovak Republic) depend on the number of children: the greater the number of children, the lower the retirement age. In Greece, mothers can retire as of age 55 if they have at least 20 years of insurance and care for a minor child or a child with disabilities. This age limit can be further lowered to 50, but the benefit will be lower.

The increase in the pension benefit depends on the number of children. With respect to the number of children, France's earnings-related scheme gives a generous 10 percent increase in final pension amount to both parents with three or more children, while the French occupational schemes award an increase of 5 percent. In Italy, the more generous transformation coefficient corresponds to the actual retirement age plus one year for mothers of one or two children. For three or more children, it corresponds to the actual retirement age plus two years. Thus, the effect is to increase the pension by around 3 percent for one or two children and 6 percent for three or more children.

Combination mechanisms. Both credits without stopping work and credits for interrupted work are present in some countries (e.g., France and Germany).

Table 12A.1 and figure 12A.1 in the annex provide a detailed description of all crediting mechanisms in the countries considered.

RECIPIENTS: MOTHER OR FATHER

Another issue in the treatment of interrupted careers for child-care reasons within pension systems is whether the credits are given only to mothers or also to fathers. In principle, the person who actually bears the burden of child care and experiences breaks of career should be the recipient.⁵

Child-care credits in many countries are closely related to parental leave periods. In most cases, the recipients are mothers, but in some cases, they are fathers (e.g., Denmark, Sweden). In some countries, even though priority is given to mothers who actually take the leave, the choice between mothers and fathers is allowed to compensate for women who cannot use the credits and to increase the couple's pension entitlement. For example, the Greek earnings-related pension provides women with child-care credits that enable them to complete the required minimum 15 years. However, when the mother does not make use of the credits, the father may use them to meet the conditions for his retirement pension. Likewise, in the Norwegian earnings-related scheme (now NDC), the top-up credits are given to the mother, but the family may apply to have the points granted to the father instead. In Germany, the credits for children born in 1992 or later can be taken by either employed or unemployed parents or shared between them. In Sweden, one of the parents is allowed to take child-care credits, but if no preference is expressed, they are automatically given to the parent who has the lowest pensionable income in the year. In Luxembourg, a flat-rate childrearing allowance is payable from age 60 to parents who do not have sufficient contribution records to qualify for a retirement pension. This allowance is paid to only one parent, which means that most recipients are women. This system has been serving as a special benefit for women who, because of child care, are not able to accumulate enough qualifying years for pension entitlements.

PERIODS AND CALCULATION METHODS FOR CREDITS

Child-care credits vary across countries according to the period covered, the reference period on which the earnings are based, and the ways child-care periods count toward the pension entitlement.

The period covered. Child-care credits usually cover career breaks for child care until children reach a certain age. Normally, parental leave periods are also covered. However, the credit usually declines as the child-care period lengthens or varies according to the age of the children. For instance, in Germany, contributions based on economywide average earnings are paid by the government for three years per child born in 1992 or later. However, the credits to care for children of age 10 are different. They count toward the number of years needed to qualify for a pension (*Berücksichtigungszeit*) and in addition affect the pension entitlement: if parents work and contribute when their children are under 10, or if at least two children are under 10, the parents receive a bonus of up to 0.33 pension points per year. In Luxembourg, "baby years" (two years for one child and four years for two children) are credited as an insured period. By contrast, periods caring for children under six years of age are recognized as noncontributory periods that are counted toward only the qualifying conditions for early retirement and minimum pension.

The reference earnings on which the credits are based. Some countries use the earnings immediately before the child-care periods (e.g., Belgium, Japan, Luxembourg, and Portugal), whereas others average earnings over the 6 or 12 months before the breaks (e.g., Poland and the Slovak Republic). Other countries use a flat-rate amount of earnings. For example, in Austria, credits are based on the fictitious pensionable salary of €1,350 per month. In Estonia, the government pays contributions on 33 percent of EEK 700. In Finland, pensions accrue as if the person received a salary of €556.60 per month. In Norway, caregivers are credited with three pension points per year in the supplementary earnings-related scheme. In the United Kingdom, for the state second pension, years caring for a child under age six are credited; caregiving parents are deemed to have earnings at the lower earnings threshold: £12,500 per year in 2006/07. Another group of countries, including France, Hungary, Poland, Sweden, and Switzerland, choose care-related benefits—maternity or parental—or the minimum wage as reference earnings. Sweden has a flexible system that applies to the most favorable earnings. Finally, Romania uses the social insurance benefits granted during the parental leave as the contributory base.

The ways child-care periods count toward the pension entitlement. Crediting methods in OECD countries can be categorized into five main groups.

1. The pension amount is increased as a result of childbirth or according to the number of children, irrespective of the fact that the career has been interrupted (e.g., in France, Germany, and Italy).
2. Pension entitlements are increased, crediting the period of time spent out of the labor market to care for children, which is formally considered as employment.⁶
3. Caring periods are ignored when determining the averaging period for calculating pension benefits (e.g., in Canada and the Czech Republic).
4. Child-care periods count only toward qualifying years (e.g., in Greece).
5. Pension entitlements are increased by granting specific allowances to people in retirement (e.g., in Luxembourg).

SOURCES OF FUNDING

The source of funding depends on the pension scheme. In general, child-care credits are funded from general revenue. In Austria, both the separate Family Allowances Equalization Fund, which depends on a portion of federal income tax, and the public budget are responsible for funding child-care credits. Until 2009, each source contributed equally, but as of 2010, the ratio is 75:25. Similarly, in France, a public fund financed through various earmarked taxes, such as taxes on alcohol, is the main funding source. The German federal government pays tax-funded contributions for childrearing periods on a flat-rate basis into the pension insurance. In the Slovak Republic, the government pays contributions on behalf of people caring for children up to six years of age. The amount is equivalent to 20 to 60 percent of an assessment base (average monthly wage). In Estonia and Latvia, the state pays contributions on behalf of caregivers. Most other countries rely on general revenue to pay the contributions on behalf of caring parents or to pay pension benefits.

Credits for careers in an NDC scheme are also funded out of the general revenue. However, the benefits vary according to the contributory base chosen. For example, in

Poland, caring credits are financed through transfers from the state budget; however, the subsidy is based on the minimum wage. In Italy, periods spent out of the labor market to care for children are credited under the form of a more generous transformation coefficient that increases pension entitlements according to the number of children.

OBJECTIVES

The introduction of child-care credits in different countries has been inspired by various objectives. For example, in France, such credits were intended to boost the birth rate, to reward parents with children, to cover part of the cost of children, and, in practice, to bolster pension systems. Child-care credits may also aim to encourage mothers to stay in (or to reenter) the labor market, to guarantee decent pensions for mothers, to compensate for a savings gap, to ease the retirement of mothers, or to actively promote gender equality. Thus, these credits are meant to attain more than one objective at a time. Table 12.2 enumerates these objectives for selected countries.

Table 12.2 **Objectives of implicit and explicit credits related to children in selected European countries**

Country	Boost fertility rates	Reward parents	Offset some of the cost for dependent children	Guarantee a decent income for mothers	Incentivize mothers' work	Compensate some savings gap	Ease early retirement of working mothers
Austria	✓		✓✓	✓✓			✓
Belgium	✓			✓✓	✓		✓
Denmark	✓		✓✓				
Finland	✓		✓✓				
France	✓✓	✓	✓	✓✓		✓✓	✓✓
Germany	✓	✓	✓	✓✓	✓✓	✓✓	✓
Greece	✓			✓✓			✓✓
Ireland	✓		✓✓				
Italy	✓			✓✓			✓✓
Luxembourg	✓			✓✓			✓
Netherlands	✓		✓✓				
Portugal				✓			
Spain				✓✓			
Sweden	✓	✓		✓✓	✓✓		✓
United Kingdom	✓			✓✓			✓

SOURCE: Adapted from Assous 2002.

NOTE: Two checkmarks indicate that the objective is explicit in a specific country. One checkmark indicates that the objective is implicit in the rule underlying the crediting mechanism.

In countries such as Denmark, Finland, and the Netherlands, the objective is more direct: to offset the cost of dependent children to retirees. Having a dependent child implies a substantial financial burden for a retiree, and the basic scheme takes this cost into account by paying an extra allowance that increases retired households' resources. Because the number of pensioner households with dependent children is low, this type of credit is not very important in terms both of the number of beneficiaries and its cost. This objective is mainly attained through the basic pension schemes that aim to provide enough income to satisfy some social needs.⁷ In other countries, dependent children living in the households of retirees increase pension entitlements of all retirees (Austria) or mainly of widows and widowers (France and Germany).

Some countries (e.g., Germany, Luxembourg, Sweden, and the United Kingdom) use child-care credits to incentivize mothers' work and thus increase women's participation in the labor market. For example, in Germany, mothers of young children who do not withdraw from the labor market are given the same pension as those who withdraw from the labor market—in addition to their earnings. Where women's participation is very high (as in Sweden), the main aim of this kind of credit is to make it easier for parents to reconcile work and family. The credit mechanism can be used in both Germany and Sweden to offset the wage decreases incurred by a mother working part time to care for a child under three years of age.

Where credits are granted only when a job in the labor market is interrupted (as in Austria and Belgium), the objective pursued is clearly different. Credits are, in fact, simply designed to ensure a certain standard of living to women with interrupted careers so they can raise their children.

Simulations of Pension Entitlements of a Person with Career Breaks Because of Child Care

This section assesses the situation, in terms of the old-age pension entitlements, of women who start their careers as full-time employees at age 20 and who after a child-care break (for two children with a break of 15 years maximum) return to work as full-time employees. The results show how pension credits and the redistributive features of pension systems (such as basic pensions, minimum pensions, old-age assistance, and progressive benefit formulas) work together to protect women who take career breaks for child care. The analysis uses the gross replacement rates as the main indicator. Some results based on net replacement rate are also presented. The simulations use the OECD pension models.⁸

The following main assumptions are used in the pension models. Except for those listed in the first two bullets, they are the standard assumptions underlying the results presented in *Pensions at a Glance* (OECD 2009).

- Women have two children born two years apart.
- Breaks for child care vary between 0 and 15 years.
- Women (both single and married) are assumed to earn individual entitlements as if unmarried.
- Women with full careers are assumed to enter the labor market at age 20 and continue working without interruption until the normal retirement age of the country, earning the same proportion of average earnings over the entire career.

- The measure of average earnings corresponds to that of an average worker. Real earnings are expected to grow at a constant rate each year for the entire projected period, and this growth is assumed to be equal to the growth of the country's gross domestic product. Results are presented at various earnings levels: 0.5, 1.0, and 2.0 times average earnings.⁹
- Price inflation is assumed to be 2.0 percent per year. The real rate of return on DC pensions is assumed to be net of administrative charges and taxes: it is 2.5 percent (3.0 percent of gross real rates of return minus 0.5 percent of administrative charges).
- The pension entitlements calculated reflect the prospective pension income of people retiring in the future but based on currently legislated reforms. Results presented here refer to pension entitlements under the legislation enacted by 2006, including changes to the pension system legislated up to 2010 to be implemented incrementally in the future.
- For each country, only the main national scheme for private sector employees plus all mandatory and widely covered occupational pension schemes are modeled. Schemes include classic pay-as-you-go schemes—DB or NDC—as well as the mandatory DC funded tier of the statutory scheme existing in some OECD countries.

Resource-tested benefits for which retired people may be eligible are also modeled. The calculations assume that the individual or family takes the full entitlement benefits. Where broader means tests are used, for example, taking account of assets, the income test is taken as binding.¹⁰

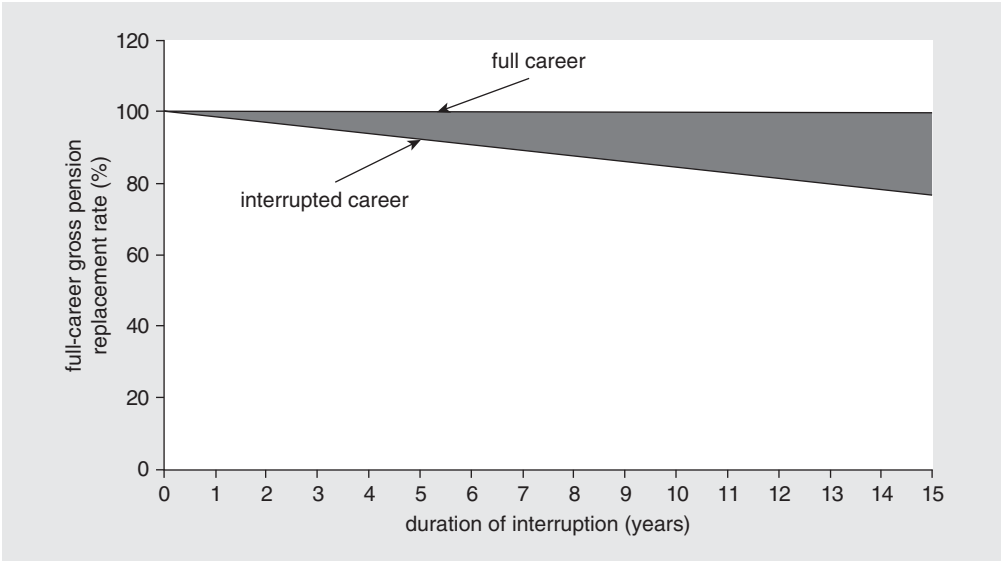
THE OVERALL PICTURE OF THE EFFECT OF CHILD-CARE PERIODS IN OECD COUNTRIES

To what extent do child-care credits affect the pension entitlements of mothers? How much lower or higher—even though the latter is very rare—is the pension entitlement of a person who has child-care career breaks and who receives the child-care credits compared to the reference person with a full working career? Do schemes with child-care credits and schemes without create any big differences? The effect of credit systems is reviewed hereafter.

Figure 12.2 shows the average difference in percentage points between the gross replacement rate for a woman who interrupted her career for child-care reasons and a woman with a full career history in OECD countries. On average, the gross replacement rate for average earners drops by 4 percentage points after a 5-year child-care break, increasing to about 8 percentage points after a 10-year break. The decline eventually averages 13 percentage points after a 15-year break. As clearly shown, the gap widens as the child-care breaks get longer.

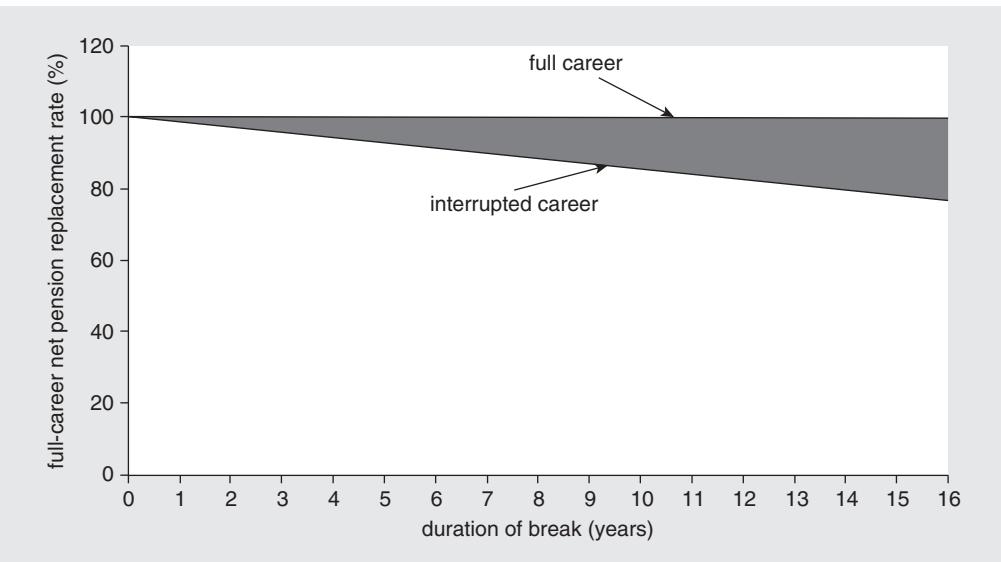
The magnitude of the decline is also maintained in terms of net pension replacement rates, as figure 12.3 shows. On average, the net replacement rate for average earners drops by 4 percentage points after a 5-year child-care break, increasing to around 9 percentage points after a 10-year break. The decline eventually averages 15 percentage points after a 15-year break.

FIGURE 12.2 Change in the gross pension replacement rates relative to full career, according to length of break, OECD average



SOURCES: OECD Pension Models database; D'Addio, forthcoming b.

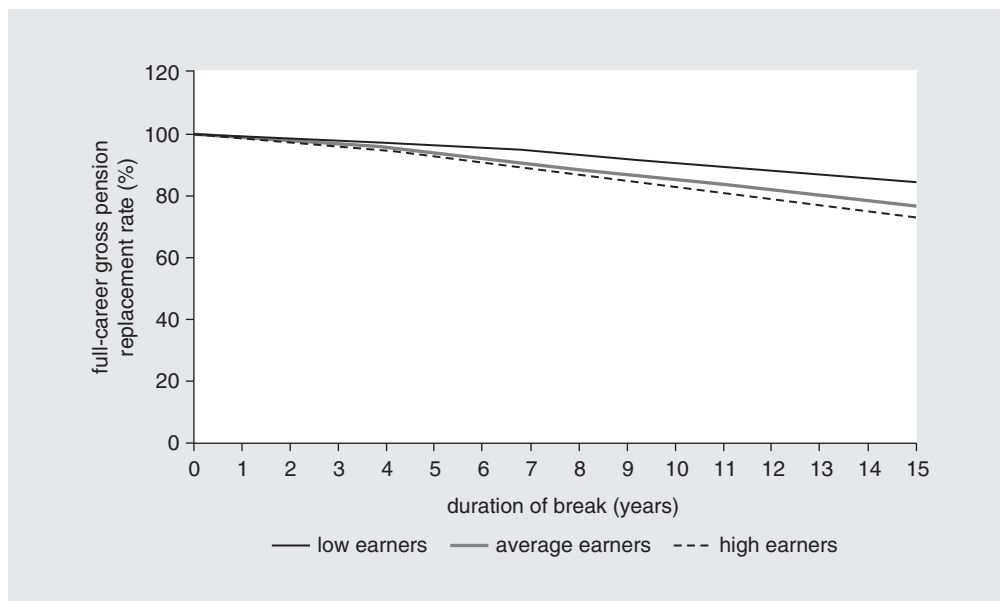
FIGURE 12.3 Change in the net pension replacement rates relative to full career, according to length of break, OECD average



SOURCES: OECD Pension Models database.

Figure 12.4 suggests that the earnings level influences the way replacement rates vary across breaks for the average OECD gross replacement rate. High earners (at twice the average earnings) will experience more substantial cuts in their pension replacement rates than low earners. Whereas for low earners (earning half the average earnings) the decline relative to a full career is 4 percent for 5 years of absence and 15 percent for 15 years of

FIGURE 12.4 Change in gross pension replacement rates for those with child-care breaks compared to full career, OECD average



SOURCES: OECD Pension Models database; D'Addio, forthcoming b.

absence, the decline averages 6 percent for average earners after a break of 5 years (and 23 percent after a break of 15 years). For high earners, the loss relative to full-career replacement rates averages 8 percent after 5 years, increasing steadily to 27 percent after a break of 15 years. This difference is often the result of the role played by the first pension pillar.

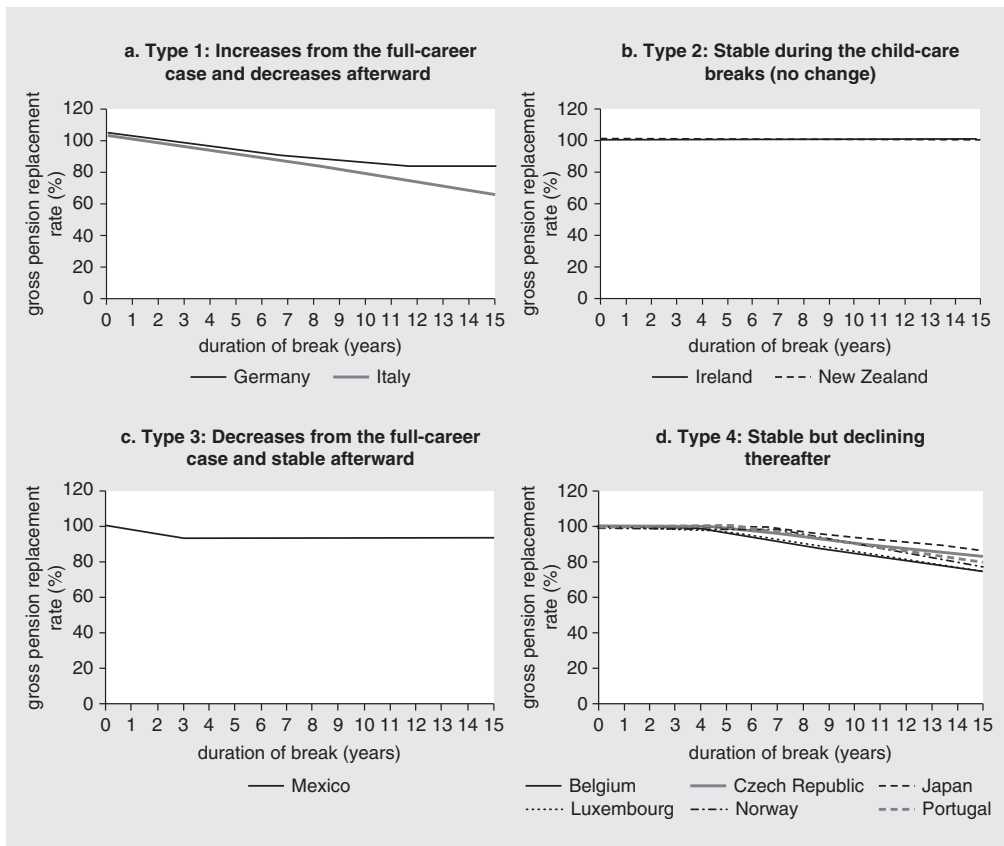
The treatment of child-care breaks may act as a penalty as wages increase, thus affecting the childbearing decisions of women at the top of the earnings distribution. However, the link between earnings and the total fertility rate is still uncertain. Although economic theory would suggest income and fertility should be positively correlated, many authors have shown that a large number of “confounding” factors influence this relationship (e.g., Becker 1960; Borg 1989). In fact, the analysis of the relationship between income and fertility would not be complete without taking into account the opportunity cost argument. This argument suggests that the role of women’s wages in childbearing decisions is such that women who earn higher wages will have fewer children because of the higher opportunity cost deriving from the interruption of their career (and this independently of their higher ability to afford child-care services). In this respect, the design of the pension system could well affect childbearing decisions.¹¹ An earnings-related pension system could, for example, reduce the incentive to have children more than a flat-rate one, especially for people whose investment in human capital is high and for whom higher wages would lead to higher pension entitlements. Not interrupting the career would result in longer contribution periods and, therefore, higher pension entitlements. However, career development opportunities and the availability of child-care services, as well as forgone losses, likely have a bigger effect on childbearing decisions than do old-age considerations.

The overall picture on the effect of child-care credits hides cross-country variation. From the results of the microsimulation of the child-care breaks for average earners’

gross replacement rates relative to full-career rates, six types of trends can be identified (figure 12.5):

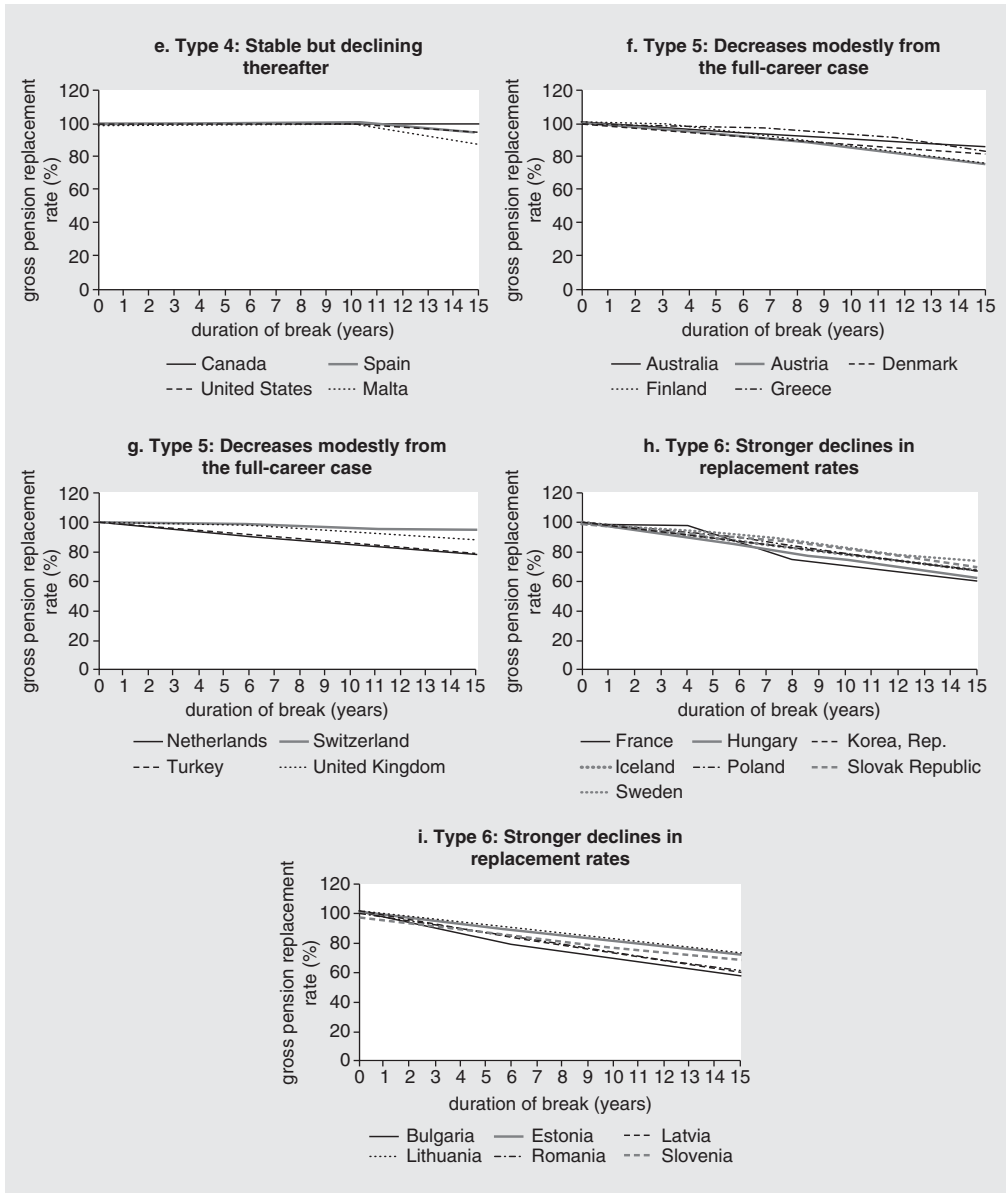
- *Type 1.* In the two countries in panel a of figure 12.5 labeled as type 1 (Germany and Italy), the replacement rate increases at childbirth and decreases afterward.¹² However, the decrease in the entitlements during the interruption is much faster in Italy than it is in Germany. The German pension scheme provides preferential treatment to mothers without child-care breaks as described in previous sections. Italy provides more generous transformation coefficients (i.e., a more favorable pension entitlement), which does not depend on having interrupted the paid activity on the labor market.
- *Type 2.* In the two countries in panel b that fit into type 2 (Ireland and New Zealand), gross replacement rates stay the same during the entire child-care break.
- *Type 3.* In Mexico (type 3), the gross replacement rate decreases during the first three years and stays stable thereafter (panel c).
- *Type 4.* In the 10 countries of type 4 shown in panels d and e (Belgium, Canada, the Czech Republic, Japan, Luxembourg, Malta, Norway, Portugal, Spain, and

FIGURE 12.5 Gross pension replacement rates for interrupted career compared to full career



(continued next page)

FIGURE 12.5 **Gross pension replacement rates for interrupted career compared to full career (continued)**



SOURCES: OECD Pension Models database; D'Addio, forthcoming b.

the United States), the replacement rate stays stable for some years and thereafter decreases very modestly. In Canada, Spain, and the United States, for example, this decline depends on the way earnings are taken into account in the calculation of benefits.

- *Type 5*. In the nine countries of type 5 shown in panels f and g (Australia, Austria, Denmark, Finland, Greece, the Netherlands, Switzerland, Turkey, and the United

Kingdom), the gross replacement rate drops only very modestly during the child-care absences. On average, in these countries, the gross replacement rates of mothers with interrupted careers are 5 percent, 11 percent, and 18 percent lower than those obtained in the case of a full career after a break of 5, 10, and 15 years, respectively.

- *Type 6.* In the remaining seven OECD countries (France, Hungary, the Republic of Korea, Iceland, Poland, the Slovak Republic, and Sweden) and the six non-OECD countries (Bulgaria, Estonia, Latvia, Lithuania, Romania, and Slovenia) of type 6, shown in panels h and i, the decline of the gross replacement rates is very sharp. In France, for example, this decline is likely related to the fact that occupational pension schemes grant credits only to mothers of three or more children. On average, in these countries, the replacement rates of mothers with interrupted careers are 10 percent, 22 percent, and 33 percent lower than those obtained in the case of a full career after a break of 5, 10, and 15 years, respectively.

Are Child-Care Credits All That Matters?

Do child-care credits achieve their goals? What are the factors that protect pension entitlements of those who perform child care? This section tries to answer these questions by looking at (a) pension gross replacement rates of mothers as a function of the duration of the break, with actual credits and without credits; (b) average replacement rates by income level and duration of the break across groups of OECD countries (all countries, countries with child credits, and countries without credits); and (c) gross pension replacement rates, compared to full-career rates, decomposed according to the pension scheme.

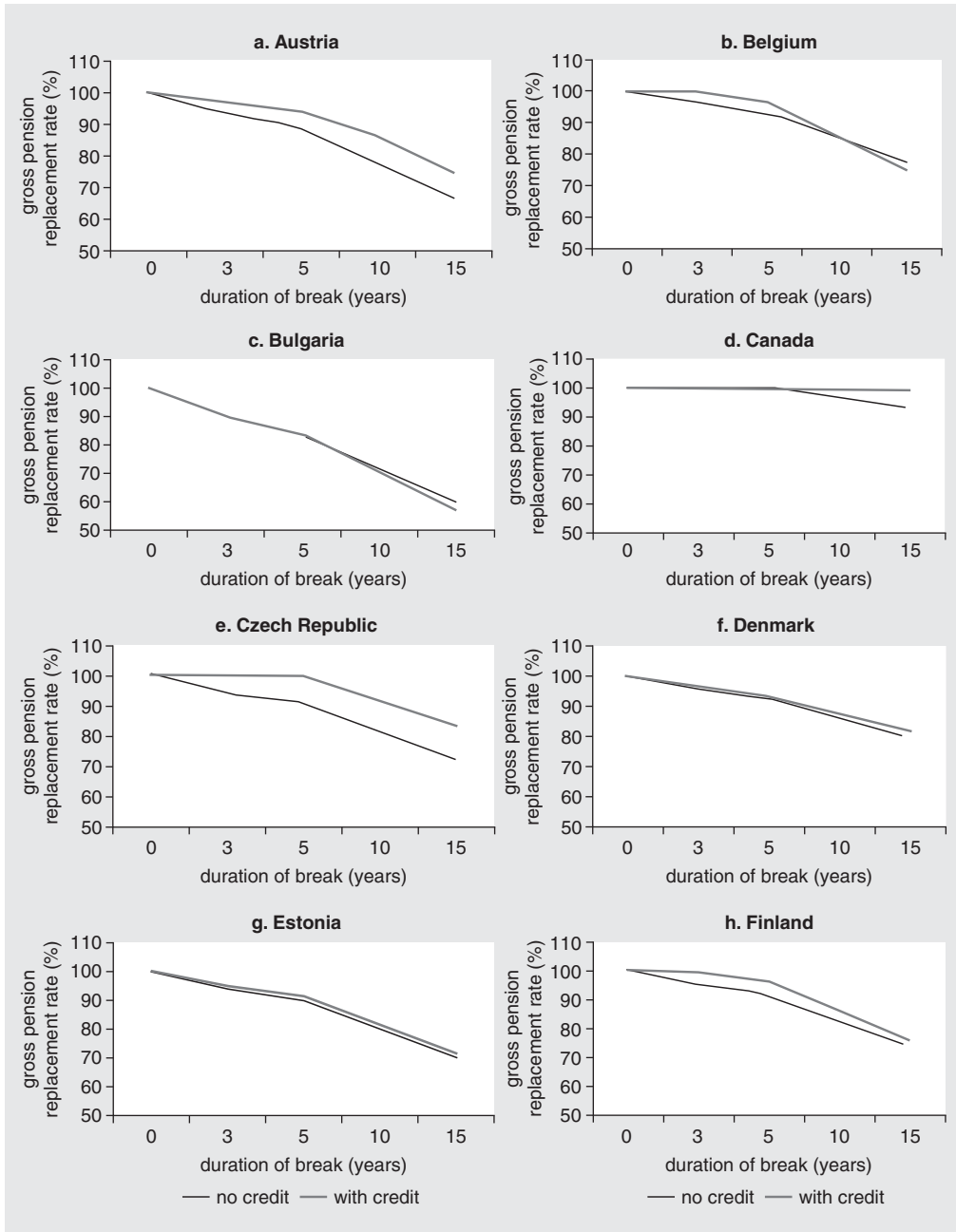
WHAT WOULD HAPPEN IF CREDITS NO LONGER EXISTED?

The analysis that excludes from the simulation the child-care credits in countries where they do exist reveals that mothers would be entitled to lower pensions without such credits. If those crediting mechanisms did not exist, mothers' replacement rates would decrease by 3 to 7 percentage points on average with between 3 and 15 years of career interruption. In other words, the credit treatment of child-care absences within a pension system is beneficial to mothers in terms of replacement rates. Their favorable position is maintained throughout the entire child-care absence. Earnings levels do not significantly affect the replacement rates, even though low-income earners generally have higher replacement rates than do middle- or high-income earners because of both child-care credit systems and redistributive mechanisms within pension systems.

This general picture, however, hides large cross-country variations, as illustrated in figure 12.6. For the first five-year period, virtually no gap exists in gross pension replacement rates either in the presence or in the absence of credits in most OECD countries. But these gaps generally become wider as periods spent out of the labor market to care for children lengthen.

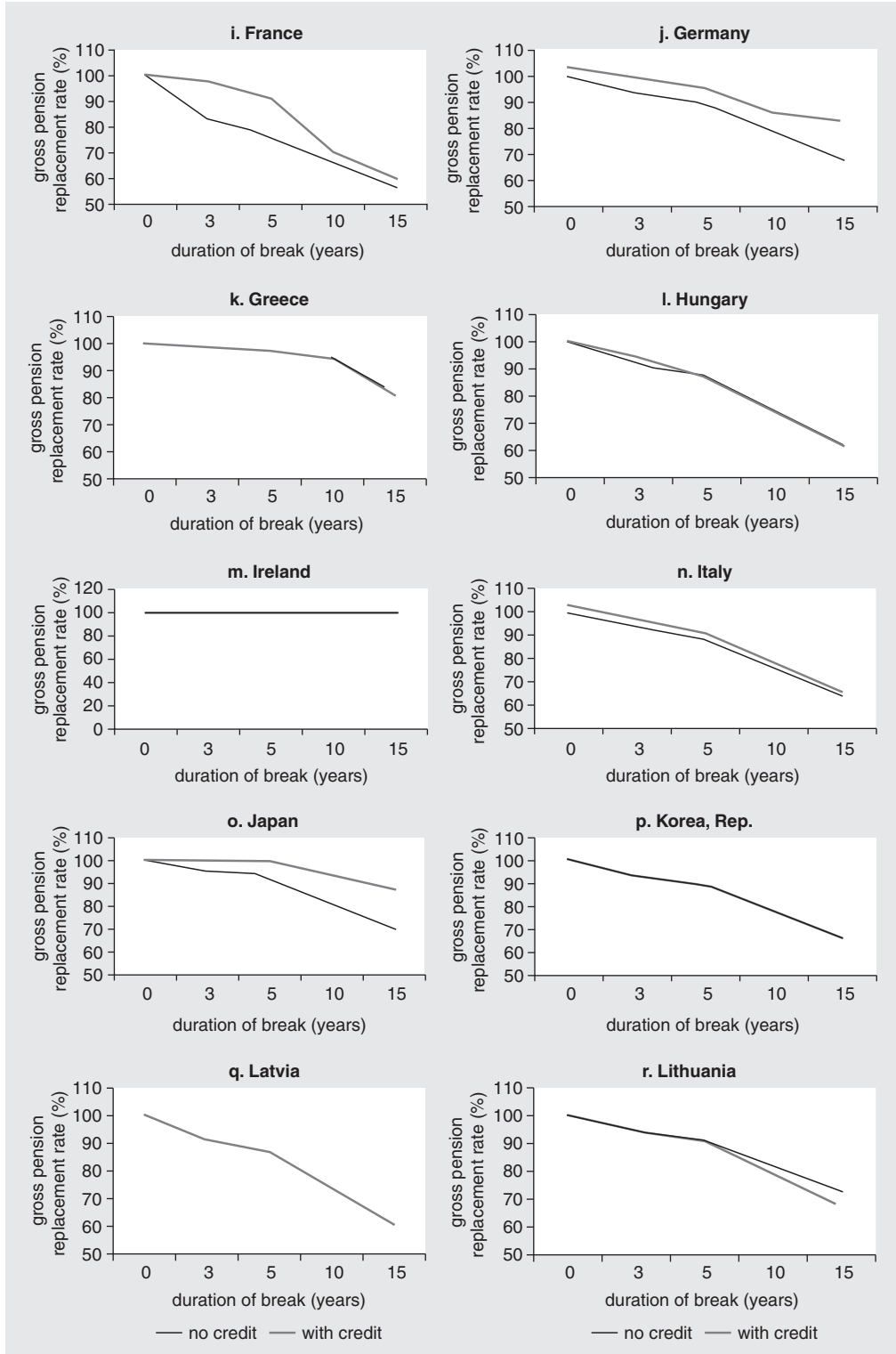
In a number of OECD countries (Denmark, Greece, Hungary, Ireland, Korea, Norway, and Sweden) and in all EU non-OECD countries (Bulgaria, Estonia, Latvia,

FIGURE 12.6 Gross pension replacement rates relative to full career if credits exist or are removed



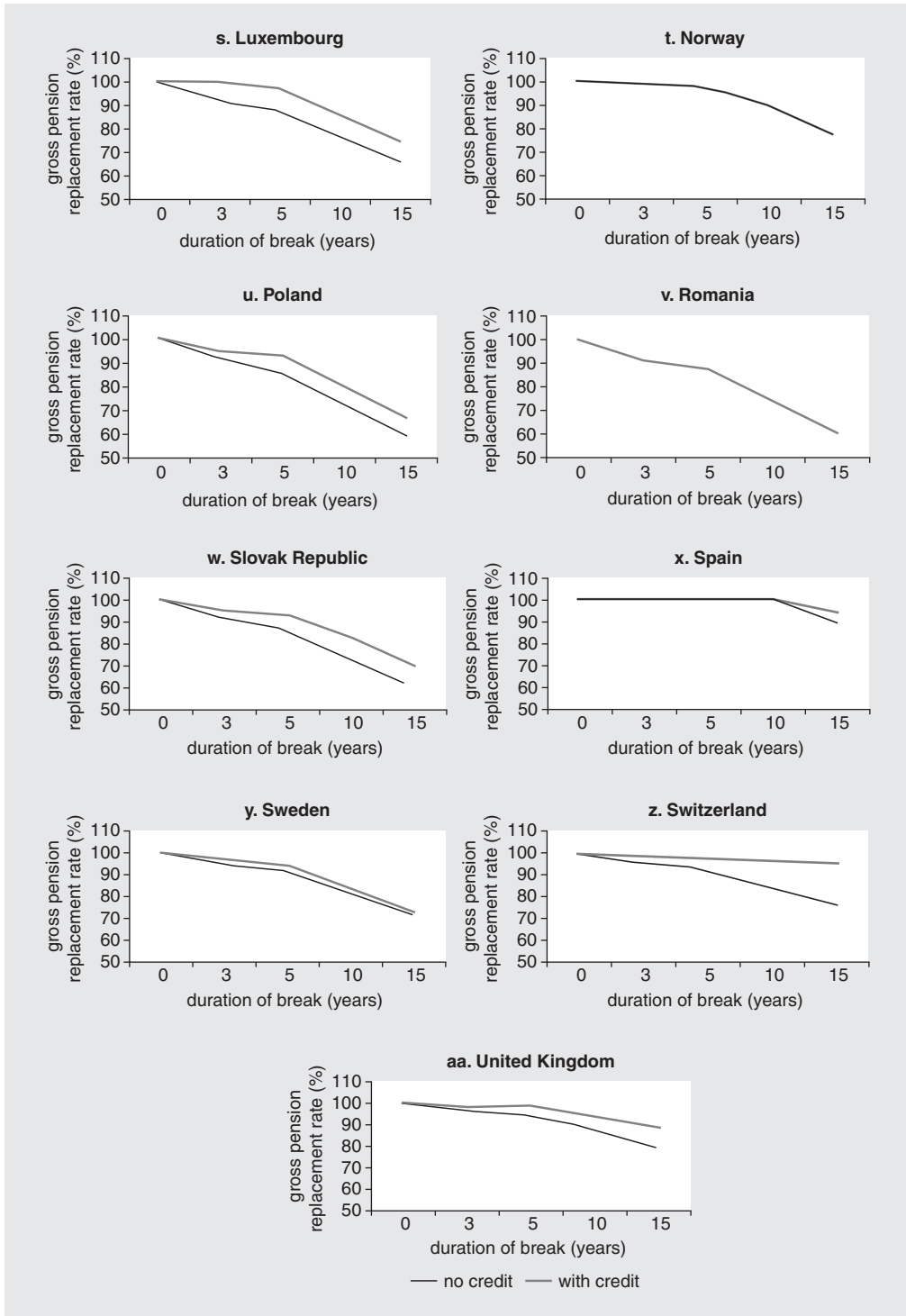
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FIGURE 12.6 Gross pension replacement rates relative to full career if credits exist or are removed (continued)



(continued next page)

FIGURE 12.6 Gross pension replacement rates relative to full career if credits exist or are removed (continued)



SOURCE: OECD Pension Models database.

Lithuania, and Romania), the gross replacement rates relative to full-career are very similar both when credits exist and when they do not exist. For example, in Greece, a maximum replacement rate of 70 percent for people retiring at the normal age could be attained after 35 years of contributions, and the earnings measure is based on the average over the last 5 years before retirement. In addition, the child-care credit system—one year for the first child and one and one-half years for the second child—applies just for qualifying years, not for the calculation of benefit.

In other countries, such as the Czech Republic, Finland, Italy, Poland, the Slovak Republic, and the United Kingdom, a constant difference is maintained relative to full-career gross replacement rates in the credit and no-credit cases, respectively, throughout the child-care absence. For example, Polish mothers with child-care credits enjoy slightly higher gross replacement rates than those without credits. The difference in the two groups goes from 2 to 5 percentage points for a 15-year absence. All periods for which the contributions are paid qualify for the minimum pension guarantee. Even though the Polish pension scheme provides child-care credits to mothers for periods of parental leave (three years per child), the effect is low because the contributions paid by the government on behalf of those taking a career break are based on the minimum wage, which is equivalent to only 18 percent of national average earnings. In many other countries, the credits are based on earnings immediately before leave is taken.

In Austria, Canada, France, Germany, Japan, Luxembourg, Spain, and Switzerland, the credit system plays a more powerful role as the period spent to care for children lengthens. Without credits, mothers who have not worked for a substantial period because of caring for children would experience a more substantial drop in their replacement rate. Mothers in Luxembourg are granted the most favorable advantage from the child-care compensation mechanism for a five-year period of absence. In fact, with the credit mechanism, relative to full-career rates, they have replacement rates higher than those they would enjoy if the credit system were to be removed. This effect is maintained continuously for up to five years of absence from the labor market for child care. The treatment is favorable to mothers for longer periods of absence. For example, a woman out of paid work for 15 years because of child care receives 75 percent of the gross replacement rate relative to full-career workers. Without child-care credit systems, the rate would be 66 percent. The generous pension system in Luxembourg and credits for “baby years” (two years for one child and four years for two children), which are based on pay immediately before the baby years, are responsible for the relatively high reward for mothers.

In Switzerland, mothers enjoy substantial advantages for long absences because the public pension scheme takes into account all years of child care for children under age 16. The reference earnings in this case are three times the minimum pension of the year in which the caring parent retires.

In Germany and Japan, the credit systems also play an important role, and unlike the case of Luxembourg, as caring periods get longer, the importance of care credits gets stronger. Both countries have nearly identical child-care credit systems for the first few child-care years. Credits of three years per child, based on average earnings (Germany) and the earnings just before leave (Japan), are granted, but the German system is more comprehensive in that it provides another credit for periods caring for children younger than 11.

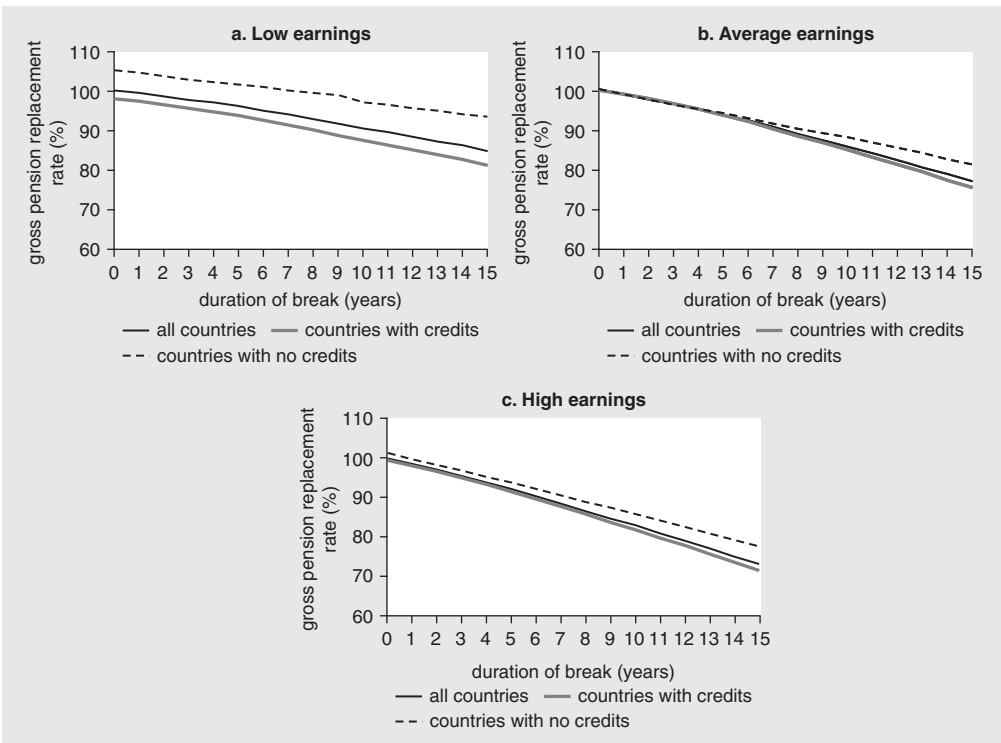
The case of France is special because the (large) gap in interrupted-career pension replacement rates relative to full-career rates is maintained for nearly 10 years and then practically disappears. This outcome is largely due to the stronger role played by the minimum and means-tested pensions as absences get longer. These two schemes prevent replacement rates for anyone with any working career from falling below a certain level.

PENSION ENTITLEMENT CALCULATION RULES

Some countries provide the same replacement rates independently of the child-care breaks. The protection largely hinges on the structure of pension formulas or on the design of the pension system, rather than special treatment of mothers. To investigate this issue a little further, figure 12.7 illustrates the average gross replacement rates relative to full career, at different earnings levels, for (a) all OECD countries considered in the analysis, (b) countries that have child-care crediting mechanisms, and (c) countries with no explicit child-care crediting mechanism.

On average, in the countries retained for the analysis and for the periods of interruption considered in this chapter, virtually no difference exists between the gross replacement rates of someone absent to care for children, relative to a person with a full career, with or without child-care credits. The analysis also suggests that after a five-year break, for low

FIGURE 12.7 **Gross pension replacement rates relative to full career at different earning levels, with credits and without credits, OECD average**



SOURCE: OECD Pension Models database.

earners, gross pension replacement rates are higher in countries where child-care credits do not exist. The same is true for longer interruptions at all earnings levels. Child-care credit mechanisms appear, instead, to offer a good protection to average earners and high earners for the first years of interruption. After that period, pension replacement rates are higher in countries without explicit credits for child-care absences. The differences are not that large, ranging from 1 to 4 percent.

EFFECTS OF PENSION SCHEMES

In most OECD and EU countries, reforms have aimed to limit the increase in public pension expenditure in the coming decades. These reforms have often modified the legislation regulating occupational and personal private pensions to make these pensions more reliable and affordable to employees and more economically attractive to employers. Improving long-term trends in employment and pension coverage across different industries and sectors means that more women have access to employers' sponsored pension schemes. However, the impact of interrupted work patterns on career progression means that many future women pensioners will still accrue lower private pensions than men.

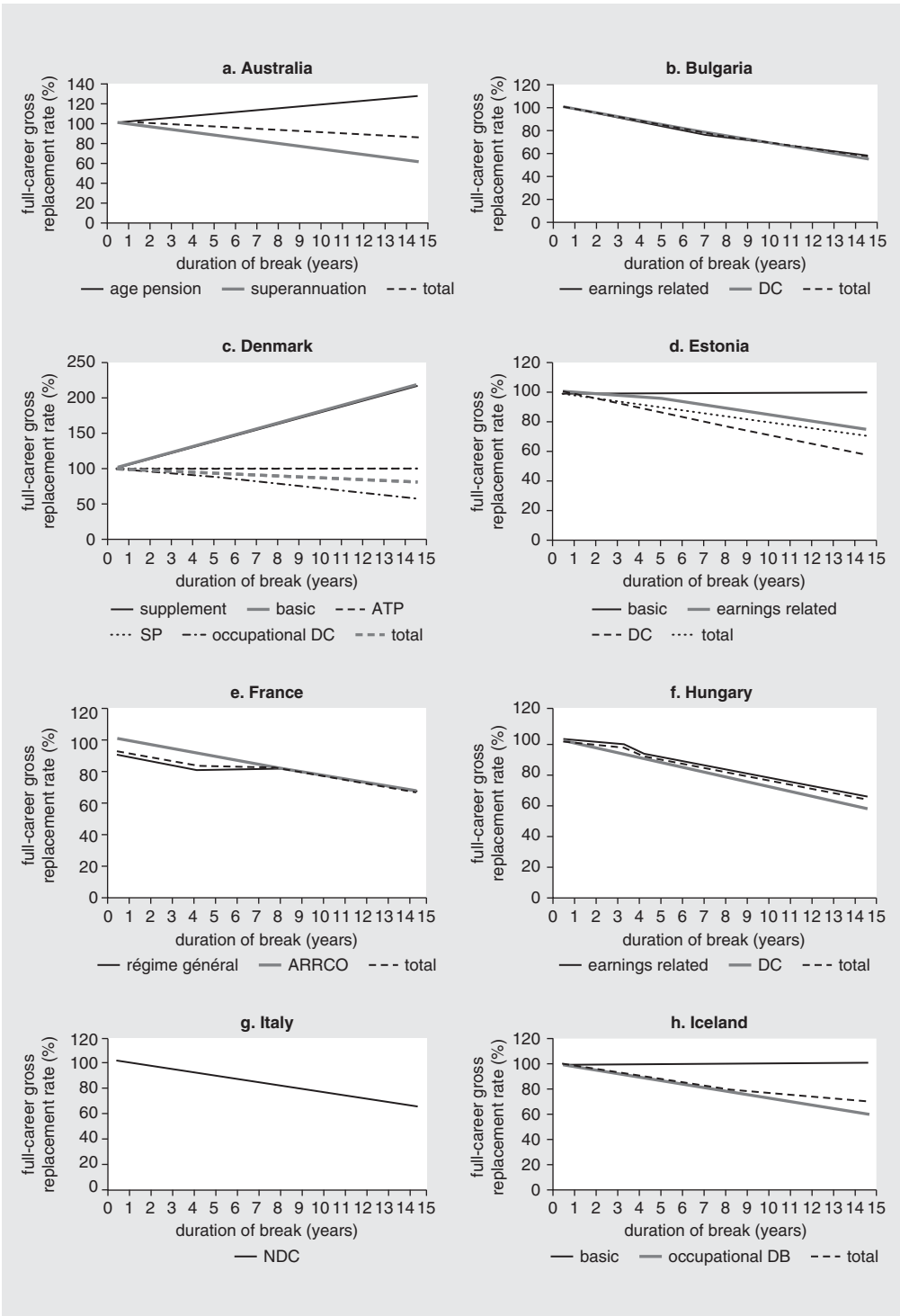
Coverage of occupational pension schemes varies from 4 percent to more than 90 percent of the working population in OECD and EU countries (see OECD 2012). Some companies also require a number of minimum years of employment before the employee qualifies as a member of a supplementary pension scheme, and the employee may lose accrued pension rights if she or he resigns before retirement age. In addition, the adjustment methods of pensions are often weaker than in statutory schemes. For women with children, therefore, these schemes are disadvantageous with respect to statutory pensions.

Simultaneously, a well-established and consistent shift has taken place from DB plans to DC plans.¹³ DC plans allow the employer to evaluate future pension expenditure more easily (because the contributions are fixed), which is significant because life expectancy has continued to increase beyond previous estimates. Similarly, some countries have replaced previous DB plans with NDC schemes.¹⁴ DC pensions have a number of implications for women, particularly women with children. In fact, in DC plans, the link between contributions and earnings (and thus, employment) is much tighter; contributions are paid from an employee's salary and directly reflect the amount of total career earnings. This feature is disadvantageous to women with children. Moreover, DC plans bear higher investment risks.¹⁵

Because mandatory and quasi-mandatory occupational schemes are included in the modeling, the simulations allow the analysis of replacement rates under the different schemes. Figure 12.8 illustrates the gross replacement rate of an average earner with a career break relative to someone with a full career in the different components of each country's pension system.

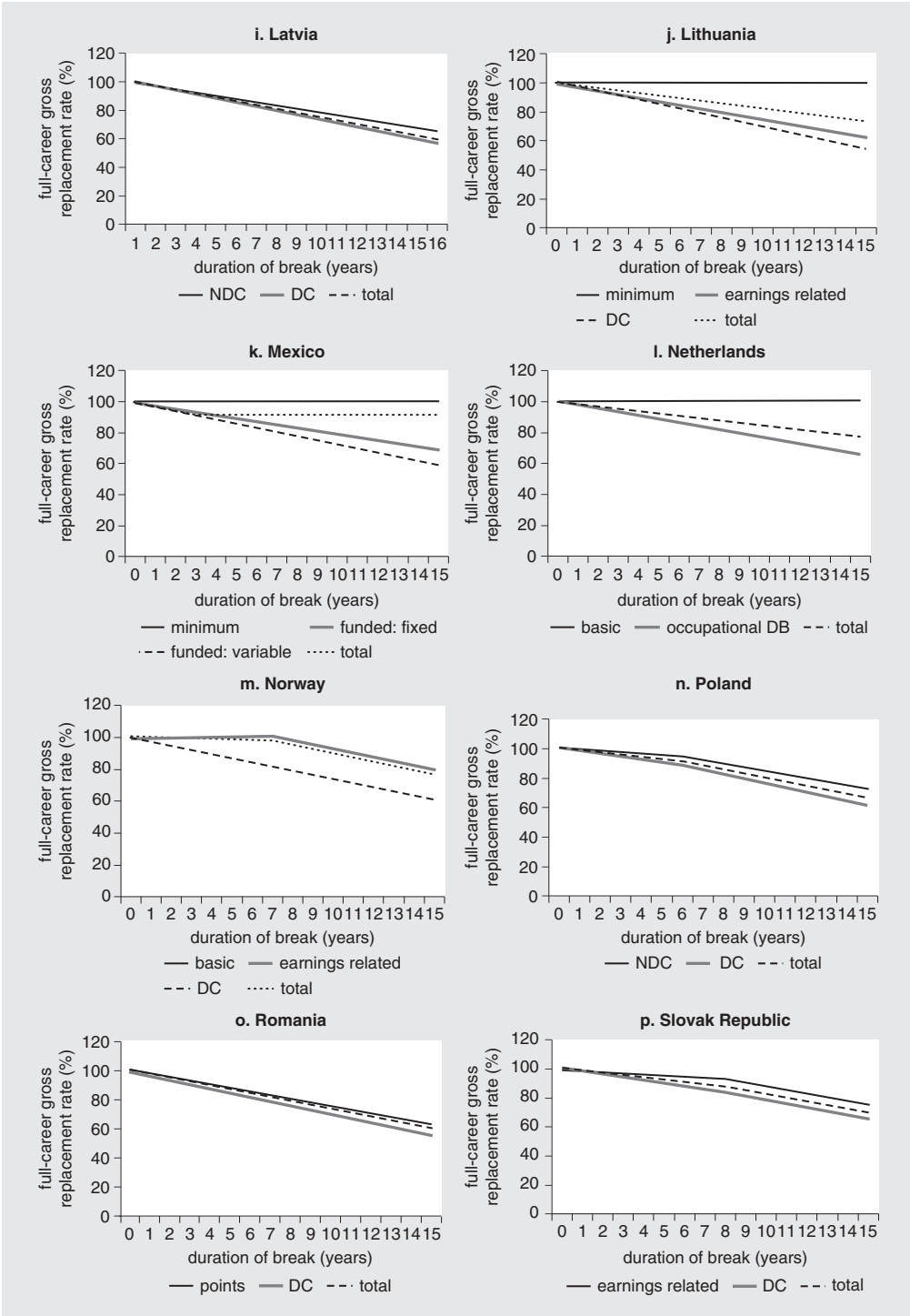
Figure 12.8 also suggests that pension entitlements diminish steeply as the child-care breaks lengthen in many of the countries. However, basic and minimum pension components seem to mitigate the effect of these reductions. For example, in countries such as Denmark and the Netherlands, where residence-based basic pensions are generous, these pensions can be considered to compensate to a certain degree for the loss of earnings-related pension benefits attributable to caregiver responsibilities. But in countries where the residence-based pension is diminished by the earnings-related pension and in

FIGURE 12.8 Gross replacement rate of average earner with career break relative to full-career earner, by pension plan



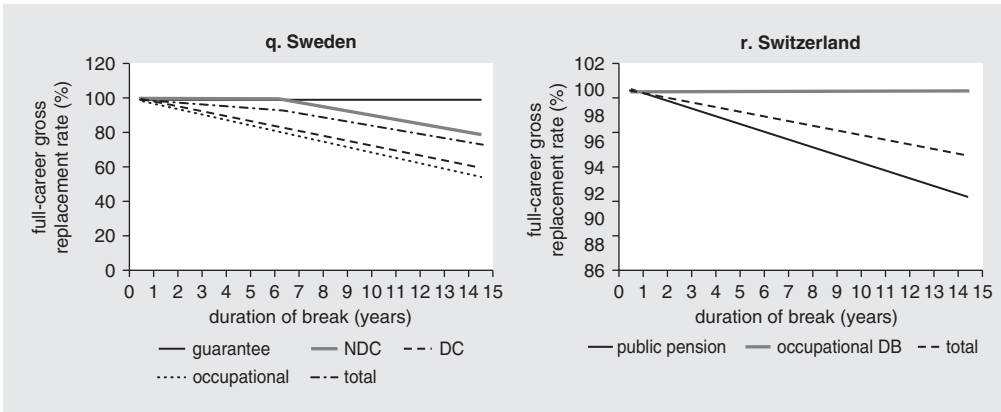
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FIGURE 12.8 Gross replacement rate of average earner with career break relative to full-career earner, by pension plan (continued)



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FIGURE 12.8 **Gross replacement rate of average earner with career break relative to full-career earner, by pension plan (continued)**



SOURCE: OECD Pension Models database.

countries where no residence-based pension exists, the absence of caregiver credits can more strongly affect pension entitlements.

The effects of eliminating child care are not uniform in countries with NDC schemes either. This lack of uniformity arises because the child-care credits are given under different forms and the pension system in which they are integrated has other features that favor a larger redistribution toward women with children. Conversely, some other features may worsen the situation of women with children. For example, a lower retirement age for women further exacerbates the problem of women's shorter tenure, and a pension system based on the individual accumulation of pension rights can exacerbate gender inequality in the labor market. Both are issues that affect NDC systems. Indeed, the combination of an earlier retirement age for women, as introduced by the Polish pension reform, has negative effects on pension levels. In fact, although the system is based on a closer link between contributions and earnings, women's lower retirement age means they have fewer contribution years relative to men. In addition, the five-year difference between retirement ages has a negative effect on compound interests in women's pension savings, whether in a public or private scheme.

The evidence suggests that factors other than child-care credits affect the pension entitlements of mothers who interrupt their career to care for their children. In particular, components of the pension systems that are either means tested or residence based and the way in which earnings are taken into account in the computation of pension entitlements seem to offer a good alternative to explicit child-care credits. Safety nets thus offer good protection for all low-income workers and for people who experience other kinds of breaks, such as those related to unemployment or to a switch between dependent employment and self-employment. The basic pension scheme financed by general revenue and based on a residence test might be one possible way to provide protection from the losses of child-care absences. For example, in New Zealand, which provides the typical universal basic pension scheme, child-care absences have no effect. Likewise, Irish mothers with

child-care absences are well protected through basic pension schemes that require relatively less strict conditions to obtain a full pension.¹⁶

The United States depends on an earnings-related pension scheme for old-age income provision, supplemented by a targeted pension. Benefits are computed with reference to the 35 best years of earnings. As a result, years out of paid work have little effect on the final pension amount. After a 10-year break, replacement rates decline, but the progressive pension formula helps maintain rates at relatively stable levels.

Policy Conclusions and Issues for Discussion

What role should credits for child-care absences have in OECD retirement systems? In particular, should the pension system compensate mothers for interruption of paid work in the labor market?

Many of the countries analyzed in this chapter grant favorable treatment to women who interrupt their careers to raise children through specific compensation mechanisms. These mechanisms vary in terms of objectives and design features and lead to important differences in their effect on mothers' pension entitlements across countries.

The analysis has shown that child-care credit systems work to boost mothers' pension entitlements, but not enough to fill the gaps caused by career breaks. On average, across the countries considered in this chapter, the gross pension replacement rate for average earners with interrupted careers relative to that for full-career individuals drops by nearly 4 percentage points after a 5-year child-care break, and the decline becomes steeper as the period lengthens: it is 8 percentage points after a 10-year break and 13 percentage points after a 15-year break. The effect is only slightly higher when net pension replacement rates are considered. The effects also vary with earnings, with the highest losses occurring at higher earnings.

The effect of child-care credits depends on the design of the pension schemes. Overall, differences between replacement rates in countries that have child-care credit systems and those of countries that do not are not significant. This is because other features in terms of design, such as pension formulas based on best or last earnings and progressive elements, also affect the level of the pension of a person who has a career break for child care.

The contributory base is another important element. For example, in Poland, caring credits are financed by a transfer from the state budget and are paid on the basis of the minimum wage. This arrangement makes the benefit much less generous than it was before the reform. As a result, women taking care of children receive lower pensions. Moreover, workers with earnings higher than the minimum wage are penalized for taking time off to care for children. A compensation mechanism depending on previous incomes might prevent this kind of distortion.

The analysis suggests that without credit systems, the replacement rates of mothers with career breaks would decrease more substantially in OECD countries. Still, the increase in the gross replacement rates as a result of the credits is rather modest at all earning levels. (France, Luxembourg, and Switzerland are the exceptions.) As a result, some of the goals of child-care credit systems, such as rewarding vital social activities, achieving

gender equality, and relieving old-age poverty of women, are attained only to a limited degree.

Child-care credits are, and will remain, a valuable tool to supplement women's low pension entitlements. This is especially true in countries where the design of the pension system leads to lower pensions for women—for example, where occupational pension schemes do not have built-in compensation mechanisms child care and where DC schemes are very widespread. In these cases, “noncontributory” periods might be an important intervention, especially if the structure of the labor market or the supply of child-care services prevent women with children from getting a paid job on either a full- or a part-time basis.

Compensation mechanisms for child-care absences also contribute to the more general objective of reducing poverty rates. In most countries, poverty rates are, in fact, higher among elderly women than among their male counterparts. This situation is partly because women live longer, and many of today's elderly women still rely in great part on the survivors' pensions of their deceased spouses. But in the future, because women will have their own careers and earn their own pension entitlements, a move away from the male-headed, single-earner household will occur, and poverty rates among female retirees should decline. However, this objective can be achieved through various forms of redistribution in pension systems that are designed to ensure decent living standards for all retirees, male or female.

Clearly, the basic trade-off between poverty avoidance and work (dis)incentives is at the core of the challenge and not at all easy to overcome. The design of the compensation mechanism for child-care absences by pension systems, whether implicit or explicit, is therefore an essential issue in the discussion.

Pension systems, however well designed, will not be able to compensate on a large scale for inequalities between men and women or between parents and the childless in the labor markets. As the analysis has shown, child-care credits are only one part of the equation in terms of income redistribution and poverty among the elderly. Although redistributive elements of pension systems in many countries take care of pension protection for parents during child-care periods, child-care credits alone will not be able to fix the problem of older women's poverty. Addressing this challenge will require a more comprehensive policy approach encompassing many of the challenges faced by women and, more generally, parents in the labor markets. Pension policies aiming to protect parents thus need to be designed in the larger context of family and employment policies.

Annex 12A: Types of Crediting Mechanisms and Rules for Credit Mechanisms

Figure 12A.1 provides further detail on the types of crediting mechanisms in pension systems. For more detail about the rules for child-care mechanisms in the various countries studied in this chapter, see table 12A.1

FIGURE 12A.1 **Types of crediting mechanisms in pension systems**

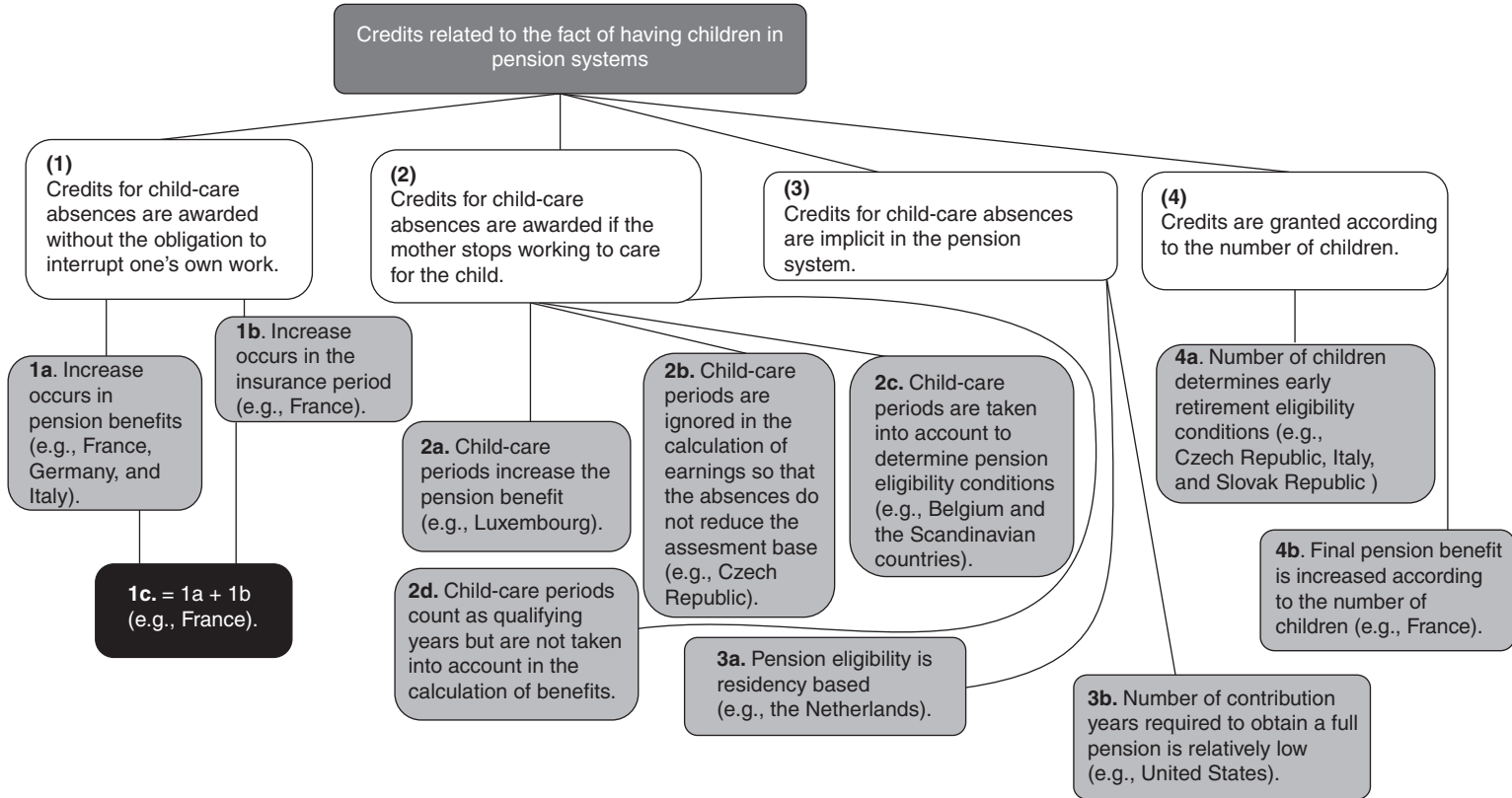


TABLE 12A.1 Rules for child-care credit mechanisms

Country	Period of care	Crediting
Australia	n.a.	No specific credit given. Some protection is offered through the means-tested age pension.
Austria	Up to 4 years per child	Contribution based on a salary of €1,350 per month is paid by the government, but only 2 years per child are covered and count toward the qualifying period for pension entitlement.
Belgium	Maximum of 3 years	Credit (<i>tijdskrediet</i>) is granted to all employees who have worked for at least 1 year for the same employer during the 15 months preceding the application. Earnings before child-care breaks are counted in the numerator of the benefit formula.
Bulgaria	Maternity and pregnancy periods, plus the following periods: Paid leave for caring for a child up to 2 years age Paid leave for caring for a child up to 2 years of age placed with relatives or in foster care Unpaid leave (up to 6 months) for caring for a child up to 8 years of age Period during which a parent or adoptive parent cares for a child with a severe disability up to 16 years of age, because of which the parent (adoptive parent) does not work and has not been insured	According to the Bulgarian Social Insurance Code, the periods of care described are considered insurance periods without payment of social security contributions. However, such periods are not taken into account in determining the individual's average contributory income.
Czech Republic	Periods caring for children up to 4 years of age	These care periods are excluded from the averaging periods for calculating the assessment base. Up to 3 years' early retirement is possible, depending on the number of children.
Denmark	Up to 1 year in receipt of parental benefits	Double the amount of contribution is paid for ATP. The beneficiary will pay one-third of the contribution; two-thirds is paid by the government or municipality. Those out of the labor market caring for children beyond the maternity period typically switch to another scheme that also carries an ATP contribution. No credits or contributions for occupational pension schemes are given for periods out of paid work caring for children.
Estonia	3 years per child	State pays the employer contribution for recipients of child-care allowances (33% on a salary of EEK 700). Individuals who receive parental benefits need to pay the contributions to the defined contribution scheme.

(continued next page)

TABLE 12A.1 Rules for child-care credit mechanisms (continued)

Country	Period of care	Crediting
Finland	Periods of maternity (11 months)	Pension accrues based on 1.17 times the salary on which the family benefit is based.
	Periods caring for children under 3 years of age	Until the child is 3 years of age as well as during unpaid periods of care by either parent during which the child-care allowance is paid, the pension accrues on the basis of a fictitious salary of €556.60 a month (in 2006), and contributions are paid by the state. During parental leave, pension contributions are not due, and pension accrual is paid by the earnings-related pension system. These periods are not included in the income test for the national pension.
France	Periods of at least 9 years caring for children under age 16	Under MDA, 2 years are covered per child in the public scheme, regardless of whether the beneficiary continues to work during that time. Both parents receive a 10% increase in final pension payout from the public plan if they have raised 3 or more children.
	Periods caring for children under 3 years of age (maximum of 3 years for the first 2 children)	Under AVPF, credits based on the minimum wage are given for a family whose earnings are under €17,600 for the first child (30% more for subsequent children). Under ARRCO, pension rights are increased by 5% for each dependent child. Pension rights accrued after January 1, 1999, are increased by 8% if the person has 3 or more children.
Germany	3 years per child	Contributions based on average earnings (1 pension point) are paid by the government.
	Periods caring for children up to 10 years of age	These years count toward the number of years needed to qualify for a pension. If people work and contribute when their children are under age 10 or if at least 2 children under age 10 are parented, parents receive a bonus of up to 0.33 pension points per year. However, this bonus cannot result in a total accrual exceeding 1 pension point per year.
Greece	1 year for the first child; 2 years for each subsequent child to a maximum of 3 children	This period counts only toward the qualifying conditions for retirement, not for the calculation of benefits.
Hungary	Periods with childrearing benefits (maximum of 3 years per child)	Contribution after the benefit is paid by insured and government. Periods are not considered creditable periods if this treatment is more advantageous for the insured.

(continued next page)

TABLE 12A.1 **Rules for child-care credit mechanisms (continued)**

Country	Period of care	Crediting
Iceland	n.a.	Residency-tested basic pension and targeted schemes automatically protect women who leave paid work to care for children. No specific credits are made for child-care absences. The occupational pension funds make no provisions for women who must leave work to care for children. The government social assistance scheme contains benefits for parents (men or women) who must take care of children with long-term illnesses or disabilities. Such benefits are also provided to people who must care for close relatives (e.g., an adult child taking care of an aged parent).
Ireland	Periods caring for children under 12 years of age (maximum of 20 years)	Periods are excluded from the averaging periods for calculating pension benefits.
Italy	1 year for 1 or 2 children; 2 years for 3 or more children	Pension is increased for mothers through a more generous transformation coefficient. For mothers of 1 or 2 children, the transformation coefficient of their actual retirement age plus 1 year is used. For mothers of 3 or more children, the transformation coefficient of their actual retirement age plus 2 years is used. Mothers may choose to retire early instead of taking a higher pension.
Japan	3 years (if additional children are born while the parent is caring for a child, the period is extended until the last child turns 3 years of age)	Contributions are made on the basis of earnings before the leave, and in calculating the benefit and qualifying conditions, the entire period is credited. If parents work part time when caring for children, pension benefits are calculated on the basis of their full-time previous earnings.
Korea, Rep.	1 year to 50 months according to the number of children born after January 2008	A person who is not working because of child care can be exempted from payment of contributions during the period requested. The insured period can be increased by paying the exempted contributions (total contributions, including that for employers) after resuming work. An insured woman who gives birth to a child (except for the first child) after January 2008 can get pension credits.
Latvia	1.5 years	State pays the contributions.
Lithuania	3 years	Persons taking care of children for 3 years are insured only for the main part of the social insurance pension. From January 2008, they are covered for the full pension, and a minimum wage credit will be given to the earning-related pension.
Luxembourg	2 years for 1 child; 4 years for 2 children ("baby years")	Pensionable earnings are based on pay immediately before the baby years are claimed. The period counts as part of qualifying conditions and enters in the flat-rate component of the pension formula. Employees who could not claim the baby years because of an insufficient contribution period have the right to a special monthly allowance in retirement of €89 per child.

(continued next page)

TABLE 12A.1 Rules for child-care credit mechanisms (continued)

Country	Period of care	Crediting
	Periods caring for children under 6 years of age	As noncontributory periods, they are counted toward the qualifying conditions for an early retirement pension and the minimum pension.
Malta	n.a.	No credits are awarded for economic inactivity caused by childrearing, but many pension systems provide coverage to people who do not work because they are caring for their relatives with disabilities. Such coverage is paid as a noncontributory carer's pension. These pension credits take different forms: they can be additional years (counted at previous earnings) or they can be qualifying years (counted without or at a fictitious income). These credits are offered in both basic and earning-related schemes.
Mexico	n.a.	There are no credits for periods spent out of paid work because of child-care responsibilities.
Netherlands		In the basic old-age pension scheme, periods out of paid work are automatically covered. In the occupational schemes, no credits are given for child-care periods during which people are out of paid work, but the accrual of pension rights continues over the remaining working years. However, many schemes allow voluntary contributions to cover the aforementioned periods of absence.
New Zealand	n.a.	Eventual public pension entitlement is not affected by periods out of paid work for caring purposes.
Poland	Periods of maternity leave (18 weeks for first child, 20 weeks for the second child, and 28 weeks for multiple births)	Contributions based on the maternity benefit (average wage over the past 6 months) are paid by the government.
	Periods of parental leave (3 years per child)	Contributions based on the minimum wage (18% of nationwide average earnings) are paid by the government. All periods for which contributions are paid are qualified for minimum pension guarantee.
Portugal	Periods of maternity leave	Credits based on pay in the 6 months before the second month of the start of the leave are given.
	Periods caring for children under 12 years of age (maximum 3 years) and working part time	Periods can be treated as if parent is working full time.
Romania	Periods of parental leave	These periods are covered and the contributory base is the social insurance benefits granted during the period
Slovenia		For maternity periods of up to 1 year, state pays contributions based on the value of the minimum wage. The benefits for this period are calculated on the basis of earnings when the mother was working.

(continued next page)

TABLE 12A.1 Rules for child-care credit mechanisms (continued)

Country	Period of care	Crediting
		In addition, a parent who switches to part-time work when the child is 3 years of age or younger is treated as if he or she worked full time.
		The possibility also exists of paying voluntary contributions for periods out of the labor market caring for children up to age 7 years.
Slovak Republic	Periods caring for children up to 6 years of age	The assessment base for pensions is 60% of earnings prior to the period spent caring for children. In the first half of each calendar year, it is based on average earnings 2 years before the absence started. In the second half, the calculation uses earnings in the calendar year immediately before the absence.
Spain	Maternity period	Maternity period is covered.
	2 years of child care	In addition, 2 years out of the labor market looking after children count toward eligibility for a pension benefit.
Sweden	Periods caring for children under 5 years of age	Government pays contributions based on wages that are most favorable, up to the earnings ceiling in the pension system.
	Periods of parental benefits (16 months)	Parental benefits paid to people on parental leave from work are also considered pensionable income.
		Under ITP, there is a recommendation that the employer contribute to an employee's pension during periods of up to 11 months for parental leave.
Switzerland	Periods caring for children under 16 years of age	Years of child care (for children under age 16) are credited in the public scheme as if earnings had amounted to 3 times the minimum pension of the year in which the caring parent retires. For 2006, this amount was Sw F 38,700, corresponding to 53% of economywide average earnings. If the caring parent is married during the caring period, the credits are split equally between the spouses. Credits for child care are not granted in occupational schemes.
Turkey	n.a.	There is no credit for periods spent out of paid work caring for children.
United Kingdom	Periods caring for children under 16 years of age	Periods are counted to reduce the number of years required for a full pension under the basic pension.
	Periods caring for children under 6 years of age	Caring parents are deemed to have earned at the low earning threshold for the state second pension.

NOTE: n.a. = not applicable; ARRCO = Association des Régimes de Retraités Complémentaires (Association of Supplementary Pension Schemes); ATP = Arbejdsmarkedet Tillægspension (Danish occupational pension scheme); AVPF = *l'assurance vieillesse des parents au foyer* (old-age insurance for parents in the home); ITP = Industrins och handelns tilläggspension (Swedish occupational pension scheme); MDA = *les majorations de durée d'assurance* (increases in the duration of insurance).

Notes

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This chapter draws in part on the unpublished manuscript of Choi (2006).

1. In 1983, for example, pension age for men in OECD countries averaged 63.6 years, 2.0 years older than the age for women. The gap between the two closed over the next decade to 1.8 years by 1993: pension eligibility age fell for both sexes, but by a larger amount for men. By 2002, a small increase for men and for women brought the gap in pension ages down to 1.2 years. Under current legislation, increases in pension ages for both sexes will bring them to an average of 65.2 years for men and 64.8 years for women in the long term.
2. In many countries, differences still exist between men and women in the length of the period to qualify for pension entitlements. By contrast, countries that use the residence criterion do not differentiate between men and women.
3. This credit, however, matters only for pension entitlements of women with less than a full career.
4. This right to retire early is increasingly being granted to both parents, not only to mothers.
5. However, the credits would be wasted when full-time housewives are those bearing the burden because they do not have any chance to use the credits for pension entitlements unless they try to accumulate further pension entitlements by reentering the labor market.
6. To this end, contributions based on reference earnings are paid or considered to be paid during the career breaks, as is the case in Austria, Poland, the Slovak Republic, Sweden, and Switzerland. In some countries, such as Germany and Norway, pension points are given up to some earnings threshold. For example, in Norway, mothers with annual point earnings lower than three have these earnings topped up. Mothers with annual point earnings exceeding three do not get any top-up. The family may apply to have the points granted to the father instead of the mother. For the other group, points are granted on the basis of individual applications. In Germany, the total accrual related to child-care absence cannot exceed one pension point a year.
7. The basic schemes generally do not provide either credits related to children's education or credits related to child raising because the pension payments are not related to the fact of having worked. Thus, a mother who cares for her child receives a basic pension equal to that of the man who never stopped working. The contributory pension, however, will likely be lower, if she has not been able to contribute for the missing years.
8. The OECD pension models rely on the APEX (Analysis of Pension Entitlements across Countries) infrastructure originally developed by Axia Economics with the help of funding from the OECD and World Bank.
9. See D'Addio and Immervoll (2010) for a discussion and analysis of earnings distribution by gender in OECD countries.
10. This research has a number of limitations. First, the reference pension level is that of single person (in most cases, the mother) not couples. Because child-care credit mechanisms are generally provided to couples, pension entitlements of couples should be the reference. In that case, the overall results hinge on which spouse would be the recipient. Second, this modeling assumes that even after child-care absences, the earnings level and job position are maintained. Although this assumption is likely to be satisfied for short absences, it would not be the case for longer absences. After career interruptions for child care, women often return to the workforce

with part-time jobs or return full time with lower wages than they would have had absent the interruption because of outdated skills and knowledge. Thus, the assumption of linear growth of wage earnings is not necessarily appropriate for mothers with long career breaks.

11. Recent literature is investigating this issue by considering endogenous fertility decisions (see Nishimura and Zhang 1992, 1995; Cigno 1993; Cigno and Rosati 1996; Rosati 1996; Kolmar 1997; Wigger 1999; Cigno, Casolaro, and Rosati 2003; Steurer 2008). For example, Steurer (2008) shows that even modest fertility payments would contribute to make pension systems more sustainable in the long run. Similar results are found by van Groezen, Leers, and Meijdam (2003).
12. France is not in this group because the assumption underlying the simulations is that of a mother working a full career. The crediting mechanisms of France's MDA (*les majorations de durée d'assurance*, or increases in the duration of insurance) are beneficial only to mothers who work for less than a full career.
13. In DC schemes, the amount of the contribution is fixed, and the amount of the pension benefit depends on the amount of contributions paid during the whole career, increased by the returns received on them during funding and diminished by administration costs. When these savings are transformed into a monthly pension, they are divided by the expected period of payment. Women, having longer life expectancy, thus receive a smaller monthly pension than men if unisex schedules are not used.
14. In such a system, all contribution payments are recorded in notional individualized accounts. Capital accumulation is virtual, however. Individual benefit levels depend mainly on past contributions and their notional rate of return, as well as on life expectancy. Thus, in an NDC system, the link between contributions and earnings is very tight, and benefits reflect individual's contributions.
15. A feature common to all funded DC schemes is that the liability for the adequacy of the pension is transferred to the individual employee. If no minimum return requirement is set, as is usually the case, periods of low returns may lead to unexpected losses in the pensions (as the current financial and economic crisis has proved).
16. Also, the presence of a mandatory occupational pension scheme, generally of the DC type, greatly affects mothers' pension entitlements because periods out of the labor market are covered on a voluntary basis only. The effect of this lack of crediting provisions within those schemes becomes more important as the periods of interruption lengthen.

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CHAPTER 12

COMMENT

Hannelore Weck-Hannemann

Gender aspects and differences between men and women are still striking and salient when considering labor market outcomes. Although women's economic opportunities have improved over the past few decades, as Anna D'Addio points out at the outset of her analysis, wage gaps and occupational segregation are still pronounced and persistent in all countries of the Organisation for Economic Co-operation and Development (OECD) and European Union (EU). In the policy conclusions at the end of her chapter, D'Addio comes back to this general perspective arguing that pension systems, however well designed, will not be able to compensate for these large-scale inequalities in the labor market. Hence, a comprehensive policy approach is required, and pension systems aiming to protect parents need to be designed in the larger context of family and employment policies.

The main focus of chapter 12 is a broad analysis of alternative pension systems in OECD and EU countries with special emphasis on the factors affecting pension entitlements for women with interrupted careers for child-care reasons. The detailed description of alternative pension systems implemented in more than 30 countries with special focus on child-care credits is to be commended and will remain an important reference. Moreover, the analysis complements the other articles in this part of the book. Whereas Estelle James, in chapter 10, focuses on gender issues in general, Anna D'Addio concentrates on women's pension entitlements and the role of child-care credits. And although James is specifically interested in gender issues in nonfinancial (notional) defined contribution (NDC) systems, D'Addio, in her analysis, looks at all types of pension systems. Because the chapter reviews pension entitlements in a large set of countries that result from complex rules in terms of eligibility conditions and the calculation of benefits—including the different kinds of child-care crediting mechanisms—the overall picture given is broad and less detailed than what would be possible in a country study. Nevertheless, the systematic overview is useful to get a picture of similarities and discrepancies across countries.

Using the OECD pension model to estimate gross pension replacement rates for individuals with child-care breaks in comparison to a full career gives insights and allows for comparisons across countries.

Creating a level playing field is the main issue for gender equality not only in the labor market but also in the context of pension entitlements. In this regard, the analysis and the conclusions given by D'Addio provide an important basis. But it is important to note that from an economic point of view that emphasizes efficiency considerations over redistribution, it would seem appropriate to favor *ex ante* over *ex post* policy measures. Unintended consequences also arise: granting child-care credits only for mothers might improve the situation for women, but only partially. Because of the disincentive effect involved, fathers might be induced to sustain their prevailing abstinence from child care, resulting in a strengthening of the traditional division of labor between family work and

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paid work instead of fostering freedom of choice. D'Addio emphasizes, "In principle, the person who actually bears the burden of child care and experiences breaks of career should be the recipient." But also in accordance to D'Addio and, moreover, James, one must admit that the basic trade-off between poverty preventions and work incentives is at the core of the challenge and not at all easy to overcome. A merit of the contributions included in this part of the volume is that they give more insights into the specifics of this trade-off with reference to the gender dimension.

Gender Policy and Pensions in Chile

Eduardo Fajnzylber

A common observation in most countries, developed or developing, is that women are often at a disadvantage with respect to men in terms of their financial protection in old age. This outcome is a result of multiple factors related to child caring, labor market participation, and pension design. Pension systems almost everywhere are based on acquiring rights through employment-related contributions. Women tend to contribute for shorter periods while taking care of children (or other dependent relatives), they have a lower attachment to the formal labor markets than men, and they usually retire earlier and live longer.

This chapter analyzes the various factors that affect pension differences by gender in the context of a pension system mostly based on a defined contribution (DC) scheme. Using the experience learned in almost 30 years under such an environment, it presents aggregate statistics and simulation results that shed light on the relative importance of the various factors. Some of this experience may be directly applied to countries with other retirement structures, including nonfinancial (notional) defined contribution (NDC) schemes.

In addition to analyzing the effects on gender equality of various design elements within the framework of defined contribution pensions, this chapter considers two additional topics: the role played by the poverty prevention pillar (first pillar) as a gender equalizer and the importance of survivorship pensions.

This chapter is not the first work to analyze the gender gap in the Chilean context. Most notably, Berstein and Tokman (2005), using the same sources of data, analyze how the pension system in place prior to the 2008 reform increased the gender gap.¹ The main contribution of the current chapter is the analysis of the gender elements included in the 2008 pension reform, with particular emphasis on the new solidarity pillar.

The chapter is structured as follows: the next section briefly describes the main aspects of the Chilean pension system that affect pension differences by gender, including the principal changes introduced by the 2008 reform. The following section shows how the different elements of DC pension calculations affect the gender gap in the Chilean context. Then, the results from a simple pension simulation using Chilean microdata are

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used to put in perspective the relative importance of the different components and the potential effects of the changes introduced by the 2008 reform. The final section is the conclusion.

The Chilean Pension System and Gender Elements of the 2008 Reform

The current Chilean pension system can be decomposed into three main pillars: a poverty prevention pillar, a contributory pillar, and a voluntary pillar.²

Before the 2008 reform, the poverty prevention pillar was based on two components: (a) a means-tested assistance pension (*pensiones asistenciales*, or PASIS) and (b) the minimum pension guarantee (MPG) for individuals who contributed for at least 20 years to the individual capitalization scheme but whose contributions were not sufficient to finance a minimum amount for their retirement. Together, these two programs were the main government tools aimed at preventing old-age poverty. Both were financed by general revenues.

The contributory pillar was dramatically reformed in 1980. The previous system was based on a number of pay-as-you-go schemes that provided defined benefits calculated as a proportion of the wages received during the last period of working life. These schemes were running increasing deficits, caused by large imbalances between the benefits that were promised and the contributions that were made into the system. In 1980, the military government created a single national scheme, which is the scheme that Chile still has today. It is a financial defined contribution (FDC) scheme. It is based on individual accounts where workers' contributions become "saving deposits" and are invested in financial instruments by professional firms known as *pension fund administrators* (*administradoras de fondos de pensiones*, or AFPs). These firms are free to set an administrative fee in exchange for the different services they provide (collection, record keeping, investment, benefit calculation and payment, and customer service), and individuals can switch at any time between AFPs.

Individuals are not allowed to withdraw funds from their individual accounts until they retire, which can happen at any point after the legal retirement age (65 years for men and 60 years for women). Retirement can also occur before that age (under early retirement) if individuals have accumulated enough funds in their account to receive a minimum replacement rate. When the individual retires, he or she can choose between buying an annuity from an insurance company and receiving a programmed withdrawal stream from the AFP. In both cases, benefits are actuarially calculated as a function of the individual's savings accumulated over the lifetime, the potential beneficiaries, and (age- and gender-specific) life expectancy.

To complement the compulsory savings made into the contributory scheme, tax incentives are provided for individuals who make additional voluntary savings in a set of specified financial products: voluntary savings accounts managed by the AFPs, mutual funds offered by banks, insurance-plus-savings products provided by insurance companies, and so on. The scheme is structured so that the part of the individual's income that is allocated into these products is exempt from income taxes during the years the deposits were made. Interest income from these savings is also tax exempt, but pensions financed

by these savings are subject regular income taxes when they are received by the worker. Individuals are allowed to withdraw funds before retirement, but with a penalty in addition to the income taxes owed at the time of this withdrawal.

GENDER ELEMENTS OF THE 2008 REFORM

In the 2008 reform, particular attention was given to introducing measures that would increase gender equality. In general, women tend to (a) have long periods without contributions, usually associated with caring for children or other dependent relatives; (b) be hired in low-remunerated occupations (relative to men with a similar educational background); (c) retire earlier; and (d) live longer. All these elements, when combined in a pension system that provides no gender redistribution at retirement, create significant differences in the distribution of benefits between men and women.

In contrast, retirement and disability benefits under the AFP scheme inherited many of the asymmetric design elements of previous regimes: women cannot provide survivorship benefits to their husbands (or the fathers of their children), unless they are disabled. Hence, they are entitled to lower benefits from the workers' disability and survivorship insurance program even though they pay the same premium. At the same time, pension formulas do not have to reserve funds for husbands in case they outlive their wives, a regulation that increases women's benefits. In addition, mortality tables used to calculate benefits under a programmed withdrawal schedule are gender specific (which is consistent with this self-insured option), and insurance companies are allowed to make differentiated benefit offers to men and women.

Introduction of the new solidarity pillar. To address these differences, the reform introduced a number of measures. The main one is the new solidarity pillar. Before the reform, poverty in old age was partially addressed by two main programs: the MPG, which provided a floor for pensions for individuals who contributed for at least 20 years, and the PASIS, which targeted poor individuals with no pension entitlements.

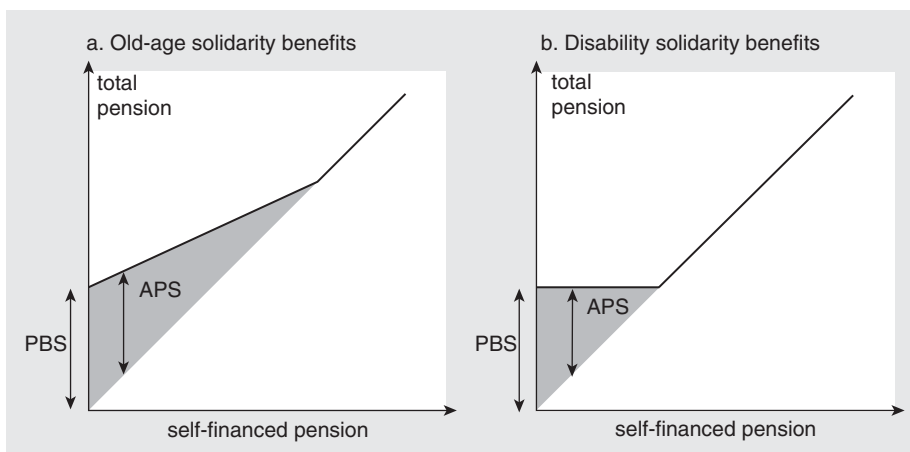
The 2008 reform replaced these programs with a single scheme that guarantees that all individuals in the 60 percent less affluent fraction of the population will receive a guaranteed basic pension, regardless of their contribution history. This new program provides old-age and disability subsidies, financed by general revenues of the state.

Individuals with no contributions are entitled to the old-age Basic Solidarity Pension (*Pensión Básica Solidaria*, or PBS) once they reach 65 years of age and fulfill the income and residence requirements. Individuals who made contributions but will receive a pension below a certain threshold are entitled to the Pension Solidarity Complement (*Aporte Previsional Solidario*, or APS), with similar income and residence requirements. The disability program provides benefits under similar conditions, but for individuals between the ages of 18 and 64. Once such individuals reach the age of 65, they are eligible for old-age solidarity benefits.

The schedule of subsidies is described in figure 13.1, which presents solidarity subsidies and total pensions as a function of self-financed entitlements.

Two particular elements of this design are worth noting: (a) the strong integration between the contributory system and the solidarity pillar and (b) the concern for contributory incentives that this integration raises. Integration guarantees that everybody in

FIGURE 13.1 Subsidies and final pensions under the new solidarity pillar



SOURCE: Rofman, Fajnzylber, and Herrera 2008, figure III-6.

the first three income quintiles receives a pension at least equivalent to the PBS. If the benefit had been established with a cap (as for disability), low-income individuals would have an incentive not to contribute because their retirement income would not increase with the number or amount of contributions. With the chosen design, the total pension increases monotonically with self-financed savings (i.e., every dollar saved always increases retirement income, even if not by a full dollar).

By design, the new solidarity pillar will be more beneficial for women, because they are more likely never to have contributed or to have done so with less frequency and with smaller amounts than men. In addition, benefits are gender neutral, therefore favoring women because of their greater longevity.

State-financed bonus to mothers for every child born or adopted. The reform introduces a subsidized bonus to mothers for every child born or adopted. The subsidy is equivalent to the contribution of a full-time minimum wage worker for 18 months and receives an annual rate of return equivalent to the net average return of the AFP from the day of birth until the mother reaches age 65. This benefit is subject to the residency requirement but is not means tested.

Because Chile is among the countries that have the longest maternity leave regulations in the region (18 weeks) and at the same time has one of the lowest female labor force participation rates, the introduction of this bonus is extremely important to achieve decent retirement income, particularly among low-income workers. But beyond the financial benefit, the measure is extremely valued by the population as a form of social recognition of the (nonremunerated) activity of giving birth and taking care of children during their first months of life.

Economic compensation in case of divorce or annulment. The reform introduces the legal concept of pension-related economic compensation in case of divorce or annulment. Under this provision, a judge can order, if required, the transfer of retirement funds

between individual accounts as a form of economic compensation to the party who incurs loss during the marital period. This transfer cannot exceed 50 percent of the resources accumulated in the account of the contributing party during the period the two persons were married.

Separation of disability and survivorship insurance contracts between men and women and transfer of the difference in premiums to the low-cost group individual accounts. The premium that is charged to participants in the AFP system for disability and survivorship insurance was, before the reform, the same for men and women, even though women are less likely to qualify for disability and do not generate survivorship benefits to their spouse unless the spouse is disabled. To avoid this cross-subsidy, the reform requires AFPs to obtain separate insurance contracts for men and women, to charge affiliates for the higher of the new premiums (most likely the men's contract), and to deposit the difference for the other group in the savings account of the less risky group (most likely, the women). As a result, women's overall contributions to their pension funds will be slightly higher than the 10 percent prescribed in the law. This approach can be seen as a way to maintain a single insurance cost for all participants while increasing the amount of savings available to women at the time of retirement.

In May 2009, the AFPs entered into the new insurance contracts, resulting in a premium for men of 1.87 percent of covered wage and a premium for women of 1.67 percent. The difference will increase the contributions of women to the system (from 10.0 percent to 10.2 percent).

Widowers' pensions. One of the main gender asymmetries prevailing in the prereform system was the impossibility of generating survivorship pensions to widowers, unless they are disabled. As part of the reform, the requirement to reserve part of the accumulated funds at retirement for paying survivorship pensions and the coverage under the survivorship insurance now apply to both men and women. In the first case—retirement calculation—the inclusion of widowers will actuarially decrease the pension of retiring woman in exchange for the additional benefit. In the second case, the additional coverage will be financed by a single insurance premium applicable to all women in the system, thus eliminating the current cross-subsidies from insured women to insured men.

SUMMARY REMARKS ON THE 2008 REFORM

The measures undertaken in the 2008 reform described in this section account for most of what can be done to improve pension equality between men and women through pension system design. Clearly, however, most of the pension inequality is associated with cultural factors governing the distribution of labor at the household level and the labor market distortions that occur through occupation or wage discrimination. Those factors cannot be appropriately addressed through pension reforms.

DC Pensions and the Gender Gap

Contributory pensions under a DC scheme (financial or nonfinancial) are affected by a number of factors related to personal contribution history, retirement decisions, financial

returns, and other design elements. One way to picture this situation is to consider a general pension calculation formula:

$$\text{Contributory pension} = \frac{\text{Balance (frequency, intensity, and timing of contributions, returns)}}{\text{Factor (age and longevity at retirement, gender, pension type, interest rates, covered beneficiaries)}}$$

In addition to the pension rights acquired through social security contributions, individuals may be entitled to noncontributory rights (for example, the new solidarity pillar under the reformed system in Chile, minimum pension entitlements, and assistance pensions) and, in some cases, to survivorship pensions.

$$\text{Total pension income} = \text{Contributory pension} + \text{Noncontributory rights} + \text{Survivorship pensions}$$

Actuarial calculations imply that pensions are in direct relationship with the frequency and intensity of lifetime contributions. In addition, the importance of returns cannot be underestimated, as they account for a large share of the balance at the moment of retirement.

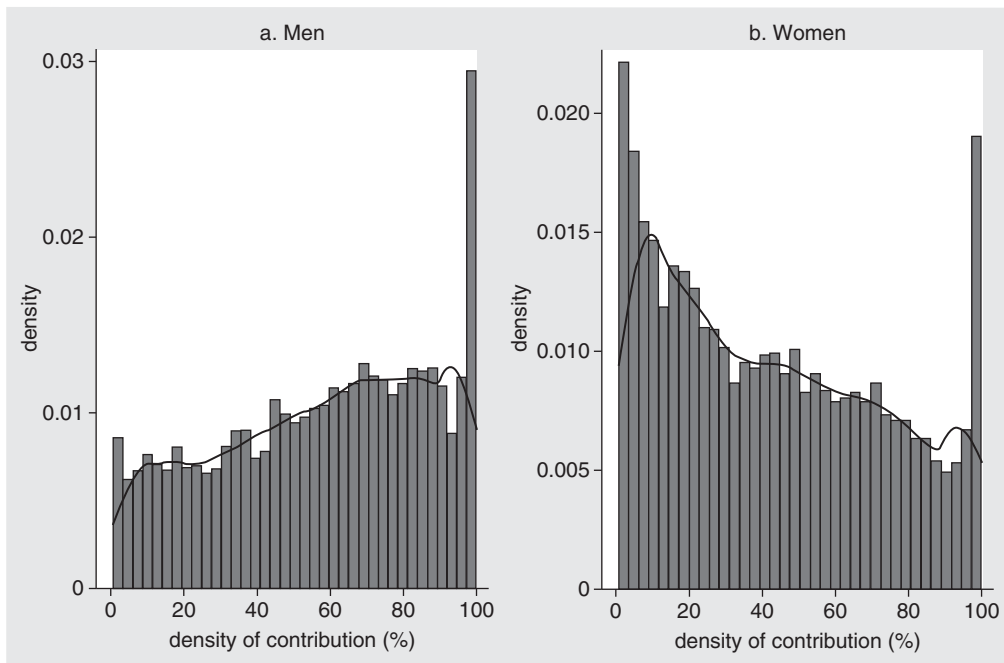
For the denominator, the most critical factor is the retirement age and longevity at retirement. Earlier retirement implies interrupting accumulation and interrupting compound interest on part of the account balance, but it especially suggests that the accumulated balance has to finance pensions for a longer period. In some cases, as in Chile, different mortality tables are used for men and women, thus translating the higher female longevity into lower pensions (for the same balance). The use of gender-differentiated tables is directly related to the existence of different pension products: annuities and programmed withdrawals. In the latter case, under which individuals slowly withdraw their balance, using unisex tables would be impractical. Expected interest rates at the moment of retirement directly affect pensions but should not have any effect on gender differences. Finally, actuarial calculations imply that pensions are reduced to finance survivorship pensions to legal beneficiaries.

This section analyzes each of these factors and their relative importance in the Chilean context.³

CONTRIBUTION HISTORIES: FREQUENCY, INTENSITY, AND TIMING

Probably the most important determinant of pensions in a DC context is how often individuals contribute to the system, a concept usually referred to as *density of contributions*. Figure 13.2 presents the distribution of this density for men and women in Chile, estimated by Forteza et al. (2009), using individual administrative data between 1981 and 2004, for a representative sample of 24,000 participants in the AFP system.⁴

Clearly, the distribution shows important differences between the contributory behavior of men and women. Men's distribution is skewed to the right, with a large mode in 100 percent contribution density. In contrast, the female distribution is bimodal, with modes at the two extremes (0 and 100 percent). As table 13.1 shows, men contribute on average 15 percentage points more frequently than women. The fraction of women who

FIGURE 13.2 **Distribution of the density of contributions, 1981–2004**

SOURCE: Forteza et al. 2009, figure 4.

NOTE: Figure is based on longitudinal data from a representative sample of participants in the Chilean pension system.

TABLE 13.1 **Working life contribution densities for men and women**

Characteristics	Mean	Median	Percentage of contributors with densities (<i>d</i>)				
			<i>d</i> < 25%	25% ≤ <i>d</i> < 50%	50% ≤ <i>d</i> < 75%	75% ≤ <i>d</i> < 100%	<i>d</i> = 100%
Total	51.4	52.2	25.5	22.4	24.9	26.0	1.3
Men	57.9	61.3	17.4	21.0	27.9	32.1	1.6
Women	43.0	39.2	36.0	24.2	20.9	18.0	0.9

SOURCE: Forteza et al. 2009, table 5.

contribute less than 25 percent of their working life is more than twice that of men (36.0 percent against 17.4 percent).

To understand the source of these differences, one can show the activity that men and women pursued when they were not contributing. Figure 13.3 shows the average fraction of working life that men and women spend in different occupational categories.⁵ Men spend most of their working life, 58 percent, in formal occupations (as contract employees). They spend an additional 27 percent as informal (employed without a contract) or self-employed workers. Only 11 percent of their working life is inactive. In contrast, women are economically inactive 39 percent of their working life, spend 41 percent as

FIGURE 13.3 Fraction of working life spent in different occupational categories, 1980–2002



SOURCE: Author's calculations, based on self-reported histories from the 2002 EPS.

formal workers, and spend 15 percent as self-employed or informal workers. If informality is the main challenge for pension participation for men, inactivity represents the bulk of the coverage problem for women.

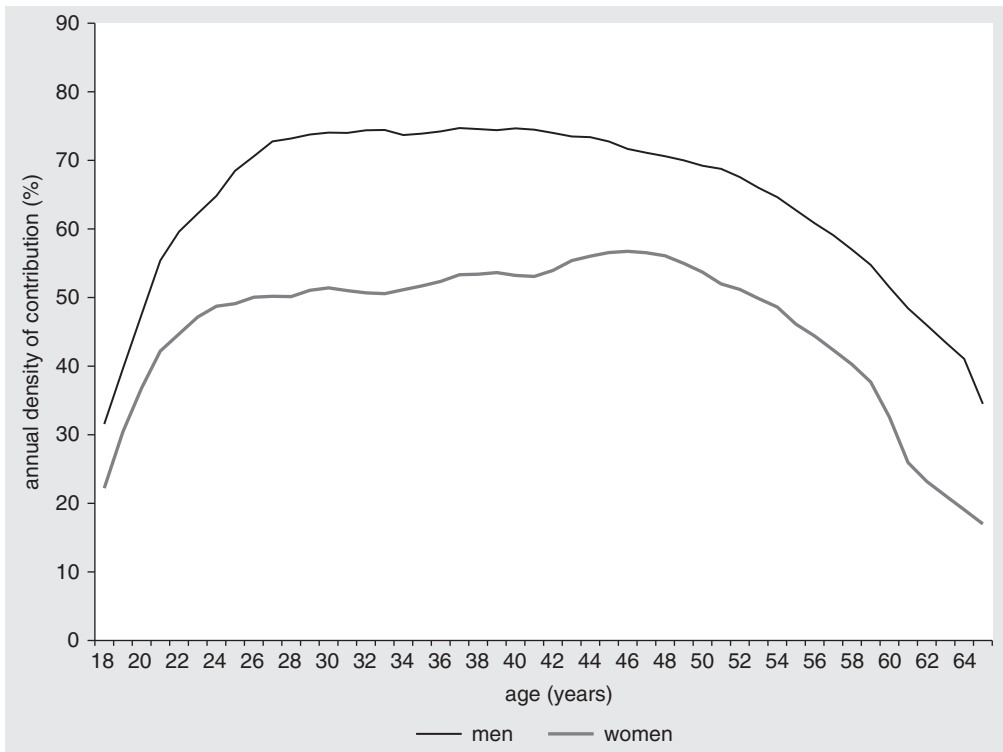
As mentioned earlier, the timing of contributions plays a significant role in DC systems, because early contributions accumulate interest over a longer period. Figure 13.4 shows the average contribution density of men and women over their lifetime, based on data from the Social Protection Survey (Encuesta de Protección Social, or EPS).⁶ Not only do men contribute with a higher frequency than women, but also their highest densities (around 74 percent) occur between the ages of 28 and 44, whereas for women, the highest densities (around 55 percent) occur between the ages of 43 and 49.

Finally, figure 13.5 shows the earnings distributions of male and female contributors to the pension system as of September 2009 (2.4 million men and 1.6 million women). These unconditional distributions are quite similar, except for certain regions: a higher proportion of women earn less than the official minimum wage (currently close to US\$320 per month), and a larger proportion of men receive earnings at or above the maximum covered wage (approximately US\$2,500). Overall, the median covered wage is between US\$600 and US\$700 for men and between US\$500 and US\$600 for women.⁷

The larger fraction of women receiving less than the minimum wage could be explained by part-time workers and domestic workers (who have a lower minimum wage). Clearly, these unconditional distributions do not capture the potential differences in wages at similar levels of education or experience.

In summary, Chilean women have substantially lower and later contribution densities than do Chilean men. This situation is essentially explained by the fact that women spend a large fraction of their working life as economically inactive. Moreover, women

FIGURE 13.4 Average contribution densities by age and gender, 1980–2002



SOURCE: Author's calculations, based on self-reported histories from the 2002 EPS.

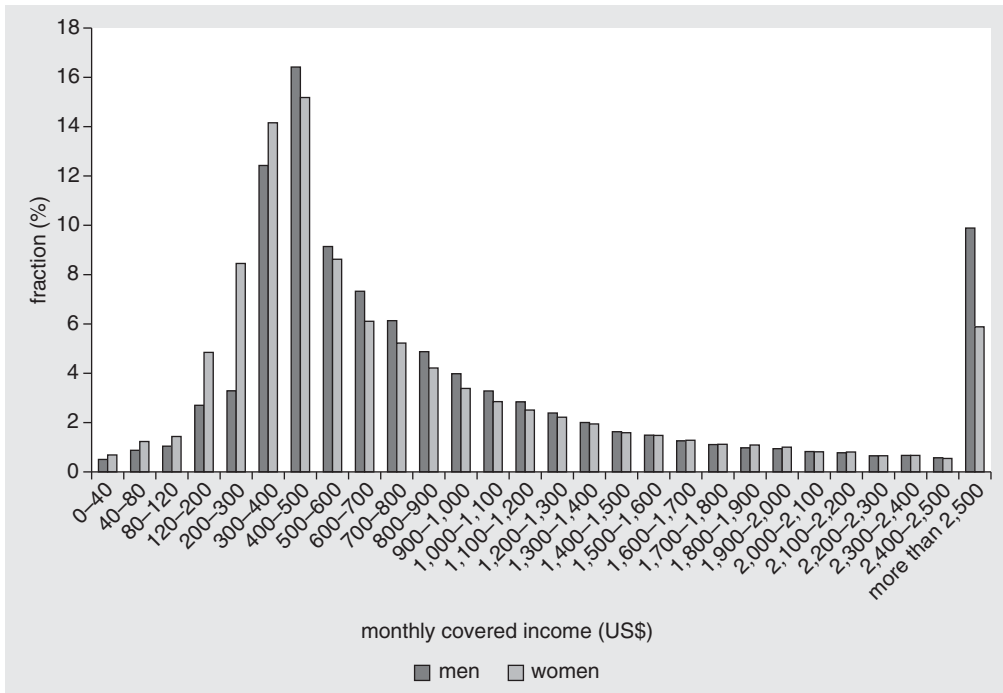
tend to receive slightly lower earnings than men, and a much lower fraction of women receive wages above the earnings ceiling for contributions. All these labor market factors directly translate into lower pensions in a DC system.

RETIREMENT AGE

Actuarial calculations of pensions in DC schemes mean that the age at which people claim a benefit has a strong and direct effect on their pension level; earlier retirement implies that individuals' savings must cover a longer payment period, thereby reducing the possible yearly amount of a pension.

Figure 13.6 shows the age at retirement (including early retirement) for both men and women, as of September 2009.⁸ The most prominent aspect is the great importance of the minimum retirement age defined by law: 28 percent of men retired at age 65 and 45 percent of women retired at age 60. A large fraction of men (55 percent), however, qualified and applied for early retirement, including 45 percent of male retirees by age 60. In contrast, only 15 percent of female retirees acquired this status before the legal retirement age, probably reflecting the fact that they often do not qualify because of their lower account balances.⁹

An interpretation of figure 13.6 is that even if no actuarial advantages accrue (as is often the case in defined benefit systems), individuals tend to retire as early as they are

FIGURE 13.5 **Income distribution of contributors by gender, September 2009**

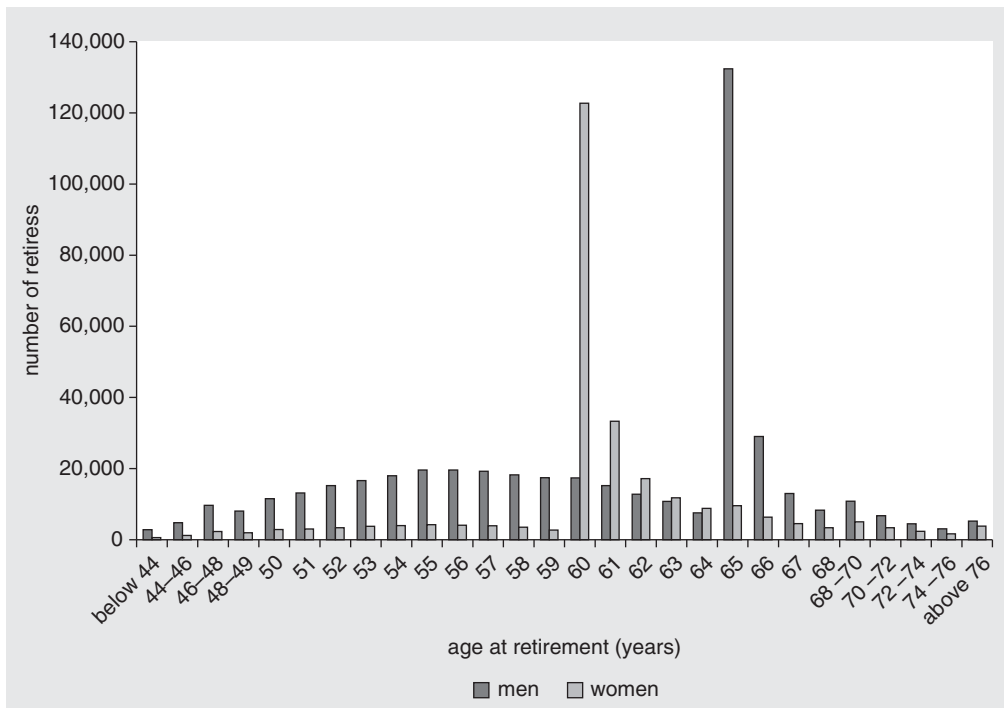
SOURCE: Author's calculations, based on official data available at <http://www.spensiones.cl>.

allowed. This outcome could partly be associated with their lack of familiarity with the way pensions are calculated in a DC scheme; individuals want to take advantage of the possibility of receiving two income streams but do not anticipate the effect of this decision on income once they actually retire from the labor market.¹⁰

In comparison with the labor market factors described in the previous section, figure 13.6 shows that pension design plays a significant role in the decision of when to retire. Raising the minimum retirement age for women (e.g., to equalize it with that of men) would automatically increase their pensions at retirement at the expense of forcing them to wait until that age.¹¹ At the same time, reinforcing the information provided to individuals looking at early retirement to make sure that they understand the consequences of their decisions on their future earnings profile would be an interesting experiment.

MORTALITY TABLES AND PENSION TYPES

In Chile, retirees can opt for two main alternative retirement instruments: they can keep their funds in the same AFP and start receiving payments from the AFP under a programmed withdrawal schedule (also called a *phased withdrawal*), or they can use their funds to buy an annuity from an insurance company. In the first case, pensions are calculated using official formulas, interest rates, and mortality tables. In the second case, insurance companies compete and offer annuities that are based on the insurance company's own calculations. In all cases, gender-differentiated mortality tables are used in the

FIGURE 13.6 **Distribution of old-age retirement age by gender, September 2009**

SOURCE: Author's calculations, based on official data available at <http://www.spensiones.cl>.

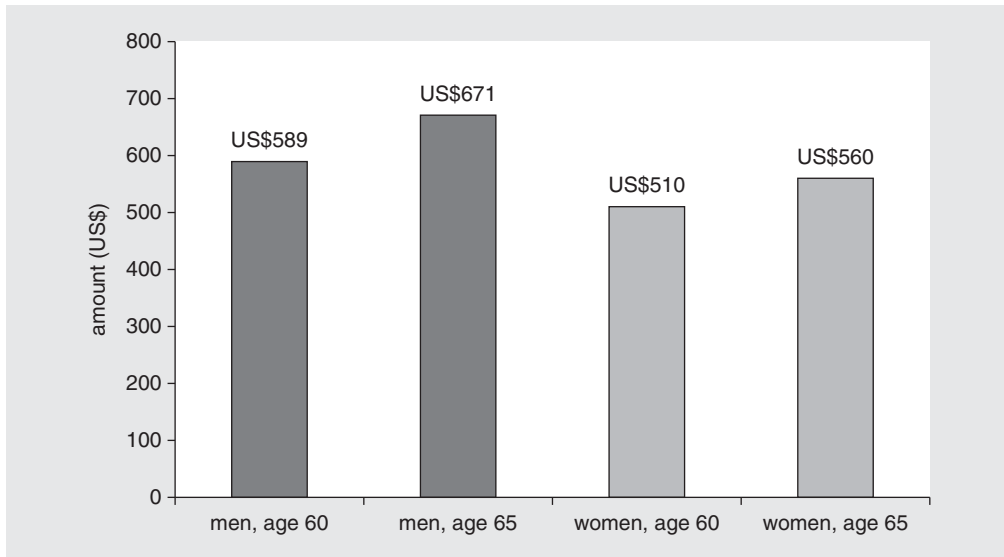
calculations, which thereby translate the higher longevity of women into lower pensions (if all other factors are kept constant).¹²

To illustrate the importance of this issue, figure 13.7 shows the pension for single men and women at ages 60 and 65, with US\$100,000 in their account (using the official mortality tables for pensioners). Women's pensions, for the same age and balance, are 13 percent lower at age 60 and 17 percent lower at age 65. The figure shows the effect of postponing retirement age for five years, from age 60 to age 65, as discussed in the previous section. This postponement alone (without including the additional contributions or interest income that might increase the balance) would increase women's initial pension by 10 percent because of a lower life expectancy factor in calculating the pension. If, in addition to the longevity effect, a 3 percent rate of return on accumulated savings between age 60 and age 65 is assumed, the pension would be 27 percent higher. Finally, assuming the person keeps making contributions from work every month until age 65 implies an overall increase of 35 percent.

During the reform process, the issue of using gender-differentiated mortality tables was discussed in the context of the Pension Reform Committee. The reasons for not including a recommendation to use unisex tables were the following (Consejo Asesor Presidencial para la Reforma Previsional 2006, chapter 5):

- In contrast with other countries, Chile allows workers to retire under a programmed withdrawal schedule. Under unisex tables, men would be more attracted

FIGURE 13.7 Simulated pensions for single men and women, 60 and 65 years of age



SOURCE: Author's calculations, based on programmed withdrawal formula and official interest rates and mortality tables for old-age pensioners.

NOTE: Balance = US\$100,000.

to this option, leaving the annuities market for women only, thereby defeating the purpose of the measure.

- There is no practical experience in using these tables in countries with individual capitalization schemes.
- Because pensions are calculated taking into consideration the group of potential beneficiaries, the effect of unisex tables would be of second order.
- Use of unisex tables would imply a cross-subsidy from retired men to retired women, but it is unclear whether this subsidy would fall on men of higher or lower income.
- Use of gender-differentiated tables implicitly incorporates the effect of other variables that affect longevity, such as socioeconomic status.
- Official mortality tables are used to calculate the reserve requirements of annuity providers. Using unisex tables might cause such providers to reserve too little or too much, depending on the gender structure of the company.
- Annuities are freely fixed by insurance companies, which have an incentive to use the mortality tables that most closely approach their pool of insured individuals.

POVERTY PREVENTION PILLAR

In addition to self-financed pensions, under certain conditions, individuals have access to noncontributory benefits financed by general revenues. These benefits are generally gender neutral in terms of their eligibility requirements and provide benefits until death, thus mitigating the longevity difference between men and women.

Before the 2008 reform, two main programs covered individuals with low pension entitlements: the MPG for individuals who contributed for at least 20 years but were not able to finance a pension above a certain threshold (the minimum pension), and the PASIS for poor elderly without another source of pension income.

Using data from the EPS 1960–65 cohort, Berstein and Tokman (2005) analyzed the effect of different components of the prereform pension system on the pension gap, including the MPG component. They concluded that even if the MPG program tends to favor women over men, it will not compensate for the differences in retirement age and gender-differentiated mortality tables. Gender differences that occur during active life are exacerbated during retirement, especially for highly educated individuals. Table 13.2 summarizes these results.

As described earlier, the 2008 reform brought a number of measures directed at reducing the pension gap, including the replacement of the MPG and the PASIS programs by the new solidarity pillar and the introduction of a bonus per live birth. The following section simulates the extent to which these new measures are able to compensate for the pension gap.

SURVIVORSHIP PENSIONS AND DIVORCE

Up to this point, the chapter has focused on self-financed pensions earned by men and women or noncontributory entitlements. An important third alternative for protection in old age is being indirectly covered by survivorship pensions. This traditional concept of social security systems depends, however, on individuals being married and maintaining their family ties until retirement. As figure 13.8 shows, in the past two decades in Chile, women have tended to postpone marriage, and a lower fraction of women are married during the period before the minimum retirement age (from 60 percent in 1990 to 55 percent in 2006).

Figure 13.9 shows the evolution between 1990 and 2006 of the civil status of women in the range of 55 to 60 years of age. The 5 percentage point reduction in married women has been accompanied by increases in cohabitation (6 percentage points), separation (4 percentage points), and singlehood (2 percentage points).

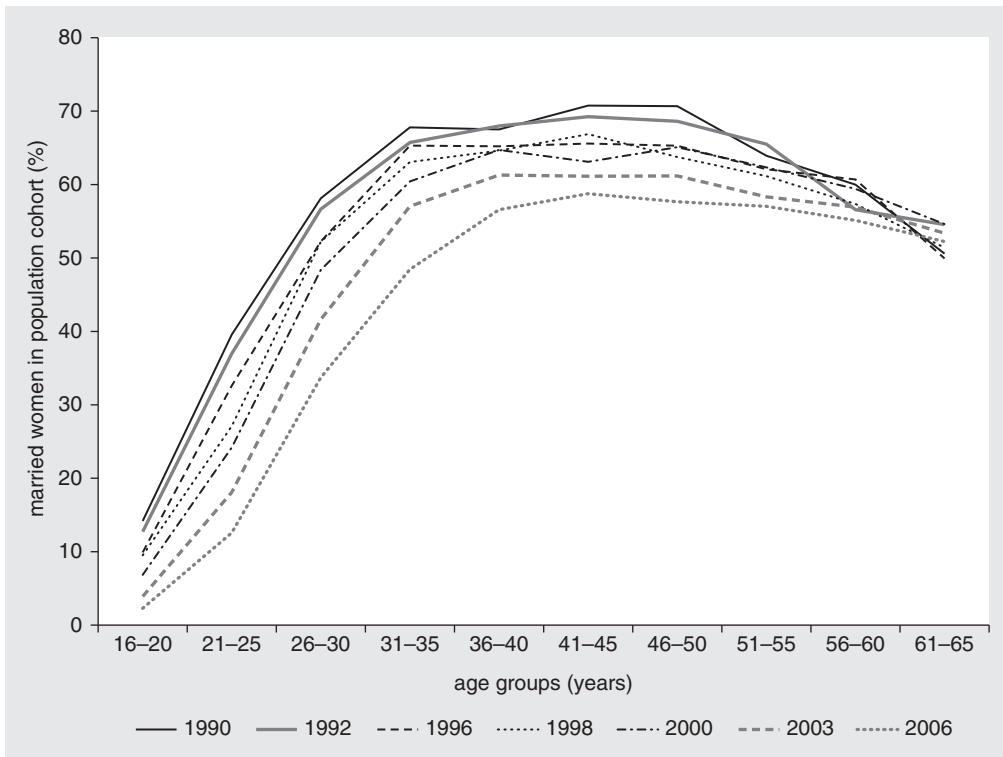
Overall, one can expect that indirect coverage provided by husbands will tend to decrease over time, as women postpone or avoid marriage and as separations, annulments, or divorces increase over time.

TABLE 13.2 **Pensions, wages, and gender gaps by education level, 1960–65 cohort**

Education level	Average wages (Ch\$)		Wage gap (%)	Average annuities (Ch\$)		Annuity gap (%)	Change in gap (%)
	Men	Women		Men	Women		
Primary education	81,842	34,833	135	104,274	43,335	141	–4
Secondary education	129,413	62,107	108	176,671	76,028	132	–18
College educated	272,898	157,949	73	380,955	150,815	153	–52

SOURCE: Berstein and Tokman 2005, table 3.

FIGURE 13.8 Fraction of women who are married, by age and cohort, 1990–2006



SOURCE: Author's calculations, based on CASEN household survey, 1990–2006.

Results from a Microsimulation

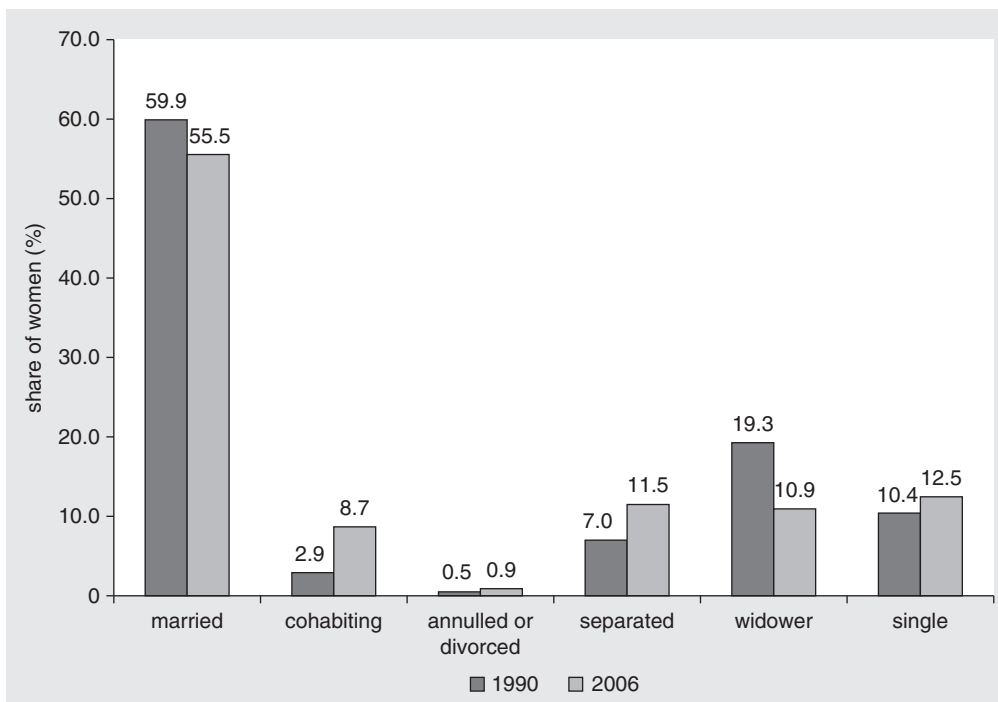
For the purposes of this study, a simulation model was constructed to compare how the different measures taken in the 2008 reform will affect female pensions in Chile. The model was based on individual-level histories taken from the 2002 EPS.¹³ Self-reported labor histories are completed using econometric projection models, and pension entitlements are calculated under different scenarios. This section describes the data, methodology, and simulation results.

DATA AND METHODOLOGY

The EPS follows a sample of approximately 17,000 individuals who were interviewed in 2002, 2004, 2006, and 2008. This chapter uses data from the first survey (2002), where individuals were asked to self-report their labor history for the period 1980–2002.¹⁴ The focus is on individuals born between 1962 and 1967, who most likely entered the labor market after the 1980 reform. Because this chapter is interested in estimating their pension entitlements, the contribution status and earnings must be predicted from 2002 until the moment they retire (60 or 65 years old).

To complete the history of contributions, the simulation first estimates a linear probability model for a variable that is equal to 1 if the person worked and made social

FIGURE 13.9 Civil status of women 55–60 years of age, 1990 and 2006



SOURCE: Author's calculations, based on CASEN household survey, 1990 and 2006.

security contributions in a given month. Because longitudinal data are available for a relatively large sample, a fixed-effect model is estimated and used to predict the probability of making contributions in a given month for the period that is not observed in the data. The estimated model has the following form:

$$\text{Contributed}_{it} = \alpha + \beta'X_{it} + \varphi_i + \varepsilon_{it},$$

where X_{it} includes the variables Age and Age^2 and their interaction with a female dummy variable and schooling. The set of parameters φ_i represents the individual-level fixed effects, which are also included in the prediction model. The results from this model are included in annex 13A. The fitted values from the previous equation (censored to 0 if the prediction is negative and 1 if the prediction is greater than 1) are used as an estimate of the probability of making contributions in a particular month.

The projection also requires an estimate of the earned income for contributors. Because the EPS self-reported histories do not include earnings, a different approach is followed. Cross-sectional data from another set of household surveys, the National Socioeconomic Characterization Surveys (Encuestas de Caracterización Socioeconómica Nacional, or CASENs), are used to estimate a linear model for labor income, and then the coefficients are used to impute earnings in the EPS labor histories.¹⁵ In this case, the model has labor income as a dependent variable. The vector of explanatory variables, Z_{it} ,

includes as before the variables *Age* and *Age*² and their interaction with a female dummy variable and schooling plus a female dummy variable, the variables *Schooling* and *Schooling*², and a cohort variable defined by the year of birth (divided by 1,000). The results from this model are included in annex 13A.

$$Earnings_{it} = \alpha + \beta'Z_{it} + v_{it}$$

With the results from these two models, together with returns data, one can construct projected pensions for each individual in the sample: the real balance in the account at retirement (which can occur at age 60 or 65, depending on the scenario) is estimated, and then the corresponding annuity is calculated on the basis of official mortality tables and annuity interest rates.¹⁶

SIMULATED SCENARIOS

The simulations examine how the 2008 reform affected women's pensions by constructing five incremental scenarios, depending on the different measures that were included. In addition, two scenarios (called scenario 4-MP and 5-MP) included an MPG instead of the new solidarity pillar. These scenarios are summarized in table 13.3.

As described previously, the current legal retirement age is 60 for women and 65 for men (scenario 1). Scenario 2 includes the state-financed bonus to mothers for every child born. This benefit is equivalent to 18 monthly contributions for a minimum-wage worker plus the rate of return (net of administration fees) that this amount would receive if it were invested in the pension system (Fund C) from the month the child was born until the date the mother reached the age of 65. The history of births is included in the EPS.¹⁷ In addition to the bonus, scenario 3 includes the additional 0.2 percent of earnings that women started to overcontribute since July 2009 as a result of the separation of male and female contracts for disability and survivorship insurance. Scenario 4 includes benefits from the new solidarity pillar for individuals with estimated pensions (calculated in scenario 3) below US\$510.¹⁸ Under scenario 4, both men and women receive benefits, even though the effect is expected to be greater among women because they have lower

TABLE 13.3 **Simulation scenarios**

Scenario	Description
1	Base scenario: women retire at age 60, men at age 65
2	Scenario 1 + bonus per child
3	Scenario 2 + 0.2% additional contribution rate
4	Scenario 3 + solidarity pillar
5	Scenario 4 + women retiring at age 65
4-MP	Scenario 3 + MPG
5-MP	Scenario 4-MP + women retiring at age 65

SOURCE: Author's compilation.

pensions and are thus entitled to higher subsidies from the new solidarity pillar. Scenario 5 includes a measure that was not included in the 2008 reform: raising the minimum retirement age for women to 65.¹⁹ Under this scenario, women keep contributing and accumulating returns until they reach age 65, when they retire.

Scenarios 4-MP and 5-MP are analogous to scenarios 4 and 5, except that instead of the new solidarity pillar, a floor is set of approximately US\$200 for all individuals with at least 20 years of contributions, which is equivalent to the MPG that was in place before the 2008 reform.²⁰ A 2 percent increase in real terms in the value of the minimum pension is allowed from 2009 onward.

RESULTS

Table 13.4 shows the mean and median of the pension distribution for men and women under the seven scenarios, together with women-to-men pension ratios. Under the base scenario, women would receive an average monthly pension of US\$218.00, equivalent to 37 percent of the average pension of men (US\$582.40). This ratio increases to 45 percent with the introduction of the bonus per child (a 20 percent increase in women's average pensions). As expected, the additional contribution rate (scenario 3) increases average pensions by 2 percent over scenario 2. The inclusion of the solidarity pillar increases both men's and women's average pensions by 5 percent and 29 percent, respectively, therefore increasing the pension ratio from 46 percent to 56 percent. Finally, the additional five years of contributions and the lower life expectancy when women retire at age 65 raises women's pensions an additional 24 percent, giving an average women-to-men ratio of 69 percent.²¹

In contrast with the new solidarity pillar, scenario 4-MP shows the almost null impact of the minimum pension program, showing a slight effect on women's average pension (5 percent) and a larger effect on women's median pension (38 percent). This finding is consistent with other studies that found relatively limited coverage of the minimum pension program (e.g., Berstein, Larraín, and Pino 2005). The reason for this outcome is that, in the Chilean labor market, the individuals who qualify for the minimum pension program (with at least 20 years of contributions) are also those who are able to

TABLE 13.4 **Simulation results: Mean and median pensions**

Scenario	Average men (US\$)	Average women (US\$)	Women/men ratio (%)	Median men (US\$)	Median women (US\$)	Women/men ratio (%)
Scenario 1	582.41	217.98	37	557.85	167.84	30
Scenario 2	582.41	260.69	45	557.85	207.09	37
Scenario 3	582.41	265.05	46	557.85	210.46	38
Scenario 4	611.89	341.94	56	557.85	298.56	54
Scenario 5	611.89	424.85	69	557.85	353.54	63
Scenario 4-MP	583.07	277.99	48	557.85	291.36	52
Scenario 5-MP	583.07	369.03	63	557.85	309.20	55

SOURCE: Author's calculations.

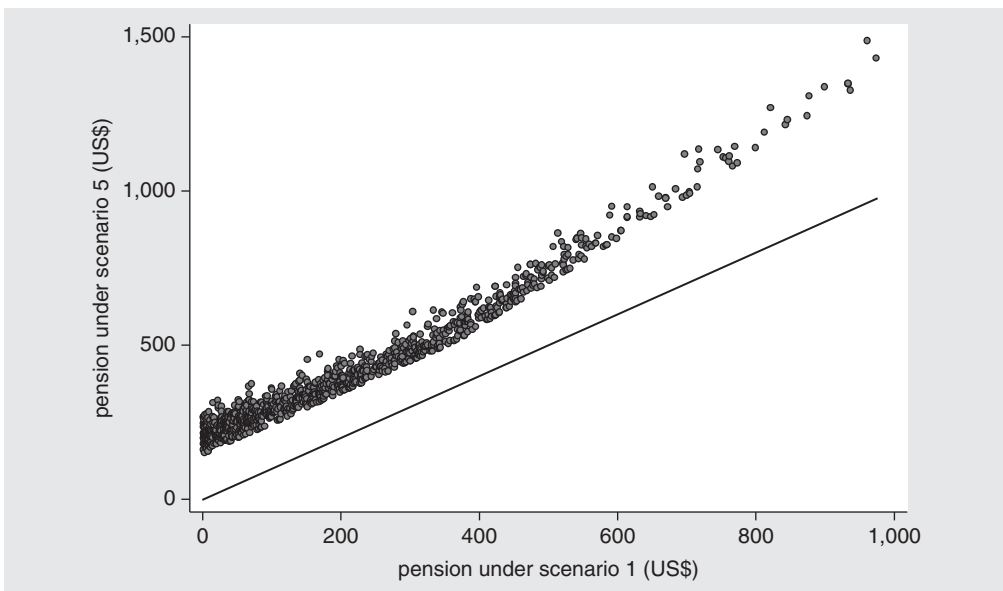
finance pensions above the guaranteed minimum pension. The intersection between the two restrictions is therefore quite small.

The median results show a large gap between men and women in the initial situation: women's median pensions in the base scenario are only 30 percent of men's median pensions. The different measures introduced, particularly the bonus per child and the new solidarity pillar, significantly reduce the median pension gap. This outcome reflects the fact that both measures were designed with a progressive goal: the bonus per child was set in absolute terms (with respect to the minimum wage) and, therefore, represents a higher fraction of total pensions for low-income women. The solidarity pillar subsidy decreases with the level of pension, therefore affecting individuals (men and women) in the lower part of the distribution. Because the median pension of men is above the threshold for the solidarity pillar, median pensions are unchanged for men in all scenarios. The addition of the solidarity pillar improves the pensions of women substantially, however.

To capture more clearly the distributional effects of the complete package of measures, figure 13.10 shows the joint distribution of female pensions under scenarios 1 (x -axis) and 5 (y -axis). As expected, all points are above the 45-degree line, reflecting the fact that all measures are pension improving. In addition, the increase seems to be higher in the lower part of the distribution. To demonstrate this more clearly, figure 13.11 shows in the y -axis the percentage increase in individual's pensions when going from scenario 1 to scenario 5.²² Whereas women with pensions above US\$500 see an increase between 25 percent and 40 percent, female workers in the lower part of the initial pension distribution see their pensions increase by more than 100 percent.

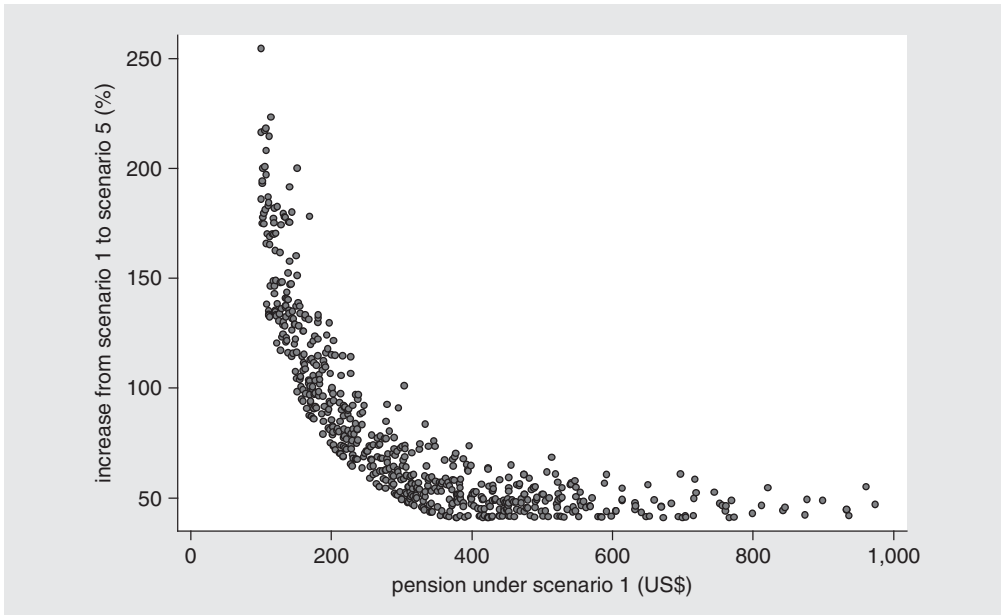
Finally, figure 13.12 shows average women's pensions for the seven scenarios for the five quintiles of the initial pension distribution. Once again, in the first three quintiles, both the bonus per child and the solidarity pillar play a significant role in increasing

FIGURE 13.10 Joint distribution of female pensions under scenarios 1 and 5



SOURCE: Author's calculations.

FIGURE 13.11 Joint distribution of female pensions under scenario 1 and relative increase in pensions from scenario 1 to scenario 5



SOURCE: Author's calculations.

NOTE: Figure shows initial pensions above US\$100 only.

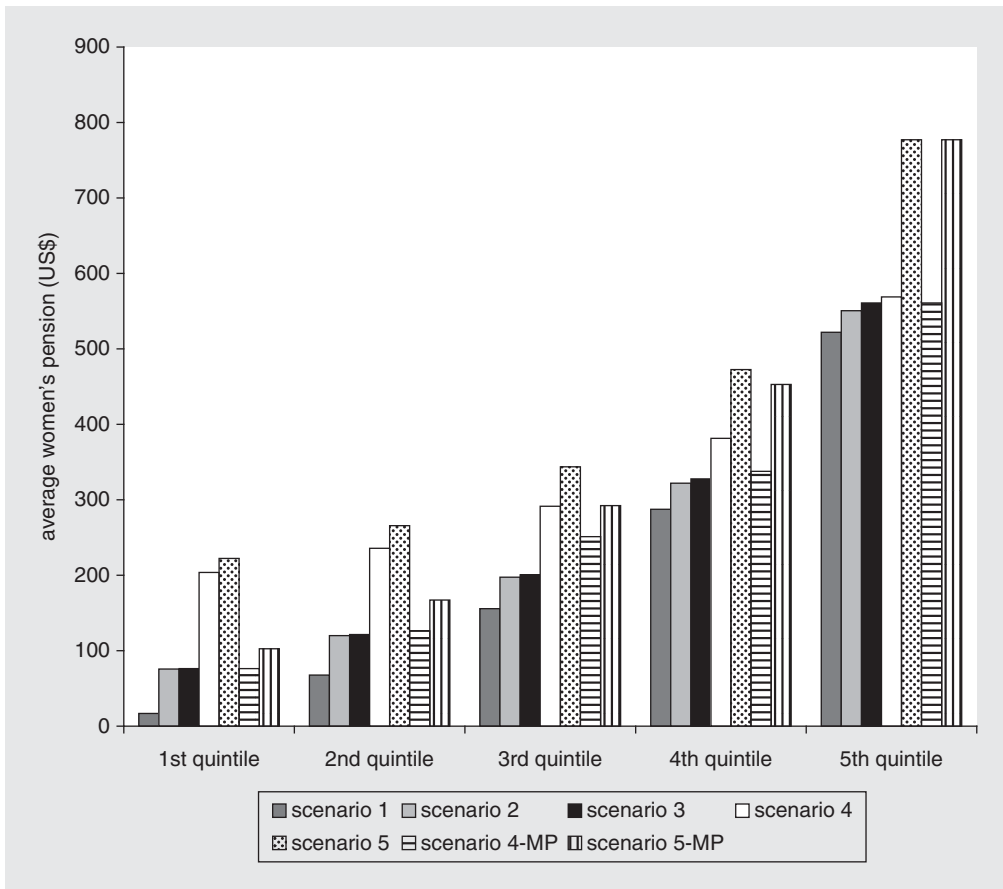
women's pensions. Interestingly, increasing retirement age has a much higher effect (with respect to scenario 4) in the upper quintiles (24 percent and 37 percent in the fourth and fifth quintiles, respectively), rather than the lower quintiles (9 percent and 13 percent in the first two quintiles). The reason for this finding is the implicit tax associated with the reduction in benefits from the solidarity pillar; additional savings (including those coming from postponing retirement) by individuals with pensions below the new solidarity pillar threshold are "taxed" at a fraction equivalent to 29.4 percent (75,000/255,000). The minimum pension has a very limited effect, except for the third quintile, the part of the distribution where the few individuals who qualify for this program are located. In this group, the minimum pension program raises women's average pensions by 25.2 percent.

Concluding Remarks

The pension gender gap is the result of both the labor market characteristics of an economy and the design elements of the pension system itself. This chapter empirically analyzes the effect of five alternative measures on the distribution of pensions of men and women. There are three main results:

- The introduction of a bonus per child (fixed in absolute terms) can significantly raise pensions of women in the lower part of the distribution. Its effect directly translates into a reduction in the gender gap, because it affects only women (at least in the Chilean case).

FIGURE 13.12 Average women's pensions by scenario and quintile of the initial pension distribution



SOURCE: Author's calculations.

- The new solidarity pillar introduced in 2008 has a tremendous effect on all individuals with small pensions, but especially among women because they are more likely to be eligible for these benefits. Its effect on reducing the average pension gap is comparable to that of the bonus per child.
- Raising women's minimum retirement age to 65 would have an important effect (24 percent on average), but especially among women who are not eligible for the new solidarity pillar (because of its implicit tax associated with the reduction in the subsidy for higher pensions).

In contrast, and coinciding with previous results, the minimum pension that existed prior to the introduction of the solidarity pillar in 2008 plays, within the framework of the FDC individual account scheme, a relatively small role in lowering the pension gender gap.

From these results, a few generalizations can be made. A strong poverty prevention pillar seems to be an attractive instrument for achieving both distributional goals and gender-equity considerations. The design of this pillar is not irrelevant, however. On the one hand, the design of the MPG in the FDC individual account scheme turned out to be

a weak protection device, at least in the context of the Chilean labor market. On the other hand, the design of the new solidarity pillar provides a high level of poverty protection together with an important gender-equalizing effect. This result comes at the cost of significantly affecting the incentives to increase one's contributory pension, however, because the saving efforts of individuals with low pension entitlements are implicitly "taxed" at a 30 percent marginal rate by the effect of reduced subsidies.²³ This effect can be seen from the relatively small effect of postponing retirement age on women who are covered by the new solidarity pillar (going from scenario 4 to scenario 5 in the previous simulations).

Using a bonus per child (or the equivalent child-care credits found in many developed countries) has a clear and direct effect on women's pensions. It seems reasonable, however, to appropriately combine the bonus with other forms of assistance for mothers who decide to keep working while taking care of their children. In addition, whether the bonus should necessarily be assigned to mothers (as in the Chilean case) or more generally to the individual who is taking care of the child is a question that needs to be discussed. Assigning it exclusively to mothers, even if they are most often the caregiver in developing countries, tends to perpetuate the traditional division of roles in the family.

Because the necessary data were unavailable, the simulations did not include the effects of economic compensation in case of divorce (which would tend to increase women's pensions) or the effect of survivorship pensions for women (which would tend to reduce women's pensions).²⁴ The evidence from Chile indicates that the single-provider family stereotype is gradually on its way out. This finding suggests that pension options should be made more flexible to allow for lower survivorship pensions in cases where both spouses are on a relatively equal career income footing.

Finally, the average effect on the gender gap of postponing the retirement age for women was smaller than the effect of introducing noncontributory benefits in the simulations. However, there is good reason to reconsider the minimum age for women to claim a benefit and the way this benefit should be calculated. Among the amendments introduced by the 2008 pension reform, a significant one was the introduction of the obligation to contribute on the part of formal self-employed workers (such contributions were previously voluntary). The main argument for this measure was that together with the extended rights associated with the new solidarity pillar came an extended obligation to contribute for one's pension. A similar argument could be made with respect to the minimum retirement age and its relation to the new solidarity pillar; the minimum retirement age of women could be increased to equate it with that of men, or the benefits of the new solidarity pillar for women who retired before age 65 could be calculated as if they had retired at 65. That way, no implicit tax would exist on postponing retirement, a reality that is inevitable given the permanent increases in life expectancy experienced by most countries in the world.

Annex 13A: Estimation Results and Fitted Values for the Contribution and Earnings Models

Table 13A.1 shows the estimation results of the simulation in this chapter. Figures 13A.1 and 13A.2 show the fitted values for the contribution and earnings models.

TABLE 13A.1 Estimation results

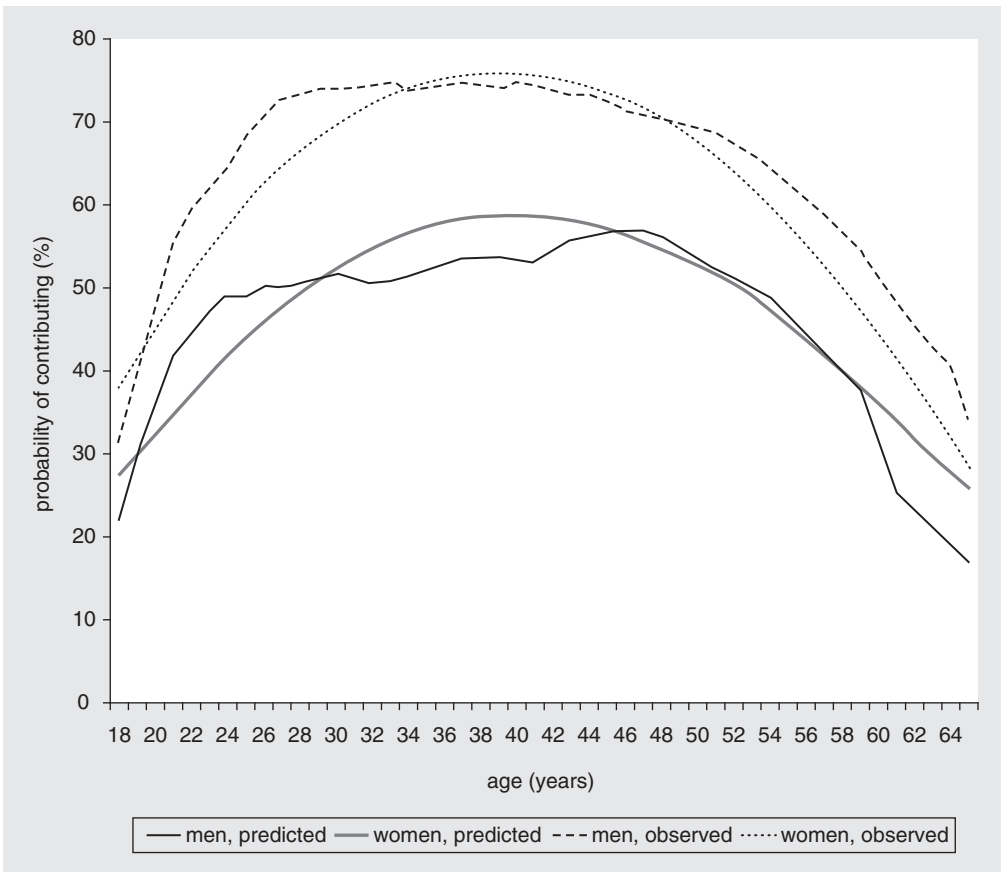
Variable	Contribution status (fixed effect)	Labor earnings (Ch\$ millions) (linear regression)
Age (100)	-0.055 (2.15)*	-0.383 (8.16)**
Age ²	-1.719 (62.28)**	0.454 (8.32)**
Age * female	-2.015 (106.77)**	-1.324 (38.01)**
Age ² * female	2.709 (116.23)**	1.410 (32.50)**
Age * schooling	64.564 (282.79)**	22.329 (51.82)**
Age ² * schooling	-66.391 (252.00)**	-20.344 (39.93)**
Female		0.184 (28.04)**
Schooling		-0.078 (86.05)**
Schooling ²		28.280 (201.70)**
Cohort (year of birth/1,000)		0.152 (2.59)**
Constant	-0.276 (139.38)**	0.011 (0.10)
Observations	3,339,907	511,352
Number of fixed effects	14,622	
R ²	0.12	0.37

SOURCE: Author's calculations.

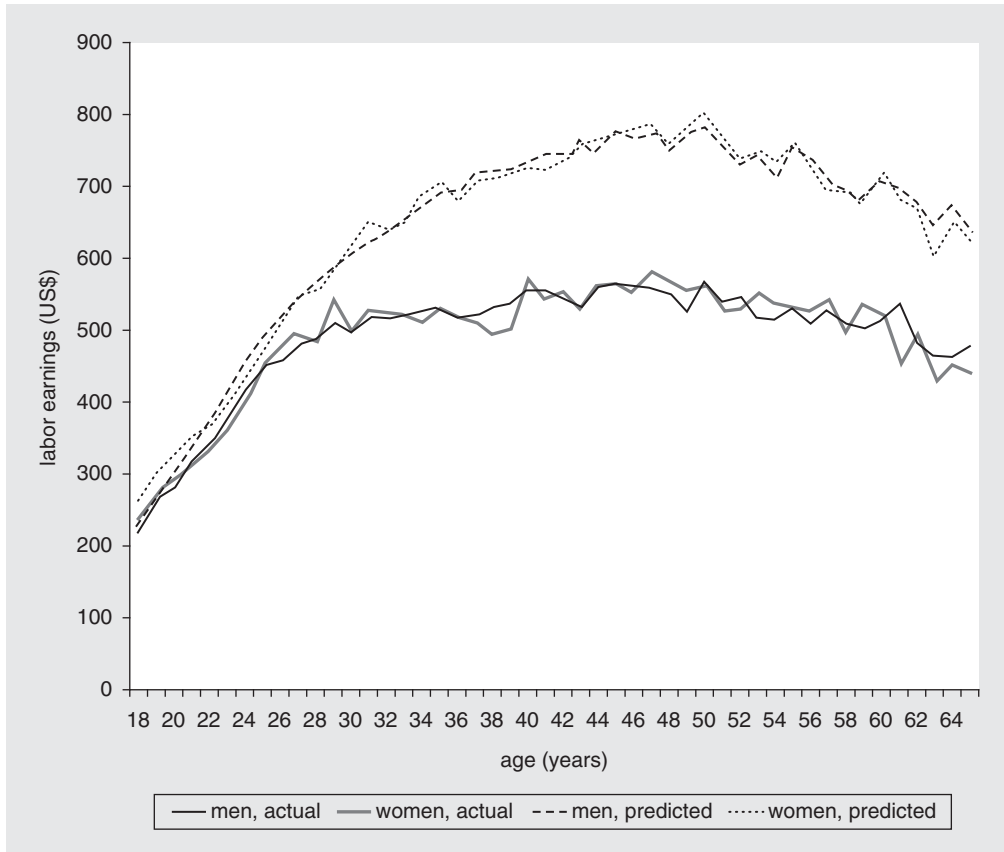
Note: Absolute value of *t* statistics in parentheses.

* significant at 5 percent; ** significant at 1 percent.

FIGURE 13A.1 **Observed and predicted probability of contributing, by age and gender**



SOURCE: Author's calculations.

FIGURE 13A.2 **Observed and predicted labor earnings, by age and gender**

SOURCE: Author's calculations.

Notes

1. For a discussion of policy options for the Latin-American region, see Bertranou (2001). James, Cox Edwards, and Wong (2003) perform a similar analysis for Argentina, Chile, and Mexico on the basis of household survey data.
2. Part of the material in this section was extracted from Rofman, Fajnzylber, and Herrera (2008).
3. See Cox Edwards (2001) for an alternative analysis of the living standards of the elderly in Chile.
4. Individuals with 100 percent density contributed during their entire working life, whereas workers with 50 percent density contributed half the months between the age of 20 and the last moment they were observed in the data.
5. The figure was constructed using self-reported histories between 1980 and 2002 for approximately 11,000 individuals included in the Encuesta de Protección Social (Social Protection Survey, or EPS). Only the reported histories between the ages of 18 and 65 were included in the analysis. More detail on the EPS is provided in the section titled "Results from a Microsimulation."

6. For more details on the 2002 EPS, see Subsecretaría de Previsión Social (2004). Note that average densities by age are calculated with data from different cohorts (densities at older ages come from earlier cohorts, intermediate ages from the whole sample, and young ages from the latest cohorts). Contreras, Bravo, and Puentes (2005) show that cohort effects are important, because younger cohorts present much higher labor force participation rates than do older ones.
7. Average earnings are greatly affected by the large fraction of individuals at the top covered income bracket: US\$938 for men and US\$825 for women.
8. The figure corresponds to the 746,325 individuals who had taken old-age retirement in the system, including 37,135 individuals who were deceased by September 2009.
9. Early retirement requires that individuals be able to finance a pension that is equal to at least 150 percent of the minimum pension and has a replacement rate of at least 70 percent.
10. In the Chilean system, there is no incompatibility or penalty for working while retired. Starting to receive a pension and retiring from the labor market do not often occur simultaneously.
11. This measure (raising legal retirement age for women to age 65) was proposed by the pension reform committee but not included in the reform bill sent to Congress. Because of its importance, this measure is included in the simulation exercise of this chapter in the section titled “Results from a Microsimulation.”
12. According to the official mortality tables for 2009 old-age pensioners, life expectancy at age 60 is 82 years of age for men and 88 years of age for women.
13. An alternative source of microlevel data would have been the Affiliates Pension Histories (Historias Previsionales de Afiliados Activos, Pensionados y Fallecidos, or HPA), a database including the administrative contribution histories of a sample of 24,000 individuals, a subsample of whom were interviewed for the EPS. For more details on this dataset, see, for example, Robalino and Fajnzylber (2012). Unfortunately, this database is not yet publicly available. The main difference is the absence of recollection error, as could be the case with the EPS. Berstein and Tokman (2005) present some comparative statistics of the distribution of densities from the EPS and the HPA. Average densities are quite similar (55 percent for men in the HPA, compared to 59 percent in the EPS, and 48 percent and 46 percent for women in the HPA and EPS, respectively), but median density for men is higher in the EPS than in the HPA (64 percent against 48 percent). This difference is a lesser source of concern here, given that the primary interest of this chapter lies in comparing pension distributions across different scenarios, rather than precisely estimating the pension distribution.
14. For more information on this survey, see Subsecretaría de Previsión Social (2004). The information includes the labor status, region, occupation, existence and type of contract, labor relationship, and contribution status.
15. The 1990, 1992, 1994, 1996, 1998, 2000, 2003, and 2006 CASENs are used here. For more information on the CASENs, see <http://www.mideplan.cl/casen>.
16. Historic returns are used for the period 1981–2006, and a 4 percent real interest rate is used for the missing period. A 3.5 percent interest rate is used for annuity calculations. The pension calculations assume that everybody in the sample was single at the moment of retirement.
17. The exact month of birth is not included in the EPS. All children are assumed to be born in the month of June.
18. The exact formula used (in Chilean pesos) was $\text{subsidy} = \text{Ch\$}75,000 - \text{pension} \times \text{Ch\$}75,000 / \text{Ch\$}255,000$. The result was then converted using an exchange rate of $\text{Ch\$}500 = \text{US\$}1$. All individuals with pensions below US\$510 were assumed to be eligible for the subsidy. As mentioned earlier, residency and means-testing requirements must also be met. In practice, most

- individuals with small pensions will meet the means-testing requirement (being part of a household belonging to the 60 percent poorest segment of the population).
19. This measure was proposed by the 2006 Pension Reform Committee, which wrote the report that was the basis for the 2008 reform. The measure was not included in the reform bill sent to Congress.
 20. In fact, individuals who were at least 45 years of age when the reform was passed are still eligible for the MPG. These individuals can choose between the two systems.
 21. Note that the comparisons made here do not necessarily show the marginal contribution of the reform relative to the previous scheme, because before the 2008 reform, two programs were in place to reduce poverty in old age: an assistance pension and a minimum pension program. The marginal increases presented here are calculated relative to a situation without a poverty prevention pillar.
 22. For visual purposes, individuals with pensions below US\$100 were not included in figure 13.11, because their pension 5-to-pension 1 ratio was too high to show in the figure.
 23. Valdés (2007) discusses the incentive effects of the introduction of the solidarity pillar, arguing that future increases in the size of benefits could crowd out participation in the contributory scheme.
 24. It is not easy to identify in the EPS marriages that ended in divorce, and it is almost impossible to predict in what proportion of cases judges in charge of applying economic compensation in case of divorce would have imposed the transfer between pension accounts. With respect to survivorship pensions, a model would be needed to predict the probability of reaching retirement while married.

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CHAPTERS 12/13

COMMENT

Ángel Melguizo

Both chapter 12, by Anna Cristina D’Addio (“Pension Entitlements of Women with Children: The Role of Credits within Pension Systems in OECD and EU Countries”), and chapter 13, by Eduardo Fajnzylber (“Gender Policy and Pensions in Chile”), address the effects on pension gaps (i.e., levels of pensions of men compared with levels of pensions of women) of different pension regulations, in particular child credits.

The chapters exhibit significant differences in methodology (simulation in chapter 12 and microestimation in chapter 13), country span (Organisation for Economic Co-operation and Development [OECD] and European Union [EU] countries versus Chile), and type of data (stylized profiles versus survey data), which make them quite complementary. My comments refer to both of these chapters together, although some are directed specifically to one or the other of the two chapters. I focus on the policy implications from these two studies for developing countries, referring specifically to two Latin American countries, Chile and Mexico. Chile is especially interesting for several reasons. First, individual pension capital accounts managed by the private sector have been functioning for nearly three decades, providing exceptionally rich data and research (see Gill, Packard, and Yermo 2005 and the references therein). Second, the system benefits from strong social and political domestic support, while being at the same time a benchmark for many emerging and industrial economies. And finally, since 2008, the Chilean system has been in the process of implementing a second-generation reform, focused on the solidarity pillar, with profound gender implications.

Summarizing the Contributions

Anna Cristina D’Addio’s study shows the effect of a dozen pension regulations that affect pension gaps. The author uses the *OECD Pensions at a Glance* model (see OECD 2011) to simulate the quantitative effects of career breaks and child-care credits on pension entitlements in OECD and EU countries. She uses stylized profiles, namely a full-time female employee starting at age 20, who after a child-care break (two children, 15 years maximum) returns to work as a full-time employee. With the underlying assumption that individual behavior is not affected, her results show that child-care credits boost pension entitlements, but not enough to fill the pension gaps. On average, the gross pension replacement rate for average earners drops between 3 and 4 percentage points after a 5-year child-care break (13 percentage points after 15 years), with a significant dispersion depending on income (up to 30 percentage points among high-incomer earners) and country (up to 40 percentage points). In conclusion, the author suggests that pension policies aiming to protect parents need to be designed in the larger context of family and employment policies.

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Eduardo Fajnzylber simulates the gender effects of various (implemented and debated) pension reforms in Chile, in particular the bonus per child, the reform of disability and survivors insurance, the new solidarity pillar, and changes in the effective retirement age (see Consejo Asesor Presidencial para la Reforma Previsional 2006). Fajnzylber uses data from the Social Protection Survey (Encuesta de Protección Social, or EPS) 2002, which contains self-reported labor histories from 1980 to 2002, and performs microeconomic simulations of contributions, earnings, and pensions for the posttransition cohorts (i.e., Chileans born 1962–67, with participation in the Chilean pension system from 1981). According to his calculations, the 2008 pension reform (basically the establishment of the bonus per child and the solidarity pillar) reduced the average pension gap between men and women to 17 percentage points (22 percentage points is the median pension gap). Additionally, if the reform had incorporated an increase in women's retirement age (up to 65 years, as for men), it would have contributed to an additional reduction of 6 percentage points in the gap.

OECD Pensions at a Glance modeling provides an excellent benchmarking instrument for analyzing the “morning after” effect of pension reforms in OECD countries. However, D’Addio’s results should be taken with caution because there may also be effects on workers’ labor supply and saving decisions in the medium term in response to changes in retirement rules. It would, of course, be more informative to compliment this form of analysis with actual profiles of workers, based on labor force surveys or administrative records. This is especially important in emerging countries where labor force histories are far from continuous (workers move frequently between unemployment, formal employment, and informal jobs).

By contrast, Fajnzylber uses the EPS 2002, an administrative records database that contains self-reported labor histories of Chilean pension plan affiliates from 1980 to 2002. In this case, caution arises from evidence that these labor histories may be upward biased, as highlighted in Berstein and Tokman (2005). As long as the bias is gender neutral, results would not change significantly. As a robustness check, using the EPS 2006, where biases have been corrected, may be advisable. In addition, this updated database incorporates pre-1980 data, which makes possible analysis of the transition period.

Issues for (Policy Reform) Discussion

Pure capitalized defined contribution schemes amplify the social and labor inequalities stemming from gender or education. Where should these issues be addressed?

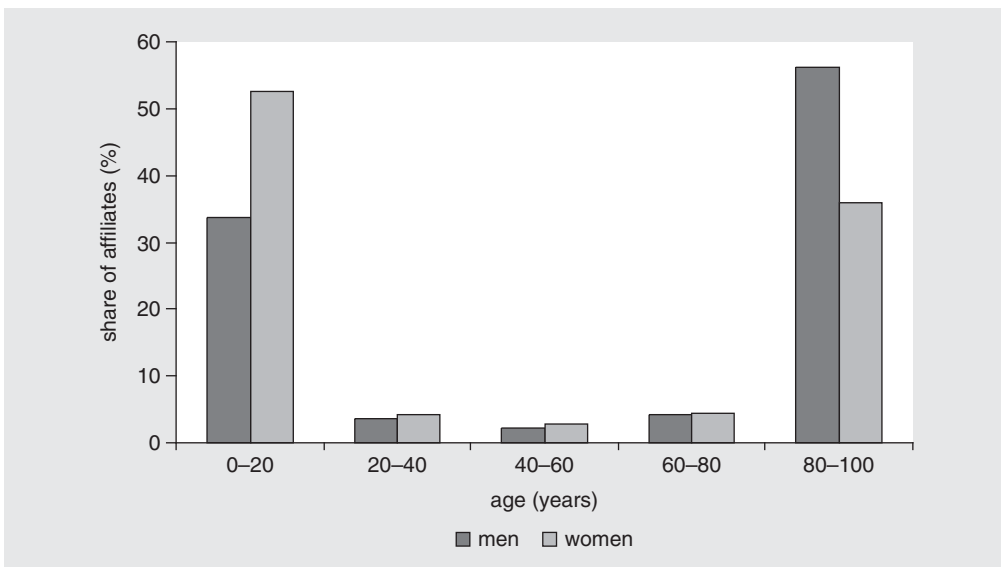
The Chilean system has kept, even after the recent reform, a lower legal retirement age for women (60 years), as in the previous defined benefit pay-as-you-go system. Compared with for example a pension age of 65, a pension age of 60 significantly affects the outcome for individuals in an individual capitalization scheme because, all other things being equal, it means lower capital accumulation and that the amount accumulated to age 60 must be spread out over five more years. The problem is further compounded by demographics (women live about five years longer than men in Chile) and by economic factors (women are paid lower salaries than men on equivalent jobs and have lower density of contributions because of maternity leaves, household work, and likely participation in the informal economy). In fact, according to the

EPS 2006, the average density of contributions for women is 42 percent, which compares to 61 percent for men (see figure 13C.1). This translates to a difference of more than 6 years of contributions. This lower density of contributions among women is explained by higher inactivity (42 percent of working life, compared with 9 percent among men) and fewer formal contracts (38 percent of working life, compared with 61 percent among men).¹

The outcome of these factors is that female replacement ratios are between 10 and 15 percentage points lower than for men, as shown in Vial and Melguizo (2009). In the long term, this situation should encourage women to enter the labor force as well as to make regular contributions to the pension system. But in the short and medium terms, several generations will have very limited funds accumulated to provide for their old age. According to Vial and Melguizo (2009), in the absence of reforms, only 2 of 10 people who needed a pension (because their accumulated savings did not allow financing a pension over the contributory minimum) would have received it, which is especially worrisome among women (see figure 13C.2). Official numbers are even more pessimistic; Berstein, Larraín, and Pino (2005) estimated that only 1 of 10 affiliates who would need pensions would access the contributory solidarity pillar.

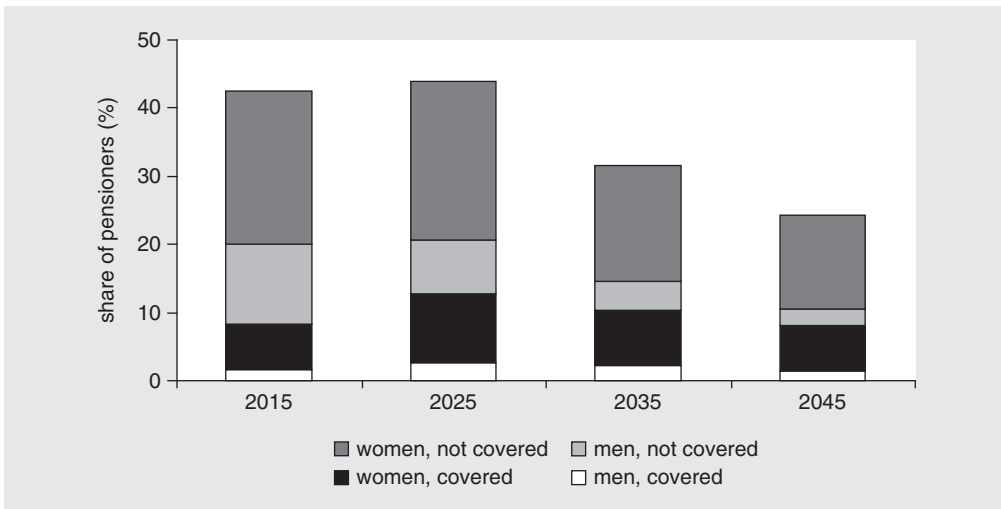
The 2008 pension reform in Chile responded precisely to this challenge by strengthening the solidarity pillar. It established a basic pension funded out of the general revenues of the government budget for those pensioners with incomes in the lowest 60 percent of the population (a majority of them women). This basic pension would not require any contribution to the pension system and would replace the existing contributory and noncontributory pensions.² Additionally, the reform established public contributions in conjunction with maternity. Both measures rightly benefit predominantly women, who

FIGURE 13C.1 **Density of contributions by gender in Chile, 2004–06**



SOURCE: EPS 2006.

FIGURE 13C.2 Projection of contributory minimum pension beneficiaries in Chile with no-reform scenario, 2015–45



SOURCE: Melguizo et al. 2009.

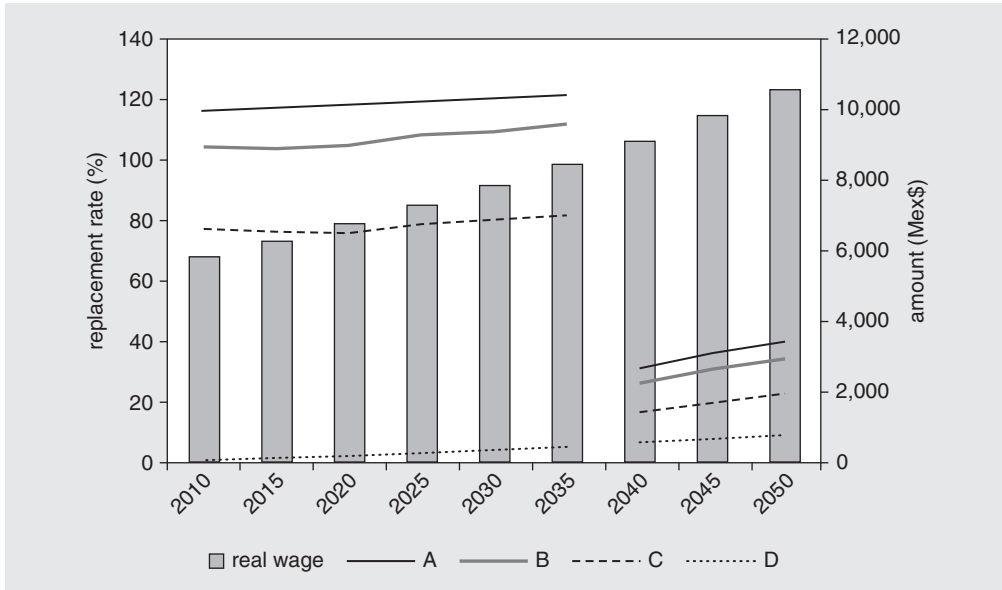
tend to be low-income, low-density affiliates. However, the measures might worsen the incentives to contribute and increase the already significant communication challenge. According to the EPS 2006, only 9 percent of plan affiliates are aware of how their pensions are calculated, and less than 14 percent know their contribution rates, knowledge that is significantly correlated with income and education. The sequence of pension reform matters. Raising the retirement age may also be necessary—but difficult.

If pension systems had a social insurance role, defined contribution pension systems would not be affected by the evolution of the effective age of retirement because affiliates would internalize all the fluctuations. But given the short-sightedness or impatience of affiliates and the existence of solidarity pillars, the establishment of the minimum age at which a pension can be claimed ends up being an issue for policy (as much as it is in defined benefit pension schemes). Can the child bonus in Chile—as well as the child credits—become a “curse in disguise” for increasing women’s retirement age? Fajnzylber’s figures show that the effect of the Chilean reform on pension gaps is three times higher than the effect of raising the minimum retirement age. But this result is explained by the sequence of reforms. If the minimum retirement age had been raised before the rest of the reform measures, its effects would have been much bigger (and the effect of the social pensions much lower). Given the political capital needed for this kind of adjustment, it might have been wise to attempt to raise the retirement age—or at least to equalize the ages for women and men—before considering other gender-related reforms.

On the Political Economy of (Very Long) Transition Periods

Finally, both chapters are silent with respect to an increasingly key issue: the political economy of pension systems during transition periods. By construction, *OECD Pensions*

FIGURE 13C.3 **Replacement rates in Mexico for men by densities of contributions over 10 years of real wages**



SOURCE: Albo et al. 2008.

Note: Densities of contributions are A (96 percent), B (76 percent), C (44 percent), and D (15 percent).

at a Glance cannot address this question, because it simulates the pensions of today's rules in the long run. Fajnzylber did not deal with this issue either, because of data limitations (although by using the 2006 edition of the survey instead of the 2002, one would solve it). However, pension systems are and will be under severe political and social pressures in the decades to come, after the transition is completed, around 2025 in Chile and 2035 in Mexico. In the short run, financial returns are showing unseen levels of volatility, and more important in the long run, in the absence of new reforms, replacement rates will decrease. In the case of Chile, this decrease is basically attributable to the high financial returns in the 1980s, whereas in the case of Mexico, it is because affiliates to the pension system before 1999 can choose whether to retire under the new rules or the very favorable old rules (see figure 13C.3). Obviously, these issues are not gender specific, but their effect is so large that they will probably set the political debate on second-generation reforms in the coming years.

Notes

1. For an analysis of informality and pension coverage in Latin America, see OECD (2010), Da Costa et al. (2011), and the references in these works.
2. See Arenas et al. (2008) and Melguizo et al. (2009) for a prospective analysis.

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NDC versus NDB for Infrequent Contributors

Álvaro Forteza and Ianina Rossi

How would a nonfinancial (notional) defined contribution (NDC) scheme work in a developing country with sparse contribution densities? Could it provide effective social protection? Would it do better or worse than a traditional nonfinancial defined benefit (NDB) scheme? Would an NDC supplemented with minimum pensions or government contributions provide effective social protection in this environment? How much would these complements to a pure NDC cost? These are some of the questions this chapter addresses.

A pure NDC scheme is usually accepted as not being well suited to protect individuals against the risk of poverty in old age, because it does not contain any built-in redistribution of the system's revenues (Barr 2006, Palmer 2006). In contrast, NDB schemes are claimed to be redistributive by nature and thus, in principle, better equipped to alleviate poverty and reduce inequality in old age. In fact, this claim is made categorically, as if it were a general characteristic of NDB schemes that distinguishes them from NDC schemes. Proponents of NDC, however, claim that the redistributive mechanisms of NDB schemes can often be imprecise and even perverse, whereas NDC enables the government to introduce targets and transparent social policy through transfers to the accounts of the groups that the government wants to support (e.g., Palmer 2006). In developing countries, where many workers have highly fragmented histories of contribution, NDC schemes may appear particularly ill suited to provide social protection.

This chapter shows, however, that insufficient coverage and weak social protection can be more serious issues in an NDB scheme than in an NDC scheme if individuals have short contribution histories. A typical pension eligibility condition in NDB schemes is to have completed a sufficiently long period of contributions. In developing countries, many workers—particularly the worse off—do not complete the length of service that is required to access a pension and get very bad deals from these NDB schemes. In contrast, NDC and financial defined contribution (FDC) schemes do not need these eligibility conditions, so workers with sparse contribution histories *do* receive pensions. However, the pensions these workers are entitled to will be small indeed and will probably need to be complemented by minimum pensions, pension subsidies, or other provisions to alleviate poverty, but at least the basic design of the system does not compound the poverty problem.

This chapter provides a real-world example of the type of issues that arise when contribution histories are short and compares the working of the existing two-tier NDB-FDC

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scheme in Uruguay with a two-tier NDC-FDC scheme. It computes the pension rights of a simulated cohort of contributors to the main pension program of Uruguay using both the existing rules and hypothetical NDC-FDC system. Since 1996, the Uruguan social security program has been mixed; with a first NDB pay-as-you-go (PAYG) pillar and a second mandatory individual financial account pillar. Using work history records from the existing system, the analysis in this chapter computes contribution patterns and simulates pension rights of the 1995 cohort, assuming the participation patterns remain unchanged. The distribution of pension rights is characterized, and the cost of providing pensions with the two schemes is computed with the current NDB-FDC and a simulated NDC-FDC scheme. Besides the pure NDC-FDC scheme, the chapter also simulates NDC-FDC schemes supplemented with minimum pensions and government contributions to the notional accounts.

The next section presents a brief description of the pension program analyzed in this chapter. The projection of pension rights is based on econometric models estimated with a sample of the social security work history records. This database and the econometric models are described in the sections that follow. Then the simulations of pension rights for the cohort of private sector workers who were born in 1995 are discussed. The simulated pension rights with the NDB-FDC and the NDC-FDC schemes are presented and compared. The chapter provides an estimation of the relative costs of these two programs. Then simulations are performed of NDC-FDC schemes supplemented with (a) minimum pensions and (b) government contributions for specific distributional rights. The final section discusses the implications of the results in the context of actuarial fairness and social protection of short contribution histories. The chapter ends with a few concluding remarks.

The BPS Pension Program

The Banco de Previsión Social (Social Insurance Bank, or BPS) is the public institution that administers Uruguay's largest social security program. The program covers about 90 percent of social security contributors in the country (Ferreira-Coimbra and Forteza 2004). It covers four types of workers: civil servants, private workers (except for some categories that have their own separate schemes), and rural and domestic workers.

Since 1996, the BPS retirement programs have been based on two pillars: (a) a public, defined benefits (NDB), PAYG pillar, which is financed with employers' and employees' payroll contributions¹ and transfers from the central government, and (b) an individual savings account pillar financed by employees' payroll contributions and administered by private firms. Also, in connection with the 1996 reform, the BPS began to keep records of contributions, which is leading to a gradual improvement in individual contribution records. Low-income workers are exclusively affiliated with the public pillar unless they choose to deposit half their personal contributions into an individual savings account. Other workers must contribute to both pillars up to a ceiling above which contributions are not mandatory.

The minimum retirement age is 60 years for both men and women, and the minimum number of years of contribution required to access an ordinary pension is 30.² Workers with hazardous occupations and other special categories have a bonus that takes the form of additional years added to the number of years of contributions and age.

The replacement rate varies from 45.0 to 82.5 percent, depending on the retirement age chosen by the individual and years of contribution. The rules are intended to induce longer working lives. Low-income workers who choose to contribute to individual financial accounts receive an extra bonus. The average wage for the individual used in the benefit formula is related to the last 10 or the best 20 years of contributions.

Workers who are not eligible for an ordinary pension may be eligible for an advanced-age pension. Until 2008, workers could claim an advanced-age pension at 70 years of age if they had at least 15 years of contributions, but these conditions were softened in 2008. Currently, a contributor can access this program at 65 if he or she has 25 years of contributions; for every 2 years of contribution less than 25, the access to benefits is delayed 1 year.³ Also, since 2001, workers who are 65 years of age or older can stop contributing to the financial account pillar and claim an annuity, regardless of their years of contribution.

Data

The analysis in this study is based on a random sample of the work history records collected by the BPS Unidad de Historia Laboral (Labor History Unit), available in December 2004.⁴ Workers in the sample contributed during at least one month between April 1996 and December 2004. The sample comprised 68,997 individuals.

The database provides information about monthly contributions to social security, gender, age, and sector of activity. Unfortunately, a survey of socioeconomic characteristics of contributors to social security is not yet available for Uruguay. Therefore, some important socioeconomic characteristics, such as education and family attributes, are lacking. However, the availability of a longitudinal sample with many observations allows estimation of the effect of time-invariant characteristics in a parsimonious way.

The average density of contributions is about 60 percent (table 14.1). The distribution of the density of contributions has two modes and is strongly asymmetric (figure 14.1). A similar pattern has been reported in Argentina (Bertranou and Sánchez 2003; Farall et al. 2003), Chile (Berstein, Larraín, and Pino 2006; Bravo et al. 2006), and Uruguay (Lagomarsino and Lanzilotta 2004; Forteza et al. 2009; Bucheli, Forteza, and Rossi 2010). In the sample, 26 percent of the workers have a full contribution density, which was the most frequent density of contributions in the database. More than 40 percent do not register contributions for at least half the potential months of contribution. Men have slightly higher densities of contribution than do women (59.6 and 57.0 percent, respectively).

As expected, public sector workers have significantly higher densities of contribution than do private sector workers.⁵ Whereas public workers contributed about 80 percent of the time, private sector workers contributed about 55 percent of the time. Contributions spanning the entire period ranged from 60 percent for public employees to less than 20 percent for private employees. A considerable number of individuals classified as public employees nevertheless present low densities of contribution, partly because workers classified as public employees may actually spend as much as half of their working life as private employees. In addition, public employees working in activities with bonuses (teachers, workers handling radioactive products, etc.) require less than 30 years of contribution and 60 years of age to claim a pension. Grouping the individuals in the sample in quintiles of

TABLE 14.1 **BPS contribution densities**

Characteristics	Mean	Median	Percentage of months contributed (d)				
			$d < 25\%$	$25\% \leq d < 50\%$	$50\% \leq d < 75\%$	$75\% \leq d < 100\%$	$d = 100\%$
Total	58.4	61.0	26.6	16.6	15.0	16.1	25.6
<i>Gender</i>							
Men	59.6	63.0	24.9	16.9	15.4	16.9	25.9
Women	57.0	58.1	28.6	16.3	14.6	15.2	25.3
<i>Sector</i>							
Public	79.7	100.0	11.8	8.0	9.8	11.5	59.0
Private	54.6	53.3	29.2	18.2	16.0	17.0	19.6
<i>Income bracket</i>							
Poorest quintile	43.5	32.4	44.4	17.1	11.9	10.8	15.8
2nd quintile	56.1	55.2	27.3	19.1	16.0	15.8	21.8
3rd quintile	60.3	62.9	21.8	19.2	17.4	17.2	24.4
4th quintile	63.9	70.5	19.2	16.6	17.4	20.1	26.8
Richest quintile	68.4	85.7	20.1	11.2	12.4	16.8	39.5
<i>Age (years)</i>							
20	37.8	16.7	51.8	10.4	7.9	6.6	23.3
35	66.3	100.0	29.1	4.4	3.8	3.9	58.9
50	71.6	100.0	24.7	3.2	3.2	3.1	65.8

SOURCE: Forteza et al. 2009.

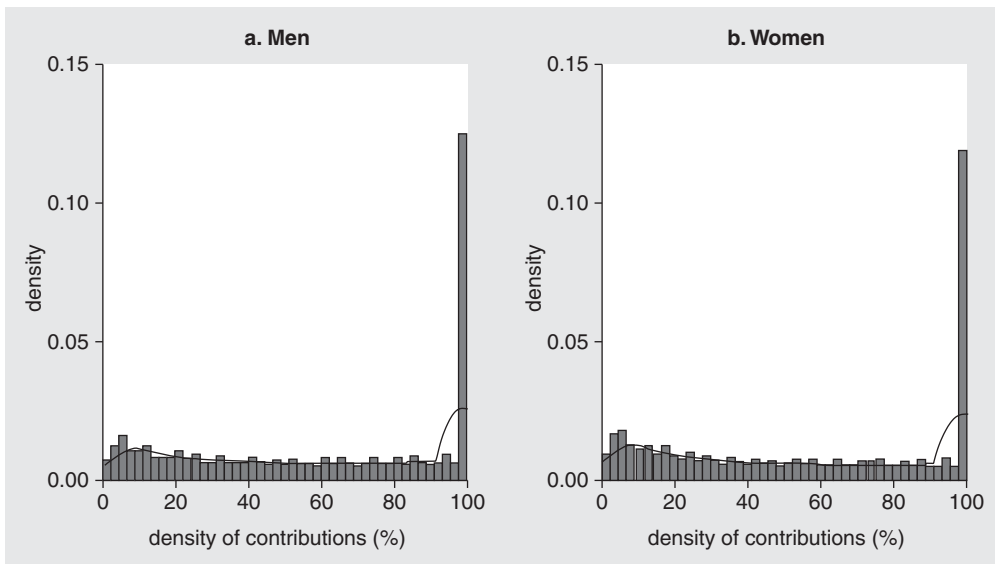
NOTE: The sample window is 105 months. Each income bracket includes the minimum of the interval.

the earnings distribution shows that the average density of contribution consistently rises with the quintile of the distribution: it is almost 44 percent for the quintile with the lowest income and more than 68 percent for the quintile with the highest income.

Significant differences also occur according to age. At 20 years of age, the density of contribution is approximately 49 percent on average, and it continuously increases with age, exceeding 71 percent when workers are in their 50s. However, there is also a substantial dispersion from low to high income among individuals of each age.

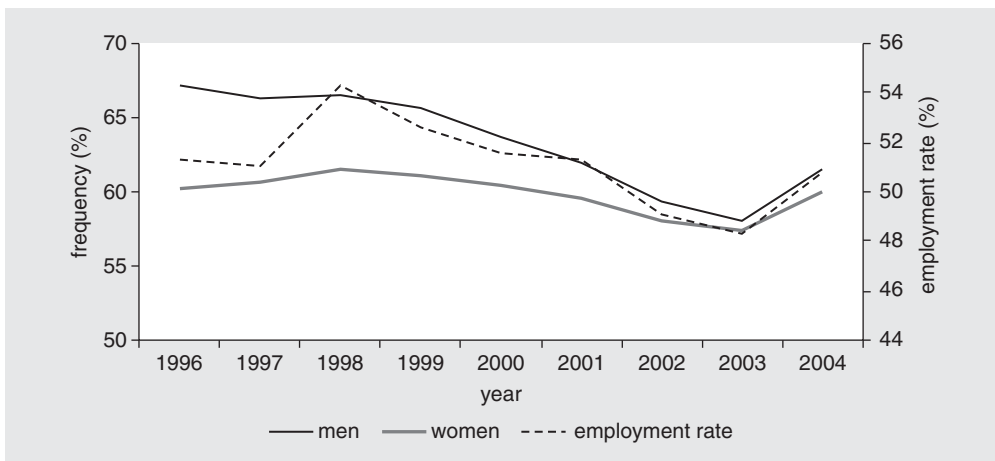
The business cycle affects the density of contributions significantly. Uruguay entered a recession in 1999, followed by the most severe economic crisis in its history. The recovery began slowly in 2003 and accelerated into significant growth by 2004. The unemployment and employment rates observed between 1996 and 2004 capture this period of significant macroeconomic volatility, and the density of contributions mirrored the rate of employment (figure 14.2).

FIGURE 14.1 **Distribution of the density of contributions in Uruguay, April 1996–December 2004**



SOURCE: Forteza et al. 2009.

FIGURE 14.2 **Density of contributions to BPS and rate of employment**



SOURCE: Authors' calculations based on work history records and Instituto Nacional de Estadística.

Tables 14.2 and 14.3 summarize the information about the duration of the spells of contributions and no contributions. On average, the spells of contributions last 33 months, and the spells with no contributions last 20 months. Notice that 105 months is the maximum duration that can be observed in this sample, which is the length of the observation window (April 1996 to December 2004). Women have longer spells of

TABLE 14.2 **Duration of spells of contribution in BPS sample**

Characteristics	Mean	Median	Percentage of spells in sample by duration				
			< 6 months	6–12 months	12–24 months	24–36 months	> 36 months
Total	33.2	13	31.5	15.3	13.0	6.8	32.8
<i>Gender</i>							
Men	31.4	12	33.5	15.7	13.0	6.5	30.7
Women	35.7	16	28.6	14.7	13.0	7.2	35.8
<i>Sector</i>							
Public	67.8	96	11.7	7.6	7.0	3.4	67.9
Private	29.1	11	33.8	16.2	13.7	7.2	28.7
<i>Income bracket</i>							
Poorest quintile	24.4	8	42.6	15.8	12.1	5.8	23.2
2nd quintile	30.4	13	30.7	17.0	14.8	7.8	29.2
3rd quintile	31.8	14	28.9	17.1	14.9	7.4	31.2
4th quintile	35.3	17	27.2	15.3	13.7	7.5	35.6
Richest quintile	46.8	30	27.4	10.1	8.6	4.9	47.9

SOURCE: Forteza et al. 2009.

NOTE: The sample window is 105 months. Only spells within the observation window were computed. Each income bracket includes the minimum of the interval.

contributions on average than men, but they also have longer spells without contributions. Therefore, men seem to have a higher rate of turnover between jobs (shorter duration of unemployment) than do women. Public sector workers have much longer contribution spells and shorter spells with no contributions than do private sector workers.

The distribution of the duration of contribution payments is skewed to the right. The median duration of contribution payments is 13 months, whereas the mean is 33. The median duration for no contributions is 10 months, whereas the mean is 20. About one-third of all spells of both contributions and no contributions lasted less than six months.

Modeling the Dynamics of Cohort Contributions

MODELING INDIVIDUAL INCOME STATUS

For the simulations, the pension entitlements for the cohort born in 1995 are computed using the profiles derived from the existing database for contribution, applied to the current NDB-FDC social security program and a reformed program that substitutes an NDC scheme for the current NDB component of the pension system. The simulations are based on econometric models estimated using the sample from the BPS work history

TABLE 14.3 Duration of spells with no contributions in BPS sample

Characteristics	Mean	Median	Percentage of spells in sample by duration				
			< 6 months	6–12 months	12–24 months	24–36 months	> 36 months
Total	20.2	10	33.7	21.4	15.7	9.2	20.3
<i>Gender</i>							
Men	18.4	9	36.4	21.7	15.9	8.8	17.6
Women	22.9	11	29.8	20.9	15.5	9.8	24.4
<i>Sector</i>							
Public	16.5	7	44.9	20.5	12.8	8.0	15.1
Private	20.4	10	33.1	21.5	15.9	9.2	20.6
<i>Income bracket</i>							
Poorest quintile	25.0	13	29.1	18.2	15.7	9.9	27.5
2nd quintile	20.1	10	34.2	20.0	16.5	9.3	20.2
3rd quintile	18.1	9	36.1	21.6	16.1	9.2	17.3
4th quintile	17.5	8	36.8	23.2	15.3	8.7	16.4
Richest quintile	19.5	9	32.5	26.2	14.4	8.5	19.2

SOURCE: Forteza et al. 2009.

NOTE: The sample window is 105 months. Only spells within the observation window were computed. Each income bracket includes the minimum of the interval.

records for the period 1996–2004 (Forteza et al. 2009). The model used to compare the two alternative pension regimes in the present context simulates the paths of labor income and contributions, assuming that the patterns of participation, the distribution of income within the cohort, and associated contributions remain unchanged in the future. Hence, possible behavioral responses associated with the NDC scheme are not captured.

PROJECTING LABOR INCOME

The model comprises two wage equations. Wages in the first month of a contribution spell are modeled with a static equation. Wages in the second and following months of the spell of contributions are assumed to be governed by the following stochastic process:

$$\ln w_{it} = \rho \ln w_{it-1} + \beta_1 \ln dur_{it} + \beta_2 a_{it} + \beta_3 a_{it}^2 + \delta_t + v_i + e_{it}. \quad (14.1)$$

where w_{it} is the ratio of the nominal wage of individual i at period t with respect to the nominal wage index of the economy at period t ; dur_{it} is the tenure in the current spell; a_{it} is the age; δ_t are month dummies; and v_i is a time-invariant unobservable characteristic of individual i . The idiosyncratic shock e_{it} is assumed to be normally distributed with mean 0

and variance σ_i^2 . As long as one expects w_{it} to be stationary, no deterministic time trend is introduced in the equation. The education level of the individuals is not observed. Therefore, the term v_i will capture, at least in part, the cross-section heterogeneity that comes from education jointly with other time-invariant unobservable characteristics such as ability. Because long panels are available, the individual effects (v_i) and the variance of the idiosyncratic shock can be computed.

The wage in the initial month of a contribution spell is modeled as follows:⁶

$$\ln b_i = \alpha_1 + \alpha_2 a_i + \alpha_3 a_i^2 + \alpha_4 \hat{v}_i + \varepsilon_i, \quad (14.2)$$

where b_i is the average of the nominal wage of individual i in the first 12 months of the contribution spell divided by the nominal wage index in the same period, a_i is the age, and \hat{v}_i is the individual effect estimated with equation 14.1. The index t is omitted to highlight the fact that here a pooled cross section is being used. The estimated model is static in nature. The ordinary least squares (OLS) estimator was used with the White formula to obtain the standard errors.⁷ The individual effect is meant to capture the unobserved education level and the ability of the individual.

THE ESTIMATED MODELS

The results of the estimations are presented in table 14.4. The persistence coefficient (ρ) is significant and positive for the four categories. The estimated coefficients are slightly greater for women than for men within each sector (private and public). In turn, the coefficients for the private sector are approximately 20 percent greater than those for the public sector.

Tenure is also significant and positive for three groups: men working in the private sector and men and women working in the public sector. However, it is significant but negative for women working in the private sector. This result is counterintuitive, but the magnitude of the coefficient is very small. Notice also that the effect of tenure appears to be stronger for men than for women working in the public sector and well above the effect for men working in the private sector. The latter results are in line with what one would expect, because pay for tenure is one of the deterministic rules used to set wages in the public sector but not in the private sector.

The coefficients of *age* and *age*² are both significant and have the expected sign in all categories. The estimated polynomials for men and women in the public sector are very similar. Moreover, the effect of *age* (after controlling for tenure) is higher in the public sector, which is in line with the expected behavior.

The coefficients of the month dummies (not reported in table 14.4) capture the seasonality of the series in a flexible manner and behave as expected. In particular, those of June and December capture the fact that in these months employees receive a seasonal bonus that attains approximately half their monthly wage. Obviously, the wage indexes smooth this effect, and thus the month dummies appear significant, positive, and with a coefficient very close to 0.50 in all categories.

The *R*-squared of the within-group estimator is between 0.37 and 0.52. The *R*-squared of regressing the observed on the predicted wage ratio is 0.88, 0.93, 0.86, and 0.85 for men and women in the private sector and men and women in the public sector, respectively.

TABLE 14.4 Estimation of labor income

a. Equation 14.1: $\ln w_{it} = \rho \ln w_{it-1} + \beta_1 \ln dur_{it} + \beta_2 a_{it} + \beta_3 a_{it}^2 + \delta_t + v_i + e_{it}$

Independent variables	Men		Women	
	Private sector	Public sector	Private sector	Public sector
$\ln w_{it-1}$	0.652***	0.511***	0.686***	0.563***
Log of duration	1.060***	6.313***	-0.116**	5.211***
Age	0.093***	0.155***	0.044***	0.130***
Age ²	-0.016***	-0.016***	-0.006***	-0.013***
Constant	0.787***	1.116***	0.635***	0.877***
Number of observations	1,572,014	391,141	1,164,871	416,175
Number of individuals	31,693	4,977	24,883	5,212
R-squared	0.48	0.37	0.52	0.41
Standard deviation of v_i	0.38	0.35	0.41	0.28
Standard deviation of e_{it}	0.32	0.28	0.29	0.28

b. Equation 14.2: $\ln b_i = \alpha_1 + \alpha_2 a_i + \alpha_3 a_i^2 + \alpha_4 \hat{v}_i + \varepsilon_i$

Independent variables	Men		Women	
	Private sector	Public sector	Private sector	Public sector
v	1.214***	1.571***	1.324***	1.577***
Age	0.304***	0.386***	0.110***	0.409***
Age ²	-0.042***	-0.041**	-0.016***	-0.044***
Constant	2.320***	2.440***	2.368***	2.217***
Number of observations	34,986	1,105	24,209	1,799
R-squared	0.24	0.37	0.32	0.29

SOURCE: Forteza et al. 2009.

NOTE: In panel a, w_{it} is the ratio of the nominal wage of individual i at period t with respect to the nominal wage index of the economy at period t . Duration is divided by 100. Age is measured in years and is divided by 10. Age² is divided by 100. Monthly dummies were included.

In panel b, b_i is the average of the nominal wage of individual i at period t relative to the average wage index of the economy in the first 12 months of the contribution spell. Age is measured in years and is divided by 10. Age² is divided by 100. v is the individual effect computed in equation 14.1.

* significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

Table 14.4 also summarizes the results of the estimation of the initial wage of a contribution spell. The coefficient associated with the estimated individual effects was significant and positive in all categories (see panel b), and the R -squared of the regressions is between 0.24 and 0.37. Also, the variables age and age^2 are significant and have the expected sign (positive and negative, respectively) for all categories.

PROJECTION OF CONTRIBUTION STATUS

A simple approach to estimating the probability of making contributions that directly exploits, for prediction purposes, the longitudinal nature of the data is to fit a fixed-effect linear probability model. The main advantage of this type of model is that it allows the use of estimated individual fixed effects to make predictions for the entire lifetime. This ability is particularly relevant if the data do not allow the inclusion of sufficiently rich control variables.

The dependent variable is equal to one if the individual makes a contribution during a particular month and zero otherwise ($Contributes_{it} \in \{0,1\}$). A model with an autoregressive error term is used to capture the persistence of contribution spells. The model is as follows:

$$Contributes_{it} = x'_{it} \beta + \eta_i + \theta_{it} = x'_{it} \beta + \zeta_{it}, \quad t \geq 1. \quad (14.3)$$

$$\theta_{it} = \rho \theta_{it-1} + \varepsilon_{it}, \quad t \geq 1. \quad (14.4)$$

The β coefficient in equation 14.3 can be estimated consistently using OLS if the regressors in x_{it} are exogenous; otherwise, the within-groups estimator may be used. The individual effects can be computed as $\hat{\eta}_i = \sum_{t=1}^{T_i} \hat{\zeta}_{it} / T_i$, where $\hat{\zeta}_{it}$ is the estimated residual of the first equation. Subtracting the individual effects from the residual of the first equation, one computes the θ_{it} , which is then used to estimate ρ and later to simulate the work histories.

The contribution status of workers was simulated across their lifetime up to 70 years of age. The simulations are thus conditional on the individual's not retiring or dying before 70. For each group of workers, the first age at which workers start contributing is determined in the database and then used as the starting point in the simulations. The contribution status of each worker is then set in each of the following periods, using the estimated regressions to simulate the probability of contributing. More specifically, the model simulates the probability of contributing ($\tilde{P}_{it} = \Pr(Contributes_{it} = 1|X)$), draws realizations from a uniform (0,1) distribution ($draw_{it}$), and sets C_{it} as $\tilde{C}_{it} = 1$ if $draw_{it} < \tilde{P}_{it}$ and 0 otherwise. In turn, the simulated probability of contributing is computed as

$$\begin{aligned} \tilde{p}_{it} &= X'_{it} \hat{\beta} + \hat{\eta}_i + \tilde{\theta}_{it}, \\ \tilde{\theta}_{it} &= \hat{\rho} \tilde{\theta}_{it-1} = \hat{\rho} (\tilde{C}_{it-1} - X'_{it-1} \hat{\beta} - \hat{\eta}_i). \end{aligned} \quad (14.5)$$

The percentage of correct predictions in the sample is computed to assess how well the models fit.

The estimated linear probability model is summarized in table 14.5. The explanatory variables include a polynomial of degree three in age, a dummy "elderly" for individuals 60 years of age and older, and the rate of unemployment. The individual effects computed in the wage equations and dummies for ages 14 through 17 for some categories of workers were also included, and different regressions were run for workers age 18 years and younger and workers age 19 years and older.

TABLE 14.5 **The contribution status**a. Equation 14.3: $Contributes_{it} = x_{it}'\beta + \eta_i + \theta_{it} = x_{it}'\beta + \zeta_{it}$, $t \geq 1$

Independent variables	Private sector		Public sector	
	≤ 18 years	≥ 19 years	≤ 18 years	≥ 19 years
<i>Men</i>				
Age	0.280***	0.005***	-4.284	0.011***
Age ²	-1.515***	-0.008***	19.596	-0.017***
Age ³	0.274***	0.000***	-2.983	0.001***
D14	-0.051***			
D15	-0.045***			
D16	-0.031***			
D17	-0.040***		0.007	
Elderly		-0.038***		-0.021***
Unemployment	-0.005***	-0.013***	0.010***	-0.001***
v	0.016***	0.279***	0.014	0.147***
Constant	-17.210***	-0.169***	311.541	-1.322***
Number of observations	265,407	2,884,624	3,153	459,540
R-squared	0.09	0.08	0.02	0.14
<i>Women</i>				
Age	0.532***	0.006***	-2.109	0.019***
Age ²	-2.748***	-0.010***	9.505	-0.034***
Age ³	0.473***	0.001***	-1.424	0.002***
D14				
D15	-0.023***			
D16	-0.017***			
D17	-0.016***		0.003	
Elderly		-0.086***		-0.121***
Unemployment	-0.001***	-0.010***	0.013***	0.002***
v	0.012***	0.268***	0.011	0.176***
Constant	-34.381***	-0.399***	155.434	-2.641***
Number of observations	162,337	2,321,848	6,339	500,437
Adjusted R-squared	0.06	0.09	0.02	0.22

(continued next page)

TABLE 14.5 **The contribution status (continued)**b. Equation 14.4: $\theta_t = \rho\theta_{t-1} + \varepsilon_t$, $t \geq 1$

Independent variables	Private sector		Public sector	
	≤ 18 years	≥ 19 years	≤ 18 years	≥ 19 years
<i>Men</i>				
θ_{t-1}	0.804***	0.863***	0.760***	0.906***
Constant	-0.000	-0.001***	0.001	-0.001***
Number of observations	258,512	2,859,826	2,981	454,735
R-squared	0.62	0.74	0.54	0.82
<i>Women</i>				
θ_{t-1}	0.803***	0.893***	0.789***	0.895***
Constant	0.000	-0.000***	0.001	-0.001***
Number of observations	157,334	2,301,968	5,991	495,573
R-squared	0.60	0.80	0.61	0.80

SOURCE: Forteza et al. 2009.

NOTE: In panel a, Age is measured in months. Age² is divided by 1,000, and Age³ is divided by 100,000. D14–D17 are dummies for ages 14–17. Elderly is a dummy equal to one if the individual is 60 years or older. Unemployment is the country's unemployment rate. ν is the individual effect computed in the wage equation (see equation 14.1).

* significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

The explanatory variables were significant at a 1 percent level in most regressions. The unemployment rate has the expected negative impact on the probability of contributing.⁸ The individual effect computed from the wage equation (ν) is meant to capture characteristics of individuals that affect wages and that could not be observed in these estimations, such as education and ability. This effect turned out to be highly significant and positive. The error terms in the contribution status equations show considerable persistence: the estimated coefficients of the lagged errors lie between 0.76 and 0.90 and are significant at the 1 percent level in all cases, as shown in panel b of table 14.5. These results indicate that the probability that a worker contributes is substantially higher if he or she contributed the previous month than otherwise.

The linear probability model fits the data reasonably well: the percentage of correct predictions is in all cases 65 percent or more (table 14.6).

Simulations of Pension Rights

Using the models described in the previous section, Monte Carlo simulations were run and lifetime income streams computed for a hypothetical cohort of private workers who were born in 1995. These simulations are designed to represent the pension program in the long run, assuming the 1995 cohort will behave the same and have the same opportunities to contribute to the program as the cohorts that were observed in the work history

TABLE 14.6 **Goodness of fit of the contribution status model**

Subsample	Percentage of correct predictions	
	$\tilde{C}_{it} = 0$	$\tilde{C}_{it} = 1$
Men, private sector	74.0	80.7
Men, public sector	67.2	95.8
Women, private sector	75.7	78.7
Women, public sector	65.0	95.0

SOURCE: Forteza et al. 2009.

the existing pension rules as of 2009. For the hypothetical NDC tier that is compared with the existing NDB tier, a pure NDC structure was chosen (see Palmer 2006 and chapter 19 of this volume). To allow for comparison of the NDB and NDC schemes, the same contribution rate is selected (22.5 percent). These contributions are accumulated in individual accounts until the selected retirement age and earn annually a notional rate of return equivalent to the real wage growth: 1.5 percent (see annex 14A.1). At the retirement age, the accumulated notional capital is divided by the remaining life expectancy at retirement to deliver the initial benefit. It is assumed that after retirement, benefits under both the NDB and the NDC schemes are indexed with the same indicator (nominal wage index).

The next subsection presents results for a pure NDC plan, without minimum pensions or other forms of redistribution. The distribution of pension rights with the NDC-FDC system is compared with the existing NDB-FDC system. The existing NDB-FDC design turns out to be less expensive than the simulated NDC-FDC system. So that the comparison could be made on equal ground, an expanded NDB-FDC was also simulated that costs as much as the NDC-FDC. This version of the NDB-FDC combination is then compared in the following subsections with, first, a pure NDC-FDC combination; second, the NDC-FDC combination complemented with a minimum pension guarantee; and, finally, the NDC-FDC combination complemented with social contributions. In all cases, the current individual savings account tier was left unchanged.

Norms regarding pension entitlements are assumed to be fully enforced when the 1995 cohort claims pensions, something that currently does not happen. Because of the lack of complete work history records, the administration of social security has to rely on informal proofs of contributions, such as the testimony of witnesses, to compute current pension rights. Therefore, the proportion of contributors who currently access pensions is much higher than what these simulations suggest would be the case had the vesting period conditions been fully enforced. In other words, current benefits (and costs) are higher than what contribution records would support.

PENSION RIGHTS UNDER THE CURRENT NDB-FDC SYSTEM AND THE ALTERNATIVE NDC-FDC SYSTEMS

A key condition for accessing pension rights under the NDB scheme is to have accumulated a minimum number of years of service. Hence, it is useful to begin the analysis of pension

records database between 1996 and 2004 (except for the unemployment rate, which was unusually high in that period and therefore set to a more normal level for the simulations).⁹

With this quantity and wage structure and with assumptions about real wage growth and inflation, pension rights are computed for the NDB scheme on the basis of

rights under the current regime by looking at the proportion of the 1995 cohort that would accumulate at least 15 to 35 years of contributions at 65 years of age (table 14.7).

According to these simulations, a significant percentage of the population cannot be expected to reach 30 or even 25 contribution years at 65 years of age. The required number of years of contribution to access an ordinary pension was set at 35 in the 1995 reform and reduced to 30 in 2008 because of evidence to this effect. But as these simulations show, the loosening of this condition to 30 years will rescue only a few workers unless work histories change significantly compared to what has been seen in the past.

Table 14.8 summarizes the simulated pension rights of Uruguayan private sector workers under the NDB-FDC and the NDC-NDB systems. Under the current NDB-FDC rules, about half of private sector workers would not be eligible for pensions at the first eligibility age (i.e., at 60), because they would not have accumulated the required 30 years of contribution at that age. This percentage is higher for women than for men. At 65, most workers would be eligible for pensions, but about one-third of men and two-fifths of women would receive less than a minimum pension. These workers would get an annuity from their individual account only. They would not be eligible for an NDB pension because they would

TABLE 14.7 **Proportion of private sector workers who accumulate at least 15 to 35 years of contribution at age 65 in the simulation**

Age (years)	Men	Women
At least 15	0.79	0.73
At least 20	0.72	0.65
At least 25	0.65	0.56
At least 30	0.57	0.49
At least 35	0.50	0.42

SOURCE: Authors' calculations.

TABLE 14.8 **Distribution of simulated pension rights among private sector workers**

Category	NDB-FDC				NDC-FDC (without minimum pension)			
	Pension rights at 60 (%)		Pension rights at 65 (%)		Pension rights at 60 (%)		Pension rights at 65 (%)	
	Men	Women	Men	Women	Men	Women	Men	Women
No pension	49	57	0	1	0	1	0	1
A pension lower than minimum pension	0	0	34	42	38	53	30	46
A minimum pension	0	0	0	0	0	0	0	0
More than one and less than two minimum pensions	24	25	8	12	25	22	24	20
Two or more minimum pensions	28	18	58	46	37	24	46	33
Replacement rate (median)	48	0	99	71	83	59	124	84

SOURCE: Authors' calculations.

NOTE: The minimum pension varies with retirement age. In this table, a fixed minimum pension was chosen, equivalent to 75 percent of Ur\$550 in May 1995 actualized by the average wage index (i.e., the minimum pension that a contributor to both pillars would receive if he or she retired at the minimum pension age).

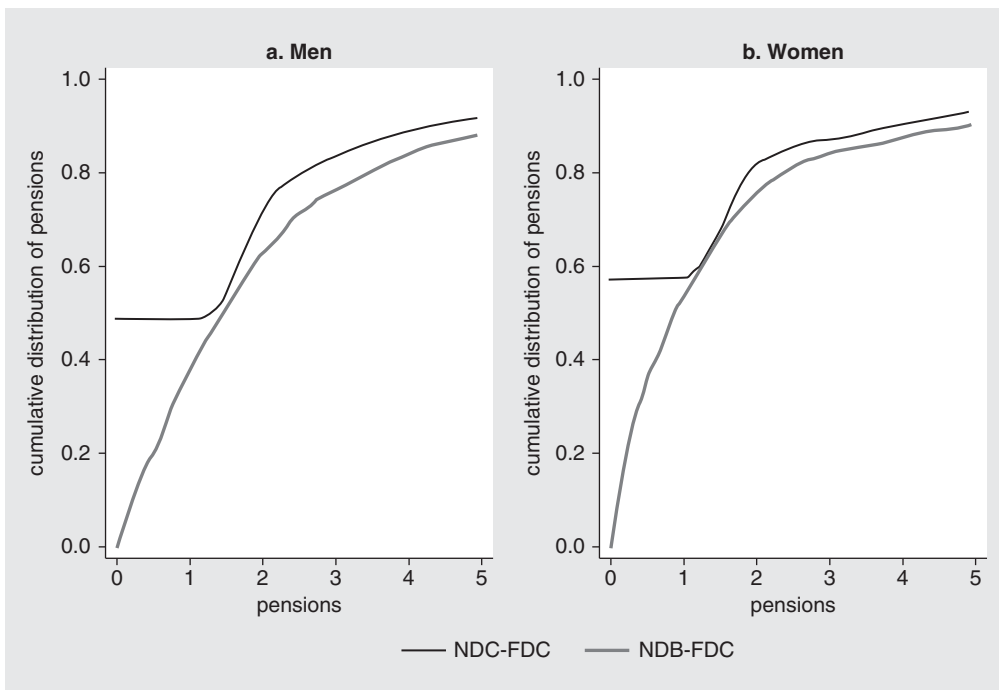
not have accumulated the 25 years of service that are required to access a NDB pension at 65. Thus, they would not access a minimum pension either.

No one in the NDB-FDC scheme would receive exactly the minimum pension because the minimum operates only on the PAYG defined benefit (PAYG-NDB) pillar and all workers in these simulations also contribute to the financial account scheme. Therefore, all workers who are entitled to a public pension receive at least the minimum from the PAYG-NDB pillar plus an FDC annuity.

With the NDC-FDC scheme, almost all workers in this simulation would be eligible for pensions at the first eligibility age (60), but about 38 percent of men and 53 percent of women would get less than the minimum pension at this age. The proportion of workers who would receive less than a minimum pension would be lower at age 65 than at age 60, but it would still be as high as 30 and 46 percent for men and women, respectively.

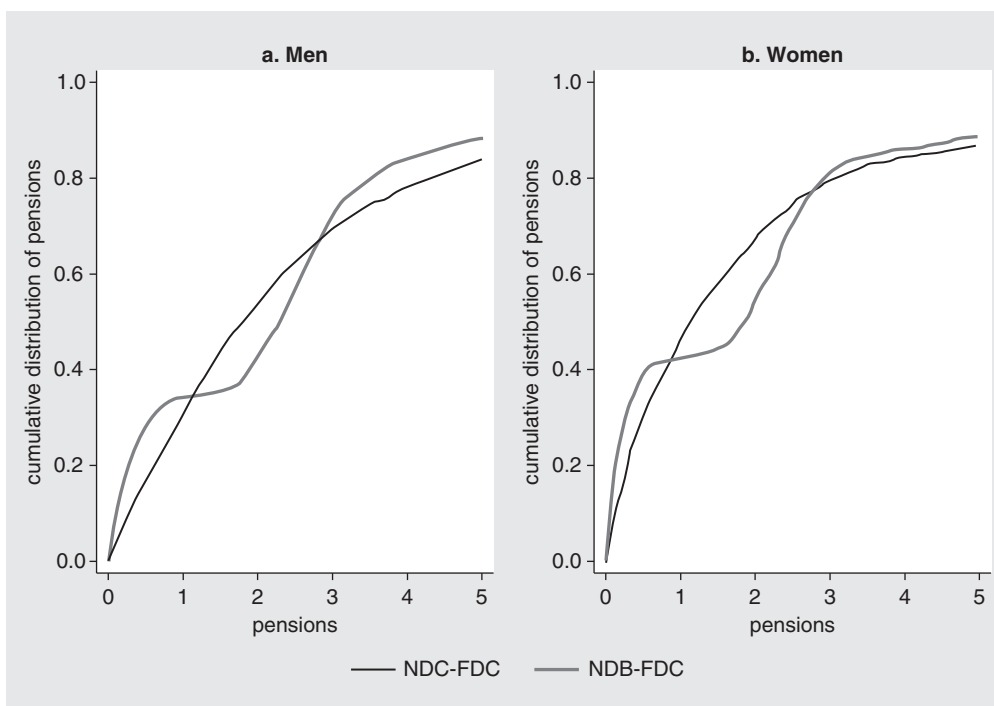
The empirical cumulative distribution functions of pensions (expressed in terms of number of minimum pensions) are presented in figures 14.3 and 14.4. At age 60, the NDC-FDC scheme dominates the NDB-FDC scheme, in the sense that the proportion of the population receiving less than a given threshold is higher in the NDB-FDC scheme than in the NDC-FDC scheme for all relevant thresholds.¹⁰ The distance between the two curves is particularly large at the lower tail because of the large number of workers who are not eligible for pensions in the NDB-FDC scheme at age 60. In contrast, in the NDC-FDC scheme, no one ends up empty-handed because no eligibility conditions apply apart from age.

FIGURE 14.3 Distribution of pension rights at 60 years of age (cumulative distribution functions)



SOURCE: Authors' computations based on work history records.

NOTE: Pensions (p) are expressed as the ratio of individual pensions to the minimum pension.

FIGURE 14.4 **Distribution of pension rights at 65 years of age (cumulative distribution functions)**

SOURCE: Authors' computations based on work history records.

NOTE: Pensions (p) are expressed as the ratio of individual pensions to the minimum pension.

The picture is quite different at 65 years of age (figure 14.4). The NDC-FDC system no longer dominates the NDB-FDC plan, but the proportion of workers receiving very low pensions is still smaller in the NDC-FDC than in the NDB-FDC plan. The main difference between pension rights at age 60 and those at age 65 occurs with the existing NDB-FDC plan: workers who are not eligible for pensions at age 60 can claim an annuity from the FDC pillar at age 65. Individuals are required to have contributed no less than 30 years to claim a pension at 60 years of age. But at age 65, they can claim the FDC annuity no matter how many years they have contributed. Had it not been for the FDC annuity, the picture would have not been very different at age 65 from what it is at age 60.

In summary, the simulated NDC-FDC scheme provides better protection against poverty in old age than the NDB-FDC scheme, despite the latter having a minimum pension provision that the former does not have. In the Uruguayan NDB-FDC scheme, the effectiveness of the minimum pension is undermined by the years-of-service requirement that is attached to it: low-income workers need the minimum pension but have little chance of fulfilling the years-of-service condition.¹¹ In fact, at the first eligibility age, workers are not eligible for any pension if they have not contributed for at least 30 years.¹² The NDC-FDC system considered in these simulations does not have a years-of-contribution condition; hence, workers can claim a pension as soon as they turn 60.

Contributions are the same for the two alternative systems, but expenditures are not. Total expenditures would be 41 percent more with the NDC-FDC scheme than with the NDB-FDC scheme if all workers who were eligible for a pension at age 60 claimed it at that age in the NDC regime. The NDC-FDC scheme would cost about 11 percent more if workers retired at age 65, because at this age there are many more NDB pension recipients. Does this finding mean that the assumed NDC-FDC scheme would not be sustainable? Not at all. The FDC component is sustainable by nature, and the NDC component was built with an internal rate of return equal to real wage growth and is sustainable by definition. This assumption is conservative because the long-run rate of growth of labor income, which is a proxy for the average rate of return of a PAYG scheme, is equal to the rate of growth of real wages plus the rate of growth of the labor force.

What is more, the reason that the existing NDB-FDC scheme is cheaper is simply that the pensions it provides to workers with short contribution histories (like many of the workers in the simulations) are very small. With the existing program, workers with short contribution histories—mostly low-income, low-educated workers—make a very bad deal with social security.¹³

Is it the case that the simulated NDC-FDC design provides better social protection than the existing NDB-FDC program simply because it spends more money? Is it fair to compare two designs that involve different budgets? To level the ground, one can simulate an expanded NDB-FDC system that spends exactly as much as the simulated NDC-FDC system. More specifically, one can (a) compute a flat per capita NDB supplement by dividing the total cost difference between the two alternative regimes by the number of pensioners and (b) recompute pensions by adding the flat supplement to NDB pensions. Figure 14.5 illustrates the distribution of pension rights at age 60 with this more generous design.

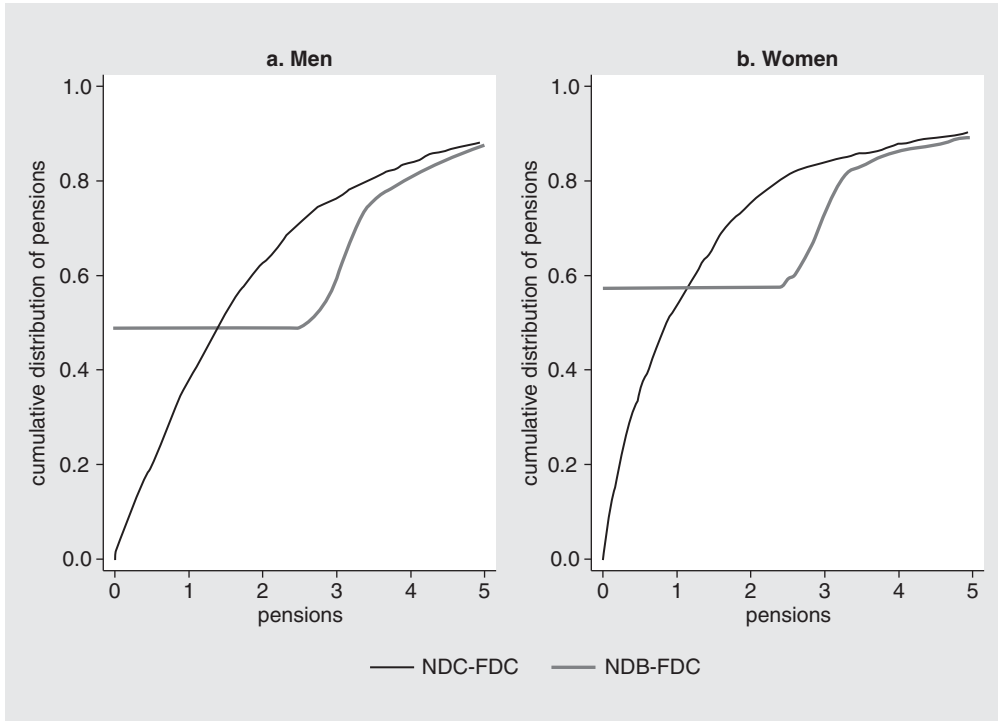
As is clear in figure 14.5, the supplemented NDB-FDC program would not solve the basic flaw in the NDB-FDC design—namely, that many contributors would not be eligible for pensions because of their short contribution histories. Those who are eligible would, of course, get better pensions with the supplemented NDB-FDC program than with the existing program. For that reason, it is no longer true that at any pension level the proportion of individuals receiving less than that level would be higher with the NDB-FDC than with the NDC-FDC design (there is no dominance). But the supplemented NDB-FDC program would still provide poorer social protection than the NDC-FDC program because the basic result is still that a large number of individuals are nevertheless ineligible for the pay-as-you-go NDB pension.¹⁴ The picture improves if the retirement age is set at age 65, but the basic message remains.

In view of these results, a different reform of the NDB-FDC program could have been simulated: one in which the extra money was devoted to loosening the eligibility conditions rather than to improving the pensions paid to those who are already eligible. This reform of the NDB-FDC program would improve social protection, but as discussed later, the lack of actuarial fairness of NDB designs imposes limits to this line of improvement.

ADDITION OF MINIMUM PENSIONS TO THE NDC-FDC PROGRAM

Even though the NDC-FDC scheme provides better protection than the existing NDB-FDC scheme to individuals with short contribution histories, it still leaves many workers receiving low pensions. More than one-third of the 1995 cohort would receive a pension

FIGURE 14.5 **Distribution of pension rights at 60 years of age with an expanded NDB-FDC program (cumulative distribution functions)**



SOURCE: Authors' computations based on work history records.

NOTE: Pensions (p) are expressed as the ratio of individual pensions to the minimum pension.

below the minimum pension at 65 years of age with this scheme. What would be the cost to complement the NDC-FDC scheme with a minimum pension at age 65?

The total cost of this provision was computed as the extra money the government would have to spend to supplement all pensions that fall below the minimum, using the current minimum pension.¹⁵ Unlike in the current NDB-FDC scheme in which the minimum applies only for the NDB tier, the minimum pension added to the NDC-FDC scheme supplements the sum of the two-tier pensions. Therefore, all workers who would receive a pension below the minimum are taken exactly to the minimum. No behavioral responses to the introduction of the minimum pension are assumed, despite the distortion of incentives it represents.

The introduction of the minimum pension would imply an increase in the PAYG expenditure on the order of 13 percent if all workers retired at age 65. This sum would have to be financed out of sources other than payroll contributions.

GOVERNMENT SOCIAL CONTRIBUTIONS

An NDC scheme supplemented with government contributions instead of minimum pensions is now considered here. Unlike matching contributions paid by employers in

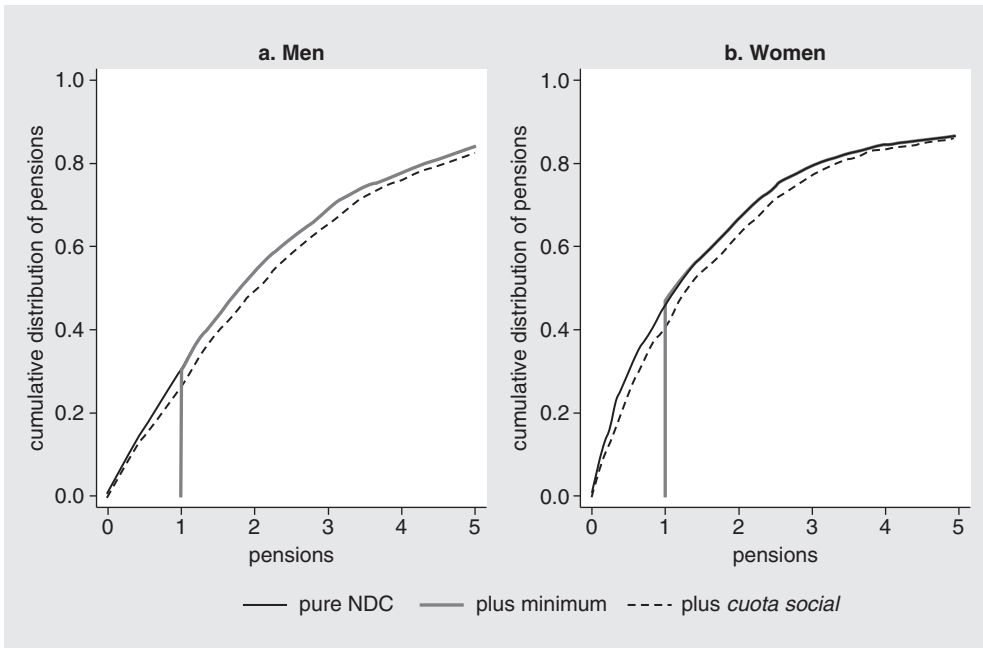
U.S. 401(k) plans, the government contributions simulated here are flat, very much like the Mexican *cuota social*.¹⁶

So that the NDC-plus-minimum-pension and the NDC-plus-government-contributions would be comparable, the two programs were simulated with the same fiscal cost. The focus could then be on the distribution of benefits. The details of this computation are explained in the annex. Although government contributions and employer matching contributions are designed to provide incentives for workers to contribute, these simulations assumed that individual contributions would remain the same. This assumption is conservative, but it is probably a sensible starting point.

Government contributions in this simulation are US\$6.20 per month, which represents about 3.7 percent of the minimum wage. As a reference, the Mexican *cuota social* is 14.5 percent of the minimum wage plus 0.35 percent of individual earnings. So the government contribution assumed in the simulations is rather small (in minimum wage metrics) compared to the Mexican *cuota social*.

Figure 14.6 presents the cumulative distribution functions of pension rights at 65 years of age with the pure NDC-FDC, the NDC-FDC complemented by a minimum pension, and the NDC-FDC complemented by government contributions in the form of a *cuota social*. The NDC-FDC complemented by a *cuota social* provides better pensions than the pure NDC-FDC at all pension levels, but the effect is rather small. In particular, the *cuota social* does not have a large effect on low pensions, so it does not look like an effective mechanism to alleviate old-age poverty. Instead, minimum pensions guarantee

FIGURE 14.6 **Distribution of pension rights at 65 years of age with three variants of the NDC-FDC scheme (cumulative distribution functions)**



SOURCE: Authors' computations based on work history records.

NOTE: Pensions (p) are expressed as the ratio of individual pensions to the minimum pension.

that no one falls below the minimum, but workers who self-finance pensions above this threshold do not benefit at all.

Minimum pensions are more effective than flat government contributions at alleviating poverty mostly because of better targeting. The disadvantage is that minimum pensions reduce incentives to contribute, something not taken into account in these simulations. The incentive effects could, however, be particularly important in developing countries in which the enforcement ability of the social security administrations is low and informality is pervasive.

A potential alternative to a lump-sum subsidy that is given to all could be a targeted subsidy that is given only to low-income earners below a ceiling that is tapered off up to this ceiling. It could be designed as a matching defined contribution (MDC) scheme, with the government matching individual contributions, which works in the framework of both NDC and FDC schemes but not NDB schemes. The question is whether and under what conditions *ex ante* subsidies of this kind are as efficient as *ex post* subsidies.¹⁷

Actuarial Fairness and Social Protection

An NDC-FDC scheme can provide better social protection than an NDB-FDC scheme, as shown in this chapter. This finding does not imply, of course, that NDC schemes provide better social protection than NDB schemes in general, but the results show that, in practice, even a pure NDC scheme can outperform an NDB scheme when low-income workers have highly fragmented histories of contribution. Behind this result lies the length-of-service requirement to access pensions that is necessary in the NDB-FDC scheme but not in the NDC-FDC scheme. Workers with sparse contribution histories may not be eligible for pensions in an NDB-FDC scheme, so they end up empty-handed.

Is this an intrinsic characteristic of NDB schemes as opposed to NDC schemes? Or is this just a design characteristic in the existing Uruguayan NDB scheme? The reading of these simulation results would be different in each case. In the latter case, the results would show that the existing Uruguayan scheme could be improved not only by introducing an NDC scheme, but also probably by fixing the existing NDB scheme. No additional, more general implications emerge from this analysis. However, if NDB schemes necessitate length-of-service conditions that NDC schemes do not need—NDC schemes could have an advantage, in principle, over NDB schemes where workers tend to have short contribution histories.

NDB schemes, unlike NDC and FDC schemes, need to impose a length-of-service condition to the extent that they are nonactuarial. Typically, NDB formulas are designed to redistribute in favor of people whose lifetime earnings are low. As a result, the expected internal rate of return on contributions for the lower-wage earners is higher than for the higher-wage earners, provided they are eligible for the benefit and assuming they have the same mortality rates and hence life expectancy. This gap in the return to contributions creates a disincentive to contribute: individuals may choose to contribute less—either working less or working in the informal sector—to raise the rate of return of their social security contributions. Conditioning benefits on having contributed a minimum number of periods—that is, imposing vesting period conditions—is a way of limiting these distortions.¹⁸ In turn, in NDC and FDC schemes, the internal rate of return is the same across

lifetime income levels and there is no need to impose long vesting period conditions in these schemes.

The disincentives to work inherent in NDB schemes might be particularly severe among older workers who are close to the retirement age. An NDB scheme creates strong incentive effects and distortions if it is nonactuarial at this margin—that is, if retirement earlier or later is not actuarially punished or rewarded (Gruber and Wise 1999, 2004). NDC schemes include such an actuarial mechanism by design through the linking of the benefit level to remaining life expectancy. NDB schemes can achieve the same effect but require a specific benefit formula with actuarially determined deductions or increments for earlier or later retirement against a standard retirement age. Furthermore, this retirement age needs to be adjusted with increases in life expectancy. A number of countries in the Organisation for Economic Co-operation and Development have started to adjust their NDB schemes in this direction (see Whitehouse 2012), but none has been politically able to fully mimic an NDC scheme. If they would do so, such a scheme could still be called NDB, but it would essentially be equivalent to an NDC scheme.

Lindbeck and Persson (2003) and Lindbeck (2006) use three features to classify pension programs: (a) degree of prefunding, (b) actuarial fairness, and (c) residual adjustment parameter (contributions or benefits).¹⁹ Both the NDB-FDC and the NDC-FDC combinations considered here have a mandatory individual savings account—that is, the prefunded FDC tier—and a first tier that is not prefunded, but they differ in the other two first-tier dimensions. The NDB-FDC scheme's first tier is NDB and has a limited degree of actuarial fairness, and the NDC-FDC scheme's first tier is NDC and is actuarially fair or almost actuarially fair, if one takes into consideration that the economic rate of return in NDC is expected to be lower than the financial rate of return in FDC.²⁰

Equipped with these concepts, one can rephrase in the following terms: mature and financially stressed, unfunded nonactuarial schemes tend to impose stringent length-of-service conditions that undermine their ability to provide social protection to workers with short contribution histories. More actuarial schemes do not need to impose this condition and hence do not face this dilemma. What matters is not so much which is the residual adjustment parameter—benefits in DC and contributions in NDB schemes—but what the other two characteristics are: whether the systems are unfunded and actuarially fair at the margin.

Lindbeck and Persson (2003) and Lindbeck (2006) point out that there is a continuum of options for the design of pension schemes in the three dimensions. In addition, some NDB schemes share many of the characteristics of NDC schemes, like the French and German point systems (Börsch-Supan 2006) or the Brazilian *fator previdenciário*. Also, an NDB formula can produce the same pensions as an NDC scheme if parameters are specified to achieve this result (Lindeman, Robalino, and Rutkowski 2006), albeit an NDB scheme makes no claim to maintaining financial stability with a constant contributions rate, as does an NDC scheme. Therefore, the frontier between NDC and NDB designs is not as neat in practice as could appear in stylized reference models. Nevertheless, the individual account setup of NDC schemes makes it possible to add explicit socially motivated transfers from the government budget to the individual accounts of parents (usually mothers)—for example, for time spent in early child care, whereas NDB schemes do not allow this possibility. It follows that countries can move gradually and

only partially in one or the other direction according to their needs and preferences, which is precisely what some countries in Latin America are doing.

Uruguay introduced very tough eligibility conditions in its main pension program in the 1995 reform. A minimum of 35 years of contribution was required for individuals 60 years of age or older, but younger than 70, to access pensions. This condition is very demanding for the population covered by this program (Bucheli, Forteza, and Rossi 2010). Only at age 70 could workers claim a pension with 15 or more years of contributions. Clearly, these requirements were too tough for the Uruguayan labor market conditions, and in the following years, they were gradually loosened. In 2001, a law was passed that allows workers to claim their savings account (FDC) annuity at age 65, regardless of the number of years they have contributed. Until then, both pensions had to be claimed together, which is why everybody in the simulation would get a pension at age 65 and not at age 60. Ironically, it is not thanks to the NDB first tier (called in this program “the solidarity pillar”) but to the individual accounts FDC pillar that many low-income workers who tend to have short contribution histories nevertheless get a pension at age 65. In 2008, the eligibility conditions were softened: the years of contribution required to access an ordinary pension were reduced from 35 to 30, and the minimum age required to access the advanced-age pension was reduced from 70 to 65. But this change implied that the minimum replacement rate had to be reduced. Hence, linking pension amounts to contribution histories was a prerequisite to loosening the eligibility conditions that were necessary to improve the social protection capacity of the system.

Concluding Remarks

This chapter’s results show that an NDC scheme may provide better social protection than an NDB scheme, even without minimum pensions. More generally, a movement toward actuarial fairness may be welfare improving for low-income workers. The argument is simple: nonactuarial schemes often require a considerably long period of service for workers to access pensions. Otherwise, the incentives would be too high to claim a pension with few contributions. But such conditions undermine the social protection ability of these programs, particularly in environments in which low-income workers have short contribution histories. By making the schemes more actuarial, NDCs can help overcome the problem.

The NDC-FDC scheme simulated in this chapter for the Uruguayan main social security program would cost much more than the existing NDB-FDC scheme, but only because the NDB-FDC scheme is very “cheap” when the eligibility norms are strictly enforced and many are left without NDB pensions. With strict enforcement of eligibility conditions, many workers get a very bad deal from social security with the existing NDB-FDC scheme and current contribution densities. In addition, the counterfactual examined here, the simulated NDC-FDC scheme, is financially sustainable by construction, whereas the NDB-FDC scheme is not.

Even though the NDC-FDC scheme would provide better social protection than the existing NDB-FDC scheme, the simulations show that it would still leave a large number of workers with very low pensions. Therefore, options were also considered to supplement the pure NDC scheme with a minimum pension. Providing a minimum pension equal

to the one that the system currently has in the NDB tier would imply an expenditure increase on the order of 13 percent.

An NDC-FDC scheme supplemented with government contributions was also simulated. To make it comparable with the NDC-plus-minimum-pension option, the simulations assumed that the discounted sum of government contributions was equal to the amount the government would spend with the minimum pension. According to these simulations, because of poor targeting, government contributions are not as effective as minimum pensions in alleviating poverty in old age. However, behavioral responses to either minimum pensions or government contributions were not considered in these simulations. Although the former are expected to reduce the incentives to contribute, the latter are expected to increase them. Therefore, the results regarding the minimum-pensions versus government-contributions dilemma should be seen only as an approximation of the direct effects.

A relatively simple extension of this study would be to compute pension rights with a subsidy to small pensions rather than a minimum pension. Minimum pensions impose a 100 percent implicit marginal tax on contributions when self-financed pensions are smaller than the minimum pension, which has been shown to distort incentives significantly (e.g., Boldrin, Jiménez-Martín, and Peracchi 1999; Jiménez-Martín and Sánchez Martín 2007). The implicit tax can be reduced by choosing a subsidy that decreases less than one to one as the self-financed pension increases (Valdés-Prieto 2002, 56–58). The Swedish NDC-FDC system is supplemented with this type of subsidy. A similar provision has been introduced in Chile's 2008 reform (Berstein 2007; Valdés-Prieto 2007; Rofman, Fajnzylber, and Herrera 2008). This type of provision reduces incentive distortions, but at the cost of reduced targeting.

Annex 14A.1: Assumptions for the Simulations

GENERAL ASSUMPTIONS

The average nominal wage grows at 9.5 percent per annum (ppa), and inflation is 8 ppa in this chapter's simulations, so real wages grow on average 1.5 ppa. Pensions are indexed to wages and so are minimum pensions, ceilings on insurable wages, and all thresholds settled in pension laws.

Individual saving accounts are assumed to yield 4 ppa, net of fees in real terms. On average, the individual accounts yielded a real interest rate (net of fees) of about 9 ppa between 1998 and 2009. A much smaller figure was chosen for the simulations because the return has been falling, as it has in other countries that introduced saving accounts in which returns were initially very high.

The internal rate of return of the simulated NDC tier is 1.5 ppa, equal to the real wage growth. The rate of return of PAYG schemes is usually proxied using the long-run rate of growth of labor income in the country. According to United Nations (PNUD 2008, 186) labor income grew in real terms about 30 percent between 1986 and 2006 in Uruguay, which corresponds to about 1.3 ppa. Twenty years is probably not long enough to capture long-run trends, so the rate of growth of the gross domestic product (GDP) is proxied for labor income growth, using the fact that labor and capital share in total value added remain approximately constant in the long run (Kaldor 1963, as cited by Acemoglu

2009, 57). Project data from the Groningen Growth and Development Centre were used for the Uruguayan real GDP between 1950 and 2008.²¹ The geometric average of the rate of growth of real GDP is 2.2 ppa, and the linear trend of the natural logarithm of GDP is 1.8 ppa in this period. The difference is due to the unusually high rate of growth of GDP in recent years, which has a stronger influence on the average than on the trend. With these alternative estimations, the NDC tier was projected with an assumed 1.5 ppa of internal rate of return, which is a conservative assumption given that long-run rate of growth of labor income is equal to the rate of growth of real wages plus the rate of growth of the labor force. Therefore, these simulations are assuming that the labor force is not growing. Sensitivity analysis was done running a scenario in which the rate of return in the NDC tier is 2.0 ppa, and the results did not change qualitatively. These alternative results are available on request.

GOVERNMENT CONTRIBUTIONS

The total fiscal cost of providing minimum pensions was computed, and this amount was distributed as a flat contribution (indexed to the average nominal wage) along the life cycle of all contributors in the population.

The expected fiscal cost as of period T of providing the minimum pension to all members of the cohort that survived until $T(I_T)$ is

$$\begin{aligned} \text{MinPenCost} &= \sum_{i \in I_T} \sum_{t=T}^{110} \pi_{T,t}^i (mpen_t - pen_{it}) (1+R)^{T-t} d_{it}; \\ d_{it} &= 1 \text{ if } pen_{it} < mpen_t; \\ &= 0 \text{ otherwise,} \end{aligned}$$

where T is the retirement age, R is the nominal interest rate, $\pi_{T,t}^i$ is the probability that individual i is alive in t given that he or she is alive in T , $mpen_t$ is the minimum pension, and pen_{it} is the self-financed pension of individual i in t .

These are the fiscal resources used to provide a flat subsidy to contributions (s_t):

$$\sum_{i \in I_T} \sum_{t=0}^{T-1} c_{it} s_t (1+R_{NDC})^{T-t} = \text{MinPenCost},$$

where $c_{it} = 1$ if i contributes in t and 0 otherwise, and R_{NDC} is the internal rate of return of the NDC. In this expression, government contributions are considered as if they were recorded only in the notional accounts of workers who survived until T . In the real world, the administration cannot do that because the identity of these workers is unknown at this stage. But if one assumes that the accounts of dead workers are proportionally distributed among the surviving workers, the subsidy effectively paid to each surviving worker is S_t , as computed in this expression.

The government subsidies to contributions were assumed to grow at the same rate as the average nominal wage (\hat{w}):

$$s_t = s_0 (1 + \hat{w})^t.$$

Therefore,

$$s_t = \frac{MinPenCost(1 + \hat{w})^t}{\sum_i \sum_{t=0}^{T-1} \pi_{0t}^i c_{it} (1 + \hat{w})^t (1 + R_{NDC})^{T-t}} .$$

Notes

We are indebted to Edward Palmer, Rafael Rofman, David A. Robalino, Robert Holzmann, and participants at the joint Swedish Social Insurance Agency and World Bank conference on NDCs held in Stockholm in December 2009 and at the 2010 Latin American and Caribbean Economic Association meeting for useful comments on previous versions. We hold full responsibility for the specific contents of this document.

1. In 1996, the contribution rates for the old-age, disability, and survivors program (known as *IVS*, for the Spanish name) were set at 15 percent for employees and 12.5 percent for employers. Over the years, the government introduced exemptions for employer contributions, and in 2007, in the context of a tax reform, some of the exemptions were lifted and the general employer contribution rate for the IVS social security program was reduced to 7.5 percent.
2. In the 1996 reform, the minimum number of years of contribution was raised from 30 to 35, but it was reduced to 30 again in 2008.
3. The minimum years of contribution required to access this program are 15, and the contributor must be 70 years of age or older.
4. This section draws heavily on Forteza et al. (2009).
5. A *public worker* is anyone who worked in the public sector at least half the total time during which contributions were made. According to this criterion, 58,617 (85 percent) are identified as private sector workers and 10,380 (15 percent) are identified as public sector workers in the database.
6. If an interruption in a contribution spell lasts fewer than three months, equation (14.1) is used as if the interruption had not taken place. The idea is that short interruptions do not break the wage process as longer interruptions do.
7. The heteroskedasticity correction to standard errors is performed as proposed by White (1980).
8. The significance of this coefficient should be taken with caution, however, because of the aggregate variable problem first identified by Moulton (1990).
9. Because NDC schemes are more actuarial than NDB schemes, the reform would increase incentives to contribute to the scheme and to retire later. No behavioral responses to the simulated social security reform are considered. In this sense, the results could be read as a floor in terms of social protection coverage and pension amounts.
10. Values of the cumulative distribution functions above five minimum pensions are not presented to highlight what happens with smaller pensions.
11. Berstein, Larraín, and Pino (2006) raise a similar point in the case of the Chilean minimum pension guarantee. This problem was one of the reasons the system was reformed in 2008.
12. The Uruguayan scheme is stricter than the Chilean pre-2008 FDC program. In Chile, workers could not receive the minimum pension if they had not contributed at least 20 years, but

- they could nevertheless claim their annuity. In Uruguay, workers with less than 30 years of contribution have to wait until they turn 65 years old to claim any benefit.
13. The NDC system simulated is, in fact, more expensive because it provides benefits to all contributors and has no maximum pension. Meanwhile, the current NDB system would not provide pensions to more than 50 percent of contributors if vesting period compliance were enforced. So the current NDB system would be very cheap if legal requirements were enforced, because it would collect contributions from all formal workers, but it would pay benefits only to half of them, and the amount of the pension has a ceiling.
 14. Notice designs are compared, not actual implementation, so in all the simulations the eligibility rules in the pension law are assumed to be fully enforced. This is currently not the case in actual implementation of the NDB-FDC plan, where many individuals get a pension without having accumulated the required 30 years of contribution.
 15. In the current program, minimum pensions vary with the retirement age and with the option low-income workers have to contribute to both pillars or to the NDB pillar exclusively. For these computations, the current minimum pension for workers retiring at age 60 who contributed to both pillars was used. In December 2008, the minimum pension was about US\$64 per month, equivalent to about 14 percent of average per capita household income.
 16. Beshears et al. (2007) analyze the effect on opting out of 401(k) plans of replacing the typical matching contributions with noncontingent employer contributions. They report a modest effect.
 17. For example, matching contributions to increase coverage in developing countries are currently being piloted in China and India. Such matching contributions to increase benefit levels are well known in developed countries such as Germany, under the Riester pension, and the United States, under the 401(k) pension. For a review of country experiences and discussion of conceptual issues around MDCs, see the presentations from a World Bank conference on this topic held in June 2011: <http://go.worldbank.org/2VD4ZF4MK0>.
 18. The point can be made in terms of optimal design of income tax theory pioneered by Mirrlees and extended to social security by Diamond and Mirrlees (Mirrlees 1986; Diamond 2003). If the government cannot observe productivity, the optimal design calls for a high marginal implicit tax rate at the lower end of income distribution as a way of inducing more productive individuals to reveal their type. Vesting period conditions impose a 100 percent implicit tax rate on social security contributions below the vesting period margin. With such marginal rates, mimicking low-productivity individuals is indeed too costly for high-productivity individuals.
 19. Diamond (2006) and Valdés-Prieto (2006) also use the three-dimensional classification, although the definition of the dimensions they suggest is somewhat different.
 20. Lindbeck (2006) argues that unfunded schemes cannot be fully “actuarial” because the internal rate of return in these schemes is lower than the market interest rate.
 21. These data are from the Conference Board and Groningen Growth and Development Centre’s *Total Economy Database*, accessed June 2009 at <http://www.conference-board.org/data/economydatabase/>.

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CHAPTER 14

COMMENT

Rafael Rofman

This chapter, by Álvaro Forteza and Ianina Rossi, is very interesting, both in terms of its methodology and innovative use of data sources and in regard to the policy implications discussed.

I see two clearly different parts in the chapter. First, the authors did some fascinating work building synthetic labor histories, using a relatively unexploited dataset and creative methodology, and simulating the results of different pension schemes, comparing defined benefit (DB) and defined contribution (DC) models and nonfinancial (notional) defined contribution (NDC) and financial defined contribution (FDC) models. The second part is their policy discussion, which is based (partially) on the simulation results. I would like to offer some comments on each of these parts.

I found the modeling section of the paper very interesting because it manages to build synthetic cohorts of workers and follow them throughout their lifetime, using a relatively short eight-year period as the empirical basis. This exercise is very creative, because it exploits a dataset rarely available in Latin American countries in a way that facilitates the assessment of alternative policy proposals. The main challenge in basing analysis on projected cohort data that reflect the outcomes of the past is whether the conditions current at the time covered by empirical observation will hold beyond that period. The problem is typical with this methodology, and it has no easy solution. The problem could be less relevant if the base period could be considered “normal” with regard to the main macro trends, but the 1996–2004 labor market trends in Uruguay have been anything but normal. Critical variables, such as unemployment, formality, and real salary trends showed high volatility and hardly constitute a good baseline for modeling future trends. Trying to respond to this problem, the authors adjusted the unemployment rate in the model to a more “normal” one but could not do something similar with other variables (wage profiles, informality incidence, labor force participation, and so on), because doing so would mean ignoring the modeling exercise and simply building the cohorts on the basis of some reasonable assumptions. In this context, there is no simple answer to what the desirable modeling strategy should be, given that the data that could be used to test whether trends during the empirical observation period 1996–2004 have significantly changed were not accessible. However, by presenting this first analysis, the authors make a remarkable contribution, showing that new methodological approaches are possible and that they yield interesting results.

The second part of the chapter is certainly more attractive to those of us interested in policy making, because the authors aim at assessing the effects of alternative system designs on several core pension indicators, including coverage, adequacy of benefits, and

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sustainability. The conclusions of this part are very clear: the current system (a multipillar NDB-FDC funded scheme) fares below a proposed NDC-FDC funded scheme in most (though not all) cases. On the one hand, the simulations show that both coverage and benefit levels under the NDC-FDC scheme are consistently better if workers retire at 60 years of age, though not so much if retirement is at 65. On the other hand, the cost of the system would be higher for the NDC-FDC scheme (by as much as 50 percent if workers retire at age 60 and 20 percent if they retire at age 65)—a finding that is to be expected, given that the main difference between NDB and NDC schemes is the benefit rule, but there are no possible differences with regard to funding (hence, more coverage and higher benefits must result in higher fiscal costs).

These findings are very interesting, but on a second look, the reader may want to go beyond the simulation and ask a more relevant question: what are the intrinsic differences between NDB and NDC schemes that produce this result? The answer to this question is clear toward the end of the chapter, where the authors state, “Behind this result lies the length-of-service requirement to access pensions that is necessary in the NDB-FDC scheme but not in the NDC-FDC scheme.” In other words, the differences the authors found in results originate in the fact that a particular restriction (a minimum vesting period) is present in only one of the two considered schemes. The underlying problem is now clearer: in countries where many workers have irregular contribution histories, the existence of strict vesting periods may result in significantly lower coverage.

Forteza and Rossi argue that the stricter vesting period requirement may be considered an intrinsic characteristic of NDB schemes, stating that “NDB schemes, unlike NDC and FDC schemes, need to impose a length-of-service condition to the extent that they are nonactuarial.” Without this condition, the incentives would be too high to claim a pension with few or no contributions, something that would negatively affect the finances of the system. However, they also note that some cases (e.g., the French and German point systems or the Brazilian *fator previdenciário*) do not seem to follow this rule, acknowledging that the frontier between the different systems is not as clear as one would conclude from the earlier discussion. In fact, some recent reforms in Latin America—including the Chilean reform of 2008, which eliminated the vesting period to access a minimum benefit, and the introduction of a “moratorium” on self-employed contributions in Argentina, which resulted in a fully flexible DB scheme in which workers may retire with any number of years of contributions and receive a proportionally reduced benefit—seem to be other exceptions to the authors’ proposed normal NDB rule.

I believe that the most valuable conclusion of the chapter is that, in a context of volatile labor markets with frequent movements between formality, informality, unemployment, and inactivity for most workers, flexibility becomes a critical characteristic to ensure the effectiveness of pension systems. The most traditional contributory schemes, designed in the Bismarckian tradition, which assumes fully formal work careers for most workers in stable labor markets, have not fared very well in Latin America, as shown by the very low coverage figures among the elderly. Of 17 countries with comparable data in the region, only 6 provided pension benefits to more than 50 percent of their elderly, and in several of these cases, they only did so because pension system rules were laxly applied in the past. Transitioning into pure FDC or NDC schemes does not seem to be the solution to people’s tendency to remain outside the system, because although many workers would then receive benefits, the levels of benefit could not be considered adequate under any

reasonable criteria. Hence, the challenge for policy makers seems to be to find a balance between providing basic coverage to most or all elderly citizens, regardless of their past working histories, with a system that does not become fiscally unsustainable or generate serious distortions in the labor market. Several countries in Latin America have started to move in that direction, and researchers and analysts should carefully follow the evolution of their recently reformed systems to identify their strongest design characteristics and propose improvements for their weakest ones.

PART IV

The Political Economy of NDCs

Is Social Security Secure with NDC?

Tito Boeri and Vincenzo Galasso

The ongoing process of population aging has so far required several adjustments in public pay-as-you-go (PAYG) social security systems around the world. More reforms will follow. In 2000, individuals 65 years of age or older represented 14 percent of the population in the industrial world (Europe, North America, Australia, New Zealand, and Japan), up from 8 percent in 1950, and the proportion of elderly is expected to reach 26 percent by 2050. Public pension spending has increased accordingly. In 2007, the average ratio of pension spending to gross domestic product (GDP) in the European Union (EU) was 10.2 percent, according to the European Commission.

In coping with the financial sustainability of the public pension systems, international institutions, academics, and policy makers have largely endorsed a multipillar system based on the existence of funded and unfunded mandated pillars as well as a voluntary private pillar (see Holzmann and Hinz 2005).¹ This view has been far reaching: several countries not in the Organisation for Economic Co-operation and Development (OECD)—mainly in Latin America—have chosen to follow this route as well as many European countries that have recently reformed their pension systems broadly in this direction (table 15.1). Since 1990, far more reforms have reduced the generosity of pension systems than moved in the opposite direction. The initial reform aimed at reducing public intervention in pension provision was perhaps the 1986 Social Security Act in the United Kingdom, which favored contracting out from the public system² into defined contribution occupational plans or into the newly introduced personal pension plans. In the next decade, several countries followed suit. Reforms also undid previous reforms that had reduced public pension outlays. This history is a clear indication of the political economy obstacles to pension reforms.

The most innovative reforms took place in Italy, Latvia, Poland, and Sweden, with the introduction of nonfinancial (notional) defined contribution (NDC) systems. For instance, in 1995, the Italian Dini reforms transformed the public pension system into an NDC scheme and contemporaneously introduced fiscal incentives for voluntary private pension schemes, which were then strengthened in 2004 and again in 2007. In Sweden, the Parliamentary Pensions Working Group produced the blueprint of the reform to switch to

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TABLE 15.1 Pension reforms in Europe (15 countries), 1986–2005

Direction of reform	1986–90	1991–95	1996–00	2001–05	Total
Increasing generosity	12	9	16	16	53
Decreasing generosity	13	26	29	28	96
Total	25	35	45	44	149

SOURCE: Fondazione Rodolfo De Benedetti Social Reforms Database (http://www.frdp.org/language/eng/topic/data-sources/dataset/international-data/doc_pk/9027).

an NDC scheme in 1992, and the actual reform was approved by the parliament in 1994 with implementation beginning the following year. The switch to an NDC scheme in the public pension system was accompanied by the introduction of a small mandatory defined contribution pension scheme and the confirmation of quasi-mandatory occupational plans, which were intended to compensate for the reduction in the generosity of the public pensions. The latest European country to adopt an NDC system was Poland in 1999. As in the case of Italy, the scheme entirely replaced the previous public pension system, but it was implemented through a lengthy transition process because only individuals under the age of 50 were affected. In contrast, the Latvian NDC scheme was introduced on January 1, 1996, and was immediately effective for all workers. Other countries where NDC-type public pension schemes were mimicked include Mongolia and the Kyrgyz Republic. The Russian Federation, the Arab Republic of Egypt, and Norway are currently in the process of joining this group.

The basic idea behind an NDC system is to introduce a PAYG system that mimics a financial account scheme in which workers contribute during their working life and draw defined benefits after retiring. Unlike financial account schemes, however, contributions to an NDC system are not invested in financial assets; hence, the returns on these contributions do not depend on stock market or bond returns. The system is *notional* in that contributions flow to the national social security administration, which uses them to cover current pension benefits. The returns on these defined contributions are, in principle, endogenous and at a level to guarantee solvency of the scheme; such returns are approximated by the growth rate of GDP or wages (at times in per capita value). Once a worker retires, the total capitalized value of his or her lifetime contributions is transformed into a (typically) real annuity: the pension benefit. As discussed in detail later in this chapter, this annuity depends, among other things, on the worker's life expectancy at retirement and, hence, on his or her retirement age.

The introduction of these NDC public pension schemes was motivated, among other things, by the need to (a) ensure the long-term financial sustainability of the public pension system by offering returns on contributions with a rate consistent with solvency; (b) reduce the existing distortions in the labor market caused by the existing strong incentives to retire early; (c) increase the intergenerational equity of the system, which was jeopardized by the different returns across generations; and (d) reduce the systematic political interference with public pension systems under aging through the introduction of a sequence of automatic adjustments in the system that would not require government intervention.

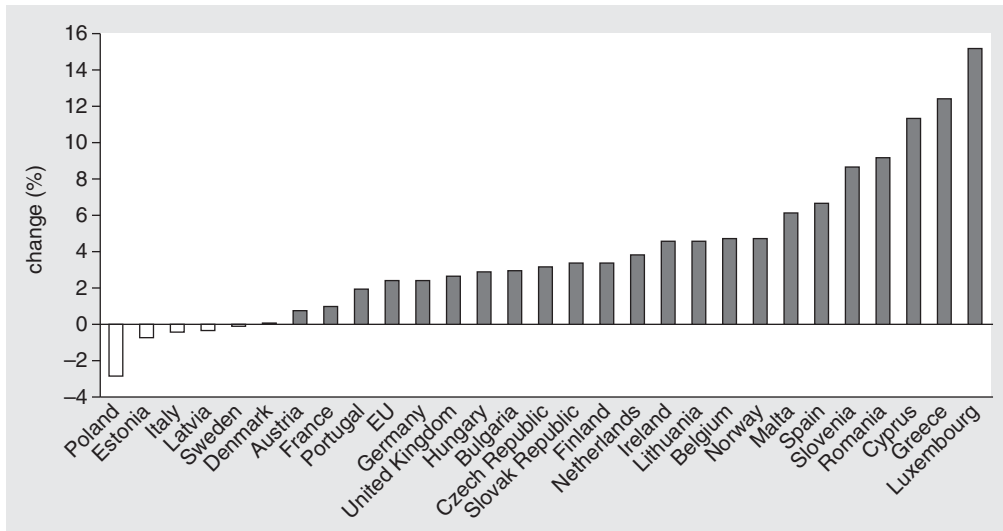
In fact, despite remaining PAYG systems, the NDC schemes have been used to curb the rise in pension spending by indexing its increase broadly to the growth rate of the economy (or contribution base). The defined contribution feature of these systems has also been exploited to reduce preexisting labor market distortions, because additional years of contributions now translate into higher pension benefits. This property of NDCs is strengthened by the adoption of transformation coefficients for the conversion of the capitalized contributions into a flow of pension benefits that depend on life expectancy at retirement. NDC systems have also been prized for their supposed higher intergenerational equity, as well as for their high degree of insulation from political influence, because most adjustments to the calculation coefficients (such as the returns on contributions and the transformation coefficients) can automatically be determined from administrative or GDP data and mortality tables.

In brief, NDC schemes have often been proposed as at least part of the structural response to the ongoing challenges to public pension systems, such as aging; growing distortions in the labor market; need to diversify retirement income, particularly in periods of low growth and stock market crash; quest for intergenerational (actuarial) fairness; and long-term financial sustainability. To some degree, NDCs appear to be the new “conventional wisdom” in pension systems. This perception is further justified by Germany’s recent adoption of some features in its point-based pension system that mimic some NDC key principles (see Börsh-Supan and Wilke 2006), and even in France there is discussion about moving in this direction (see Holzmann and Palmer 2006; Legros 2006).

After more than 10 years from their introduction, the actual effectiveness of these systems to perform all the difficult tasks described above can now be judged. Indeed, on many of these desiderata, these NDC systems perform reasonably well. For example, Auerbach and Lee (2009) provide a positive assessment of these systems’ risk-sharing properties (in particular, in the case of Sweden), although they highlight the systems’ costs in terms of low returns on contributions. Retirement age has steadily increased in the countries that adopted these systems, indeed, as well as in other countries. Most international institutions share a rather positive assessment on the future financial sustainability of these systems. NDC schemes are considered to have better properties than non-NDC PAYG systems even when these comparisons are carried out across a homogeneous set of countries, as clearly shown in figure 15.1, taken from a 2009 European Commission report.

In some countries, however, notably Italy, a high degree of political involvement with the working of the pension systems has remained. After the 1995 Dini reform, which introduced the NDC system for private workers, and the 1997 Prodi reform, which extended the NDC system to public sector workers, few other reforms have been passed that modified the original, flexible yet (almost) actuarially fair retirement age, undermining the fundamentals of an NDC system. Although the increase in the retirement age introduced by some of these reforms may present an element of continuity with the previous reforms, the reduction in the flexibility of the retirement system and in its reliance on incentives to induce later retirement represents a break with the philosophy of the NDC scheme. Moreover, a revision of the conversion coefficient was to be made in 2005 to account for the increase in the survival probability, but this change, which fell under the responsibility of the minister of economics, has been repeatedly postponed.

The main contribution of this chapter is to analyze the interactions between NDC systems, such as those introduced in Italy and Sweden, and the recent developments in

FIGURE 15.1 **Change in the public pension/GDP ratio, 2007–60**

SOURCE: Economic Policy Committee and European Commission 2006.

NOTE: EU = European Union.

labor markets. The major concern is that the combination of (a) a pension system that explicitly links pension benefits to lifetime contributions (hence, labor market status) and (b) a dual labor market (as exists in some countries) that holds young workers on the margin of formal contracts for many years creates a new, potentially very important, challenge to NDC pension systems. Many in the current generation of young workers risk approaching retirement age with pension rights reduced by the structural barriers to entrance into the labor market. Besides requiring a large increase in their age of exit, this dualism may jeopardize the future political sustainability of these NDC systems unless important labor market reforms are introduced to reduce the structural factors responsible. The chapter simulates the effect of this labor market situation on the future pension benefits of current young workers in Italy and Sweden and discusses the effects on future pensions of a labor market reform: the introduction of a single labor market contract that is aimed at reducing the dualism between temporary and permanent workers. Indeed, the potential negative impact that dual labor markets may have on the future retirement benefits of current young individuals is not limited to NDC systems but carries over to other pension systems, such as nonfinancial defined benefit schemes that are based on points or earnings, in which pension benefits are to some extent affected by the retiree's previous working career. Hence, the discussion of the relevance of solving this dual labor market issue has a more general application.

The chapter proceeds as follows. The next section discusses the political sustainability of PAYG pension systems in light of population aging and addresses some specific concerns that arose after the introduction of the NDC systems in Italy and Sweden. The chapter then describes pension systems, labor market dynamics, and their interactions in Italy and Sweden. It then presents a simple simulation of the pension benefits that current young cohorts of workers may expect to receive under different pension systems and

different labor market structures in Italy and Sweden. Finally, it discusses the future of NDC systems and concludes.

What Are the Future Challenges?

Over the past three decades, the major challenge to pension systems has been commonly viewed as coming from population aging. The widespread drop in the fertility rate and the contemporaneous increase in longevity have led to a rise in the share of elderly individuals who retire to obtain pension benefits and to a reduction in the share of working-age individuals. This situation poses a serious concern for the financial sustainability of any pension system, whether funded or unfunded, including NDC schemes. If pension benefit calculations were to remain unchanged in the future, the contribution rates used to finance the systems would necessarily increase. Alternatively, if contribution rates were to remain constant, other reform measures ought to be adopted, such as an increase in the retirement age, a reduction of pension benefits, or both. Reducing pension benefits includes switching pension indexation from wages to prices, as many countries have already done.

However, aging has economic as well as political effects. To fix ideas, consider the pension system as a potentially redistributive saving device that allows individuals to “save” in their working years through social security contributions and to receive the returns from their “savings” in old age as pension benefits. The *economic* effect of aging is given by the increase in the ratio of retirees to workers—the old-age dependency ratio. Because the average long-run return of a PAYG pension system depends on labor force growth (at a given participation rate) and on the growth rate of productivity, a worsening of the old-age dependency ratio reduces the average long-term profitability of the system. As in any portfolio decision, agents expecting lower returns from their assets should be induced to substitute their claims toward future pensions with more private savings. Therefore, the economic effect of aging should induce a reduction in the size of the pension system, because it has become less convenient.

However, as the population ages, so does the electorate—as well as other relevant political players, such as the union’s members. The aging process thus leads to an increase in the political representation of the elderly—to the appearance of “gray panthers,” who gather a larger share of votes. Politicians seeking reelection will clearly be keen on addressing the needs of this crucial voting group with generous welfare policies. Aging will thus have a *political* effect, consisting of an increase in the relevance of pension spending on the political agenda.³ A synthetic measure of the political effect of aging is given by the median age of voters. According to Galasso (2006), the median age among the voters in 2000 in a sample of OECD countries ranged between 44 years in Spain and 47 years in France and the United States. The evolution over time of the median age among voters suggest a large increase in the future. In 2050, the median age is expected to vary between 53 years in the United Kingdom and the United States and 57 years in Spain. Unsurprisingly, Italy and Spain, which are undergoing the most dramatic aging process, will also face the largest change in the median age: 11 and 13 years, respectively.

Concerns about the future financial consequences of the aging process as well as the short-term financial solvency of the pension system led to a sequence of pension reforms in Italy in the early 1990s that included the introduction of an NDC system in

1995. Similar reforms took place in many other European countries, such as France and Germany (see Holzmann and Palmer 2006). Yet these policy responses to the aging process risk not being sufficient, because, among other things, the aging process has proven more severe than initially forecast as a result of an underestimation of the increase in longevity. Table 15.2 reports the actual share of the population 65 years of age or older in several European countries in 1980 and 2007, and the forecasts for 2020 and 2050 as made in 1988 and in 2009. The current aging process is visible in the differences between the first two columns, which show, for instance, that between 1980 and 2007 the share of the elderly increased from 13.4 percent to 19.9 percent in Italy and from 16.3 percent to 17.4 percent in Sweden. The forecasting errors about the aging process for 2020 and 2050, respectively, are presented in the fifth and eighth columns. Table 15.2 shows that in 2009 Italy had to modify the previous forecast for 2020 from 19.4 percent to 22.7 percent, as well as that for 2050, from 22.6 percent to 32.6 percent. Notice that the Swedish forecast for 2020 was not revised, whereas further aging was envisaged for 2050, from 21.4 percent to 24.7 percent. Large forecasting errors for 2050 were also made in Greece, Germany, Portugal, and Spain and may thus lead to additional pressure for pension reform.

Aging—as well as, in the case of Italy, the deep short-term financial imbalance of the pension system—was among the reasons that led some countries to introduce a new

TABLE 15.2 **Actual and forecast share of elderly (age 65+) in the population**

Country	Actual (%)		Forecast for 2020 (%)			Forecast for 2050 (%)		
	1980	2007	Estimate in 1988	Estimate in 2009	Change in estimate	Estimate in 1988	Estimate in 2009	Change in estimate
Austria	15.5	16.9	19.4	19.4	0	21.7	28.2	6.5
Belgium	14.4	17.1	17.7	19.5	1.8	20.8	25.7	4.9
Denmark	14.4	15.3	20.1	20.1	0	23.2	24.5	1.3
Finland	12	16.5	21.7	22.4	0.7	22.7	26.1	3.4
France	14	16.4	19.5	20.2	0.7	22.3	25.6	3.3
Germany	15.5	19.8	21.7	22.8	1.1	24.5	31.7	7.2
Greece	13.1	18.6	17.8	21.1	3.3	21.1	31.5	10.4
Ireland	10.7	11.1	12.6	13.3	0.7	18.9	23.7	4.8
Italy	13.4	19.9	19.4	22.7	3.3	22.6	32.6	10
Netherlands	11.5	14.5	18.9	19.8	0.9	22.6	26.6	4
Portugal	10.2	17.3	15.6	20.1	4.5	20.6	30.1	9.5
Spain	10.9	16.7	17	18.8	1.8	22.9	32.1	9.2
Sweden	16.3	17.4	20.8	20.8	0	21.4	24.7	3.3
United Kingdom	14.9	16	16.3	18.3	2	18.7	23	4.3

SOURCE: Economic Policy Committee and European Commission 2006.

form of pension scheme: the NDC system. After the initial implementation of such schemes, however, additional concerns emerged as the actual working of the new systems came into play.

The lack of intergenerational fairness in the Italian system relates to two factors. The first is the delay in updating the transformation coefficients and the low frequency at which this adjustment occurs; this factor creates large asymmetries across generations depending on whether they retire before or after the adjustment. The second factor, which has so far been more important, is the long transition period, which allows individuals with more than 18 (15) years of contribution at the end of 1995 (1992) to be shielded from the Dini (Amato) reform. These problems became apparent over the years as a large policy debate took place on these and other aspects of the Dini reform. Analogously, some concerns emerged on the role of these “vintage pensions.” In fact, because pension benefits are indexed to prices only (after the 1992 Amato reform), individuals retiring in different years receive pension benefits that, in a few years’ time, may differ greatly, with individuals who retired earlier (the early vintage) receiving much lower pensions.

In Sweden, the NDC pension system was introduced much more rapidly than in Italy. The transition cohorts were those born between 1938 and 1953,⁴ who received part of their pension from the new NDC scheme: 20 percent for those born in 1938 (who reached age 65 in 2003) and 55 percent for persons born in 1945 (who reached 65 in 2010). Therefore, in Sweden, no concerns have arisen about the rate of transition. Instead, critics (e.g., Diamond 2004) have found fault with the design of the financial defined contribution scheme, which supplements the NDC scheme, because it leaves a large degree of freedom to individuals in choosing how to invest their pension capital.

Concerns arising with the Italian and Swedish NDC schemes have increasingly been addressed in a recent strand of literature (see contributions in Holzman and Palmer 2006, and this conference volume), and some policy measures have been adopted to cope with some of these shortcomings. The aim of this chapter is instead to shed some light on a new possible source of instability linked to, albeit not necessarily caused by, these NDC schemes, which stems from the current labor market situation of young individuals in some European countries. In brief, because NDC systems provide a tight link between past contributions and future pension benefits, the recent dual labor market may induce a large negative income effect on the future pension benefits of the current generation of young individuals. These individuals may find themselves with insufficient contributions—and hence pensions too low—to retire. To address this issue, the next section summarizes the working of the Italian and Swedish NDC pension systems, describes the employment situation for the young, and provides some simulations of the pension benefits that the current generation of young workers may expect to receive in the future under these NDC systems.

The Interaction between Pensions Systems and the Labor Market

An NDC system is a PAYG pension scheme in which contributions made during the working years are treated *as if* they were accumulated in a pension fund invested in assets. Contributions are typically proportional to labor earnings (floors and ceilings on

contributions may apply), but they do not go to an actual fund and thus do not receive a market return. They are only notionally accounted for, as if they were deposited in a fund, and the returns on these contributions are determined by law, using proxies to establish system solvency that are often linked to the growth rate of the economy or contribution base. On retirement, individuals who contributed to the system acquire pension rights on the pension wealth accumulated over their working years. This pension wealth is then converted into an annuity—the pension benefit—according to a benefit formula. The following equations provide a basic representation of how pension benefits are calculated in an NDC pension system (for a more comprehensive discussion of NDC systems, see Palmer 2006 and chapter 19 of this volume):

$$P = \tau \sum_{i=1}^n w_i \prod_{j=i+1}^{n+1} (1 + g_j^w) \frac{1}{\gamma} \quad (15.1)$$

$$\gamma = \sum_{i=1}^m (1 + \delta)^{l-i}. \quad (15.2)$$

In these equations, p is the pension benefit, τ is the contribution rate on the labor earnings (w), n is the number of years of contributions, g is the rate of return on the contributions, γ is the inverse of the conversion coefficient, δ is an imputed indexation rate, and m is the expected length of retirement.

Equation 15.1 shows that pension benefits depend on the accumulated pension wealth and the conversion coefficient. Pension wealth is obtained by accumulating every year of pension contributions, τw , over time, according to a rate of return on contributions, g . At retirement, these accumulated contributions are converted into a stream of income (the pension benefits) through the (inverse of the) conversion coefficient, γ . As shown in equation 15.2, this coefficient depends on the average expected longevity at retirement and on an indexation rate, δ , that regulates the returns on pension entitlements. In some NDC systems, such as those in Italy and Sweden (see Gronchi and Nisticò 2006; Palmer 2006), this indexation rate is front-loaded, because retirees obtain the average benefit of the (future) indexation from the beginning of their retirement period. Finally, notice that the age of retirement affects both equations by modifying the number of working years, n , as well as the length of the retirement period, m .

These basic, common features of the NDC system have been adopted in slightly different fashions in Italy and Sweden.⁵ The next section discusses some of the more relevant differences.

PENSION SYSTEMS IN ITALY AND SWEDEN

After the 1995 reform, the Swedish pension system rests on three pillars: a public NDC system, a smaller mandatory funded defined contribution scheme, and a wide array of quasi-mandatory occupational plans that cover almost 90 percent of the population.⁶ The first two schemes are mandatory; individuals contribute 18.5 percent of their labor income, of which 16 percent goes to the NDC system and the remaining 2.5 percent to an individual financial defined contribution account. Participants (the Swedish system covers both employees and the self-employed) are free to contribute to their most

preferred private fund and to switch among funds. A default option exists in the absence of worker choice, which today invests the accounts of about 40 percent of all participants. Funds are privately managed, but participants buy and sell shares through the government clearinghouse, which is now a part of the Swedish Pensions Agency. The Pensions Agency has set a permissible fee schedule based on the assets in all funds held by an individual participating company. In practice, the fund manager has just the Pensions Agency as a client, and the Pensions Agency keeps the accounts for all individual participants (see Tapia and Yermo 2007). The quasi-mandatory occupational plans stem from the agreements between employers' associations and trade unions. Membership is compulsory for all the eligible employees of an employer covered by the collective agreement, irrespective of whether they are trade union members. The plans can be defined contribution or defined benefit plans.

In the Swedish NDC scheme, the rate of return on the contributions, g , is set to be equal to the average real wage growth rate; the imputed indexation rate, δ (see equation 15.2), is fixed at 1.6 percent. However, if the average real wage growth rate differs from 1.6 percent per year, the pension benefits for that year are modified accordingly, as shown in the following equation:

$$\begin{aligned} \delta &= 1.6\% \\ P_{t+1} &= P_t(1+\pi_t)(1+g_t-\delta), \end{aligned} \quad (15.3)$$

where π is the inflation rate. Hence, for wage growth rates below 1.6 percent, the pension benefits are reduced in real terms, as occurred during the 2008–09 worldwide economic crisis. This reduction in benefits contributed to a modification of the pension calculation feature, linking the indexation—and thus the possible change in pension benefits—to a five-year moving average of the wage growth rate rather than to its annual realization (see chapter 21 of this volume).

In Italy, the 1995 Dini reform introduced the NDC scheme, completely redesigning the architecture of the Italian social security system. The defined benefit nature of the system was abandoned in favor of an NDC scheme. Seniority pensions were eliminated—over a long transition period—and additional rules were introduced to complete the harmonization process across regimes and to provide fiscal incentives for individuals to invest in private pension funds (for a detailed description, see Gronchi and Aprile 1998; Franco 2002; Brugiavini and Galasso 2004; Franco and Sartor 2006).

With the shift to an NDC scheme, the Italian social security system remained unfunded—because current retirees' pensions were financed by current workers' contributions—yet individuals' pension benefits became directly linked to their lifetime contributions to the system. However, this contributive aspect is only figurative: it works *as if* every worker had a personal fund where his or her contributions, corresponding to 33 percent of annual earnings, were accrued during his or her working career. These contributions are capitalized at an interest rate that is computed as a five-year moving average of the nominal GDP growth. At retirement, the accumulated asset value is transformed into an annuity through a conversion coefficient that depends negatively on the expected longevity at retirement and positively on the retirement age. The imputed indexation rate, δ , in equation 15.2, is fixed at 1.5 percent. However, unlike in Sweden, even if the average wage growth rate differs from 1.5 percent per year, no change is applied

to the pension benefits once inflation is taken into account. This NDC scheme has been applied pro rata for those workers with fewer than 18 years of contributions in 1995, whereas workers with higher seniority have remained under the previous regime.

The Dini reform also revised substantially the eligibility criteria. Seniority pensions, whose eligibility was based exclusively on reaching a minimum contribution period, were abolished. Under the private employees' scheme, the

minimum number of years of contribution to be eligible for a pension was reduced to five years; however, only individuals between 57 and 65 years of age are entitled to a pension. These measures have partially reduced the incentives to retire early, because pension benefits depend on retirement age through an actuarial adjustment factor, which is included in the pension benefit's conversion coefficient.

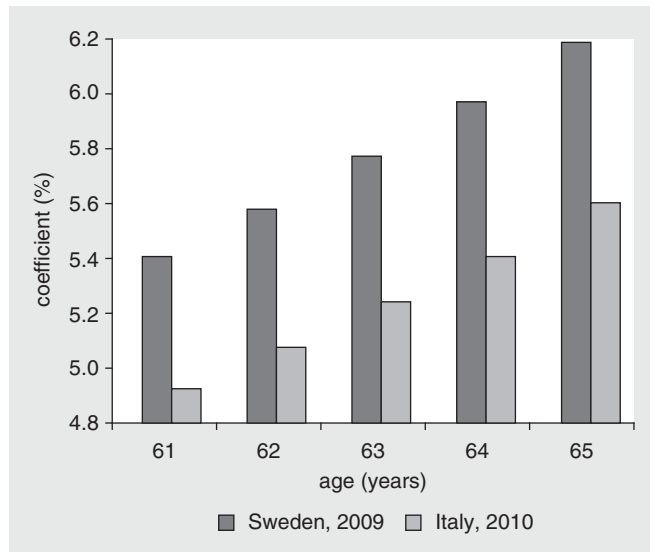
A first comparison between the Italian and Swedish NDC pension systems can be performed by showing the conversion coefficients, which summarize how the total capitalized pension wealth is converted into a flow of pension benefits. As shown at figure 15.2, for a given retirement age, the coefficients are higher in Sweden than in Italy, partially in response to a higher expected longevity at retirement among Italian women (21.94 years of expected longevity at age 65 compared with 20.88 years for 65-year-old Swedish women).

However, Italian pensioners, unlike Swedes, are completely insulated from the underlying labor market conditions. After individuals retire, their pensions are kept constant in real terms, independent of wage growth. This provision is the source of the "vintage pensions" issue previously discussed.

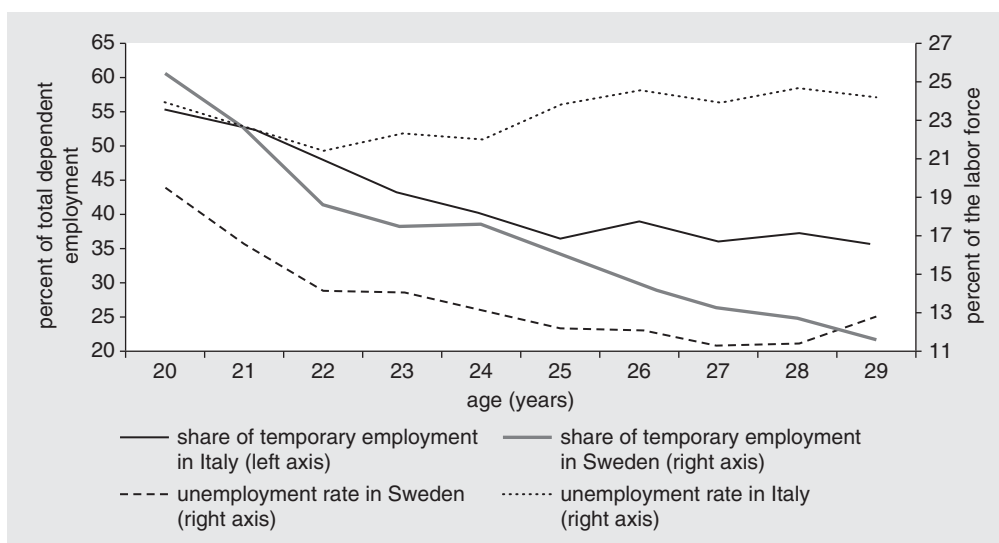
THE DUAL LABOR MARKET IN ITALY AND SWEDEN

As a result of many asymmetric reforms that introduced flexibility in the labor market only "at the margin" (i.e., for new hires), labor markets in countries with strict provisions for regular contracts, such as Italy and Sweden, experienced a large increase in the share of fixed-term contracts in total dependent employment rapidly approaching two-digit levels. Figure 15.3 graphically represents such dualism by showing the share of temporary workers and the unemployment rate by age group for the young working generations in Italy and Sweden.

FIGURE 15.2 Transformation coefficients in the Italian and Swedish pension systems



SOURCE: Data from the social security administrations of Italy and Sweden.

FIGURE 15.3 **Employment by age in Italy and Sweden, 2006**

This dualism also involves a significant wage discount for temporary contracts. This discount is imposed because of the stronger bargaining power of regular workers compared with workers who have flexible contracts and because of the lower outside options of the latter. It takes into account that, because of eligibility rules for unemployment insurance requiring some minimum contributory record, most workers with flexible contracts do not have access to unemployment benefits in case of job loss. Estimates from microdata (from the EU Statistics on Income and Living Conditions, or EU-SILC) of the coefficient of a dummy variable capturing permanent contracts, in a monthly wage regression carried out over male-dependent employment that controlled for education, tenure, and the broad sector of affiliation, point to a discount on the order of 25 percent in Italy and even 40 percent in Sweden.⁷

This dualism is likely to deeply affect future pension entitlements of the younger generations, because (a) all other things being equal, workers with temporary contracts earn less than workers on open-ended contracts; (b) they experience more frequent career breaks because job shedding is concentrated on temporary contracts (as clearly indicated by the Great Recession); and (c) during unemployment spells, they are generally not covered by unemployment insurance.

This problem of adequacy is not directly related to the NDC design itself but rather to the dualism of labor markets. Thus, solutions should be found by directly addressing this problem and reducing the dualism of labor markets. A politically feasible strategy that has been proposed for France, Italy, and Spain (Bentolila, Boeri, and Cahuc 2010) is to allow graded employment security. Thus, dismissal costs in permanent contracts should gradually increase with tenure length without those discontinuities that deter hiring on open-ended contracts in the first place. In particular, governments could promote entrance into the permanent labor market in stages, making job security provisions in the form of mandated severance payments, which would increase steadily as workers acquire tenure without large discontinuities.

To give a few examples, permanent contract holders in Italy are protected from the start by rules forcing employers to reinstate the worker in the firm in case of unfair dismissals, in addition to paying them statutory severance pay. In France, when the worker reaches two years in a permanent contract, the employer must provide a personalized plan to help the employee find another job. In Spain, economic dismissals from permanent contracts require administrative approval. Employers typically avoid going to court by paying the worker up front. These costs can be as high as 36 months of salary in Italy.

A graded tenure scheme could involve, in all of these cases, a statutory severance payment, which would increase steadily with tenure length (e.g., five days of severance per quarter) and gradually reach the maximum level currently envisaged by national regulations. This scheme reduces the firms' uncertainty about the costs of dismissals, thereby decreasing the costs of employment protection for employers. At the same time, it preserves flexibility without creating a dual labor market structure.

Simulating Future Pension Treatments in Italy and Sweden

To analyze how the current dualism in the labor market of many European countries may interact with the existence of an NDC pension system that strongly ties pension benefits to previous contributions, one can calculate the expected future pension benefits for different young individuals in Italy and Sweden. This chapter considers three cases. Case A illustrates the situation of a (male) individual with a career pattern characterized by a sequence of temporary and permanent jobs and unemployment spells. It is compared to case B, the career of a (male) individual who enjoys an uninterrupted career with permanent jobs only but enters the labor market with the same wage as the temporary worker in case A. Case A is also compared to case C, a (male) individual who, like the case B worker, enjoys an uninterrupted career with permanent jobs only but enters the labor market with an initial wage that is 25 percent higher than in cases A and B (see Boeri 2011). Specifically, case A describes the labor market situation of a (male) individual who enters the labor market at age 25 and holds a temporary job until age 28. He then remains unemployed until he turns 29, when he finds a fixed-term job, which he holds until he is 32, when he becomes unemployed again for one year. At age 33, he obtains another fixed-term job, which he holds for two years, until he finally gets a permanent job until retirement. In cases B and C, a (male) individual has instead permanent jobs from his entry in the labor market at age 25 until retirement.

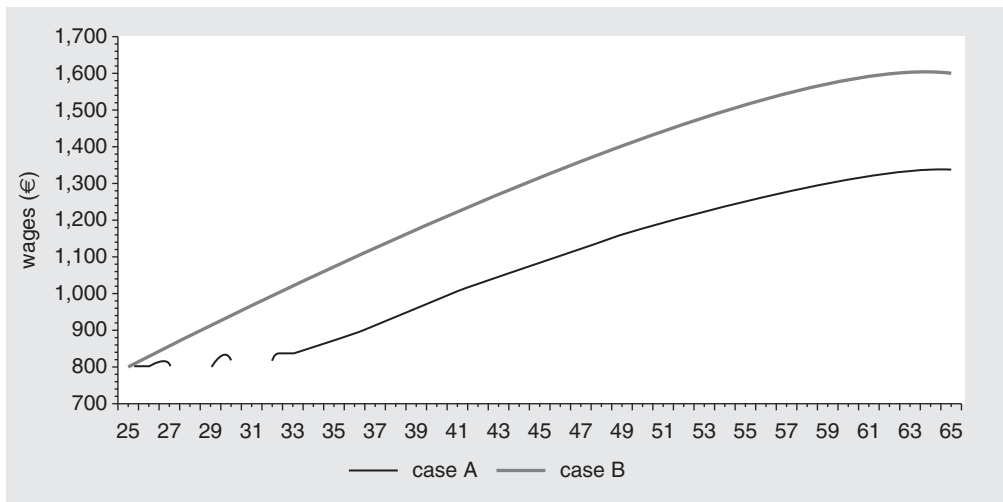
Case A is more typical of the Italian labor market than that of Sweden, but the expected pension benefits for cases A and B are calculated in both countries—hence under both systems—to be able to compare the results. In both countries, the two representative young individuals will thus have the working careers described. However, the entry wage will clearly differ between the two countries. Individuals will also face different contribution rates: 33 percent in Italy and 16 percent plus an additional 2.5 percent in Sweden and another 4.5 percent for occupational benefits. They will also have different retirement ages: 60, 65, and 67 years in Italy and 65, 67, and 70 in Sweden. In addition, the expected growth rate of the economy (and of the wages), which was shown in the previous section to be crucial for pension benefit calculations differs across countries, is between 1 percent and 1.5 percent in Italy and between 1.5 percent and 2 percent in Sweden. For Italy, where labor market dualism is more pronounced, simulations are provided for case C.

SIMULATING THE ITALIAN LABOR MARKET AND PENSION SYSTEM

To simulate the effect of the Italian dual labor market on the future pension benefits of current young generations, this chapter considers three representative young individuals with a discontinuous (case A) and a continuous (cases B and C) working career. The focus is on male individuals with upper-secondary education. Their wage profile is calculated using European Commission Household Panel data obtained by pooling the 1994–2001 waves. The labor market prospects for the representative young Italian male (case A) entering the labor market at age 25 and featuring a discontinuous career are shown at figure 15.4. In his initial temporary job, he earns a monthly wage of €800 (in 2001 prices), which remains relatively constant until age 35, when he obtains a permanent job. At this point, his wage growth becomes steeper, and his monthly wage (at constant prices) reaches €1,300 by the end of his working life.

What pension benefit will this individual, who cannot rely on beneficial compounding capitalization on the very early contributions because of his discontinuous working career, get? The answer is shown in table 15.3, which provides the monthly pension benefit and the pension replacement rate (namely, the ratio between the pension benefit and the average wage in the five years before retirement) for three different retirement ages (60, 65, and 67 years) and for three (optimistic) projections of the growth rate of the Italian GDP (1.0 percent, 1.2 percent, and 1.5 percent). The results show some variation. If he retires as early as 60 years of age (i.e., on average at the same age as his parents), his monthly pension benefit will range between €638 and €690, depending on the average growth rate of the economy during his working life, with a replacement rate fluctuating around 50 percent. In the absence of additional old-age resources, such as individual savings or private pension funds, the representative individual will thus be induced by the low pension benefit to postpone retirement (see also the simulation in Galasso 2008). Retiring at age 65 will allow him to reach a monthly pension benefit of between €910 and €996, depending on the realized economic growth, thereby replacing about 70 percent of

FIGURE 15.4 Labor market prospects in Italy, cases A and B



SOURCE: Authors' representation.

TABLE 15.3 Monthly pension benefit for cases A, B, and C, Italy

Growth rate (<i>g</i>)	Retirement age (years)	Transformation coefficient, 2010	Case A		Case B		Case C	
			Monthly pension (€)	Replacement rate (%)	Monthly pension (€)	Replacement rate (%)	Monthly pension (€)	Replacement rate (%)
1.5 percent	67	0.05620	1,052	79	1,342	84	1,677	84
	65	0.05620	996	75	1,273	79	1,591	79
	60	0.04798	690	53	889	57	1,112	57
1.2 percent	67	0.05620	1,015	76	1,261	79	1,576	79
	65	0.05620	943	71	1,202	75	1,502	75
	60	0.04798	658	50	846	54	1,058	54
1.0 percent	67	0.05620	953	71	1,210	75	1,513	75
	65	0.05620	910	68	1,157	72	1,446	72
	60	0.04798	638	49	819	52	1,023	52

SOURCE: Authors' compilation.

NOTE: Case A shows a discontinuous working history, case B shows a continuous working history, and case C shows a continuous working history with an initial wage that is 25 percent higher.

his wage income. Only when retiring at 67 years of age will he be able to obtain a more sizable monthly pension benefit ranging between €953 and €1,052.

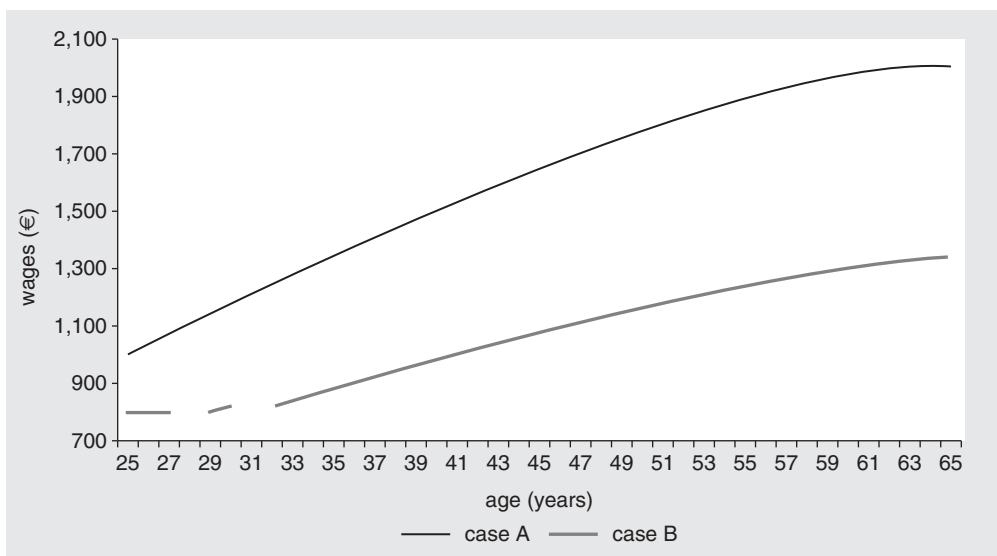
To appreciate the magnitude of the effect of a dual labor market on the future pension benefits of current young generations, consider the representative young (male) individual, who enjoys instead a continuous working career (case B). This individual enters the labor market at age 25 with a permanent job and the same monthly wage as in case A—that is, €800 (in 2001 prices)—which grows constantly over time until reaching €1,600 at the end of his working life, as shown in figure 15.4.

Compared with the previous individual (case A), the case B individual's final wage is approximately €300 higher because of the progressive increase enjoyed during his permanent job tenure. Moreover, the representative individual with a continuous working career will enjoy early career contributions and will therefore have better prospects for his pension benefits. Table 15.3 (case B) shows his monthly pension benefits and pension replacement rates for three different retirement ages (60, 65, and 67 years) and three projections of the growth rate of the Italian GDP. As before, the results show some variation, but pension benefits and replacement rates are consistently more generous than in case A. If he retires early (at 60 years of age), his monthly pension benefit will range between €819 and €889, depending on the average growth rate of the economy during his working life. These monthly benefits are almost €200 larger than the benefit received by the individual with a discontinuous working career—that is, almost one-third of a pension benefit higher. Retiring at age 65 allows the case B individual to enjoy a benefit of between €1,157 and €1,273, depending on the realized economic growth, thereby replacing about 75 percent of his wage income. Finally, by retiring at 67 years of age, he will obtain a pension benefit ranging between €1,210 and €1,342, with a replacement rate of between 75 percent and 84 percent.

Finally, case C considers the situation of a male individual who enters the labor market with a permanent contract and enjoys a 25 percent higher initial wage. His earning profile, as described in figure 15.5, differs widely from the previous cases, because his wage starts at €1,000 and reaches almost €2,000 by the end of his working career. Pension benefits differ accordingly. When retiring as early as age 60, he still enjoys a pension benefit between €1,023 and €1,112, depending on the growth rate, although the replacement rates are around 55 percent (table 15.3). Postponing the retirement age to 67 years would lead to sizable pension increments, with benefits between €1,513 and €1,677.

The dual labor market is known to have a strong negative effect on the current young generation. These simulations suggest that it will continue to take its toll even in the long run, because pension benefits and replacement rates will be much lower than today. To see to what extent this negative impact can be imputed to the existence of an NDC system, which provides a tight link between (early) contributions and pension benefits, one can calculate the pension benefits for the individuals in case A and case B under the old defined benefit system that was in place in Italy before the Dini reform and after the Amato reform. Table 15.4 presents the results in terms of pension benefits and replacement rates for both individuals at two retirement ages, 60 and 65 years. In this case, the difference in pension benefits stemming from the different working careers is also substantial. When retiring early (at 60 years), a young individual with a continuous working history would receive €1,117, amounting to €243 more a month than an individual with a discontinuous career, although the replacement rates would be comparable

FIGURE 15.5 Labor market prospects, cases A and C



SOURCE: Authors' representation.

TABLE 15.4 Defined benefit system simulation, Italy

Retirement age (years)	Redistributive system			
	Case A		Case B	
	Replacement rate, 2009 (%)	Monthly pension (€)	Replacement rate, 2009 (%)	Monthly pension (€)
65	77	1,034	80	1,274
60	67	874	72	1,117

SOURCE: Authors' compilation.

NOTE: Case A shows a discontinuous working history, and case B shows a continuous working history.

(72 percent versus 67 percent). The absolute difference in the pension benefits remains when individuals retire later (at 65 years), but now the young individuals affected by the dual labor market (case A) could nevertheless count on a pension benefit of €1,034.

This negative impact of the dual labor market on the future pension benefits of current young workers is due to the combined effect of a lower entry wage (if compared to permanent workers) and a discontinuous working career. However, even absent the former effect, the dual labor market would still negatively affect future pension benefits.

These simple simulations thus suggest that the troubles lying ahead for the NDC system in Italy may not be due to some intrinsic feature of the system, but rather to its interaction with the dual labor market that exists in the country. In fact, particularly in the case of high economic growth and late retirement, the NDC system seems more sensitive to the lack of early career contributions than the previous defined benefit pension system, where in fact early enrollment often increases the implicit rate of return on contributions.

However, NDC systems are also better equipped to allow individuals to compensate for the effects of these labor market distortions later in life. In fact, postponing retirement age is shown to be more beneficial in increasing pension benefits in the NDC system than in the previous defined benefit scheme.

These simulations seem to support a two-pronged policy that tries to reduce the dualism of labor markets—for instance, by allowing for graded employment security, as discussed previously (see also Bentolila, Boeri, and Cahuc 2010)—while at the same time postponing the retirement age. In this chapter's simulations, when this strategy was coupled with an average 1.5 percent growth rate of the economy, it would have led to a monthly pension benefit of almost €1,350 for the representative middle-educated male individual.

Allowing for a more complete working career would also largely help to mitigate the pension coverage of young workers, particularly in countries such as Italy, where workers in temporary jobs accrue fewer pension rights than permanent workers and unemployed individuals accrue no rights at all.

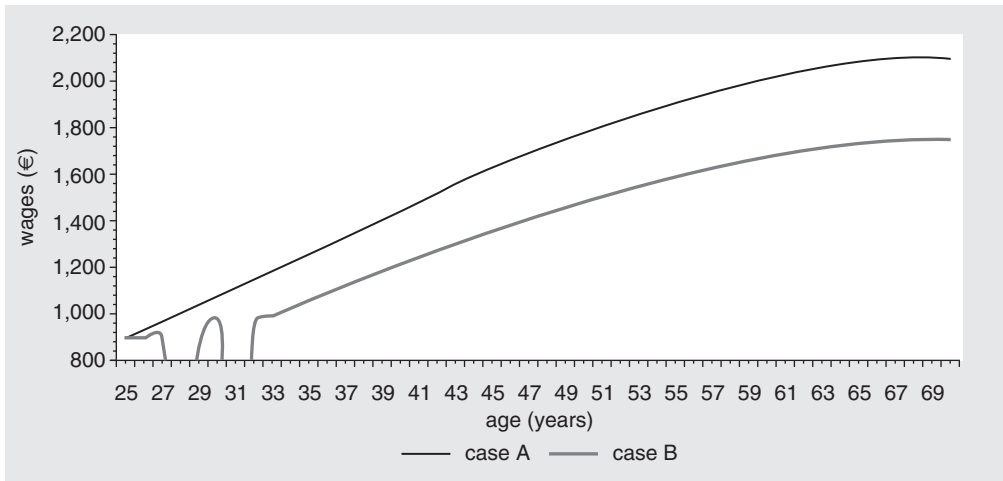
SIMULATING THE SWEDISH LABOR MARKET AND PENSION SYSTEM

This section replicates the previous simulations for the Swedish pension system and labor market, considering two representative young males with upper-secondary education: one with a discontinuous working career (case A) and one with a continuous working career but the same entry wage (case B). Their wage profile is calculated using data from the 1997 and 2001 waves of the European Commission Household Panel. The same labor market prospects are used as for Italy. The representative individual with a discontinuous career enters the labor market at age 25 with a temporary job that he holds until age 28. He is unemployed from age 28 to 29, when he obtains a fixed-term job. At age 32, he is unemployed again for a year; he then holds a fixed-term job for two years and finally a permanent job until retirement. However, the Swedish representative young individual enters the labor market with a higher monthly wage, almost €900 (in 2001 prices). Again, this wage remains relatively flat until age 35; then the young male obtains a permanent job, and his wage growth becomes steeper until reaching about €1,700 at the end of his working life,⁸ as shown in figure 15.6.

Table 15.5 summarizes the pension benefits of this individual with a discontinuous working career, who cannot enjoy the beneficial compounding capitalization on contributions early in his working life. The monthly pension benefit and the pension replacement rate are shown for three different retirement ages (65, 67, and 70 years) and two GDP growth rates (1.5 percent and 2 percent). Again, the range of variation is large. If the representative young individual retires early by Swedish standards—that is, at 65 years of age—his monthly pension benefit ranges between €811 and €957, depending on the average growth rate of the economy during his working life, thus providing a replacement rate of about 46 percent. Retiring later clearly increases the amount of the pension benefits, which rises as high as €1,506 if the individual retires at 70 years and the average growth rate of economy has been 2 percent.

To understand the relevance of the effect of a dual labor market, this chapter simulates the future pension benefits for the representative young (male) individual with a continuous working career (case B). This individual still enters the labor market at age 25,

FIGURE 15.6 Labor market prospects, cases A and B



SOURCE: Authors' representation.

TABLE 15.5 Monthly pension benefits for cases A and B, Sweden

Growth rate (<i>g</i>)	Retirement age (years)	Transformation coefficient, 2009	Case A		Case B	
			Monthly pension (€)	Replacement rate (%)	Monthly pension (€)	Replacement rate (%)
1.5 percent	65	0.0621	811	47	1,005	48
	67	0.0678	964	55	1,192	57
	70	0.0784	1,249	72	1,541	74
2.0 percent	65	0.0621	957	46	1,206	48
	67	0.0678	1,147	55	1,444	56
	70	0.0784	1,506	71	1,892	72

SOURCE: Authors' compilation.

NOTE: Case A shows a discontinuous working history, and case B shows a continuous working history.

but he has a permanent job. His monthly wage (about €900 in 2001 prices) increases constantly over time, until reaching €2,100 at the end of his working life, as shown in figure 15.6. This case represents a wage gap of almost €400 at the end of the working life, entirely driven by the early experience in the labor market. Table 15.5 displays the associated monthly pension benefits and pension replacement rates for three different retirement ages (65, 67, and 70 years) and two GDP growth rates. Clearly, pension benefits, albeit not replacement rates, are consistently more generous than in the previous case. If the current representative young individual retires early (at 65 years), his monthly pension benefit will range between €1,005 and €1,206, about €200 more than the corresponding benefits for the individual with a discontinuous working career. Retiring at 70 years of age boosts the pension benefits to between €1,541 and €1,892 and the replacement rate to between 72 percent and 74 percent.

Even in Sweden, the dual labor market thus has the potential for a strong negative effect on the pension benefits of current young generations. However, the reduction in pension benefits driven by the same dual labor market seems to be of less concern in Sweden because pension benefits drop by less, albeit on average still by a sizable 25 percent owing to negative early labor market experiences. Nevertheless, because of the extremely large boost that postponing retirement seems to have on pension benefits, an individual with a discontinuous working career retiring at age 70 would obtain a larger pension benefit (€1,249 or €1,506, depending on the average GDP growth rate) than an individual with a continuous working career retiring at age 67 (€1,192 or €1,444).

Concluding Remarks

The introduction of NDC systems in the 1990s was often advocated as the appropriate reform to achieve several crucial objectives, such as the long-run financial sustainability of these PAYG pension systems and the reduction of distortions introduced in the labor market. Ten years after their introduction, an evaluation of their effects is positive overall. Yet some aspects of the implementation of these systems raise concerns. For instance, the indexation of pension benefits adopted in Italy gives rise to a “vintage pensions” problem, which may be further exacerbated by an aging electorate. Analogously, the indexation to wages (rather than to the wage bill) in Sweden proved problematic during the Great Recession. Careful consideration should be given to adopting an indexation mechanism that is based on deviations in the growth of the wage bill (the contribution base) from the potential growth rate of the economy. This indexation scheme would have the advantage of explicitly linking the fate of pensioners to that of current workers, thereby reducing the conflict of interest between mostly young workers and pensioners and thus increasing the support of growth-friendly policies. It would therefore improve risk sharing across generations in addition to improving the sustainability of the pension system.

In pension reform, problems typically emerge in the political arena. NDC reforms may not prove different from these past experiences, particularly in the near future, when the application of the NDC rules in countries that have adopted long transition periods, such as Italy and Poland, will lead to the retrenchment of pension benefits. This situation may provoke the political opposition of future older generations having to retire on low pensions. Although NDCs have often been designed to isolate their functioning from political interference, some features of NDC schemes, such as the conversion coefficients, may still be open to manipulation by politicians to increase pension generosity. Dual-track reform may also be used to increase the burden on younger generations.

This chapter has focused on a new challenge to NDC systems, as well as to defined benefit systems that are based on points or earnings: a structural problem reflecting how labor markets are currently working in many European countries. NDC systems provide a tight link between contributions and pension benefits. Moreover, because of the compounded effects of interest rates, early contributions have particular relevance for final accumulated pension wealth and thus for pension benefits. Unfortunately, in dual labor markets, young individuals experience discontinuous working careers and thus typically fail to accumulate pension contributions early in their working lives. This chapter’s simulations suggest that their experience translates into low future pension benefits and the

need to postpone retirement. Young individuals who are off to a bad start in the labor market also finish behind in the pension system.

A possible solution to this new problem is to adopt a double-pronged policy. To help individuals early in their working career, a contract that features graded employment security could be introduced (see also Bentolila, Boeri, and Cahuc 2010) to reduce the dualism of labor markets and to ensure that young workers can enjoy contribution years early in their working career. Later in their working lives, however, individuals have to be ready to postpone retirement age.

Notes

The authors thank participants at the NDC Conference in Stockholm for useful comments and Massimo Anelli for skillful research assistance. All remaining errors are ours.

1. A recent critical appraisal of this World Bank view is in Barr and Diamond (2008).
2. The contracting-out option was already present since 1975 in the Social Security Pension Act.
3. The political influence of the elderly is magnified by two crucial features. First, their preferences in terms of economic policies are homogeneous. In fact, whereas young and middle-aged individuals typically differ along several dimensions (employment status, economic conditions, family profiles) and may thus have conflicting preferences over many economic policies, elderly individuals (retirees) are “single-minded” (see Mulligan and Sala-i-Martin 1999): they care mostly about pensions and health care. Second, in several countries, elderly voters tend to have higher turnout rates at elections—defined as the percentage of people who actually vote among those who are entitled to—than the young. Because the aggregate effect of this voting pattern may be sizable, the aging process may lead to a disproportionate political representation of the elderly.
4. Historical NDC accounts were created for the entire workforce on the basis of information from 1960.
5. For a comprehensive comparison of the two pension schemes on these issues, see Gronchi and Nisticò 2006.
6. For a detailed description, see Palmer (2000) and Könberg, Palmer, and Sundén (2006).
7. Unfortunately, fewer observations are available on temporary employment in Sweden in the EU-SILC (see Boeri 2011).
8. Here, a retirement age up to 70 years is considered.

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CHAPTER 15
COMMENT

Sergio Nisticò

The simulations run by Boeri and Galasso about the adequacy of the pension benefits that nonfinancial (notional) defined contribution (NDC) schemes grant in the case of discontinuous career patterns touch on the issue of the complex relationship between the stream of pension contributions paid into the system and the stream of pension annuities that the NDC scheme awards to each individual.

Recalling some essential properties of the NDC scheme may, therefore, help clarify the general properties of the relationship between the career pattern and the adequacy of the pension provisions pointed out by Boeri and Galasso. In the NDC scheme, the pension annuities depend on the notional capital or account balance at retirement (AB_R). Thus, it can be useful to express this latter amount as the sum of n “pieces,” each deriving from the contributions paid in the i th of n working years and from the interests matured on those same contributions according to the following expression:¹

$$AB_R = \sum_{i=1}^n a \cdot w_i \cdot \prod_{j=i}^n (1 + \pi_j), \quad (15A.1)$$

where α denotes the fixed contribution rate, W_i the wage earned in year i , and π_j the rate of return credited on the account balance in year j . According to equation 15A.1, the relative weight, within AB_R , of the contributions paid in year i with respect to those paid in any year $i - x$ depends essentially on the difference between the growth rate of the individual wage and the rate of return credited on the individual account between year $i - x$ and year i . Actually, both the individual wage growth and the conventional rate of return yearly credited on each account can be expressed in terms of a deviation with respect to the growth rate of the average wage of the economy, so that the relative weight, $\tau_{i/i-x}$, of the contributions paid in year i with respect to those paid in year $i - x$ is

$$\begin{aligned} T_{i/i-x} &= \frac{a \cdot w_i}{a \cdot w_{i-x} \cdot [(1 + \alpha) \cdot (1 + \delta_w)]^x} = \frac{W_{i-x} \cdot [(1 + \alpha) \cdot (1 + \delta_w)]^x}{W_{i-x} \cdot [(1 + \alpha) \cdot (1 + \delta_\pi)]^x} \\ &= \frac{(1 + \delta_w)^x}{(1 + \delta_\pi)^x}, \end{aligned} \quad (15A.2)$$

where α is the growth rate of the average wage of the economy between period $i - x$ and period i , whereas δ_w and δ_π are the deviation rates of, respectively, the growth rate of the

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individual wage and the conventional rate of return credited on the account balance with respect to the average growth rate of the average wage of the economy.

The Adequacy of the NDC Scheme's Replacement Rates

If one assumes that the conventional rate of return credited on the account balance of each individual coincides with the average wage growth, so that the denominator of the last part of equation 15A.2 is equal to one, an interesting benchmark case emerges—namely, that of a worker whose individual wage growth coincides with that of the average wage, so that also the numerator and, hence, the whole fraction in equation 15A.2 are equal to one. In other words, when the average wage growth is credited as rate of return on all account balances, according to equation 15A.2, for an individual whose wage grows in line with the average wage, all yearly contributions have the same weight independently of their age.

Table 15A.1 simulates the interaction between the career pattern and the account balance at retirement for three typical workers. The assumption is made that the three individuals start working at age 25 (earning a yearly wage equal to 100 money units) and retire at age 67, after having contributed to the pension system and having had credited to their NDC account 30 percent of their yearly wage together with a yearly rate of return of 2 percent. The equality of the weights in AB_R of the various yearly contributions for the benchmark case is shown in column 4.

In contrast, two other typical cases can be studied on the basis of the last part of equation 15A.2, according to whether the worker's wage growth is higher or lower than the average wage growth (still considered to be equal to the conventional rate of return). In the case of a worker whose individual wage grows more than the average wage does, because the numerator of the last part of equation 15A.2 is greater than the denominator, the weight of the more recent contributions in AB_R exceeds the weight of the older ones, as shown in column 7 of table 15A.1. Finally, in the case of a worker whose individual wage grows less than the average wage does, simulated in column 10 of table 15A.1, the weight of the older contributions in AB_R exceeds the weight of the more recent ones. Hence, Boeri and Galasso's thesis applies, according to which the NDC rules punish individuals with early discontinuity in careers.

DISCONTINUITY IN THE CONTRIBUTION HISTORY WITHIN THE NDC SCHEME

The last three rows of table 15A.1 show the values of the account balance at retirement of the first pension² and of the replacement rate (at age 67) for each of the three working careers, all characterized by a full contributive record of 43 years.

Because of the strict correspondence between contributions and benefits characterizing actuarially fair NDC schemes, any gap in the contributive history with respect to the full record will negatively affect the account balance and thus both the first pension annuity and the replacement rate. Boeri and Galasso point out that the NDC rules penalize "early" discontinuity, which characterizes, at present, the typical career pattern in Italy more than in other European countries. Moreover, their argument seems to imply that the old defined

TABLE 15A.1 **Weights of yearly contributions in the account balance at retirement for three typical workers**

Age	Individual wage growth = average wage growth			Individual wage growth = average wage growth + 1%			Individual wage growth = average wage growth - 1%		
	Wage	Contributions	Weight (AB_R)	Wage	Contributions	Weight (AB_R)	Wage	Contributions	Weight (AB_R)
25	100.00	30.00	68.92	100.00	30.00	68.92	100.00	30.00	68.92
26	102.00	30.60	68.92	103.00	30.90	69.59	101.00	30.30	68.24
27	104.04	31.21	68.92	106.09	31.83	70.28	102.01	30.60	67.57
28	106.12	31.84	68.92	109.27	32.78	70.96	103.03	30.91	66.91
29	108.24	32.47	68.92	112.55	33.77	71.66	104.06	31.22	66.25
30	110.41	33.12	68.92	115.93	34.78	42.36	105.10	31.53	65.60
31	112.62	33.78	68.92	119.41	35.82	73.07	106.15	31.85	64.96
32	114.87	34.46	68.92	122.99	36.90	73.79	107.21	32.16	64.32
33	117.17	35.15	68.92	126.68	38.00	74.51	108.29	32.49	63.69
34	119.51	35.85	68.92	130.48	39.14	75.24	109.37	32.81	63.07
35	121.90	36.57	68.92	134.39	40.32	75.98	110.46	33.14	62.45
36	124.34	37.30	68.92	138.42	41.53	76.72	111.57	33.47	61.84
37	126.82	38.05	68.92	142.58	42.77	77.48	112.68	33.80	61.23
38	129.36	38.81	68.92	146.85	44.06	78.24	113.81	34.14	60.63
39	131.95	39.58	68.92	151.26	45.38	79.00	114.95	34.48	60.04
40	134.59	40.38	68.92	155.80	46.74	79.78	116.10	34.83	59.45
41	137.28	41.18	68.92	160.47	48.14	80.56	117.26	35.18	58.87
42	140.02	42.01	68.92	165.28	49.59	81.35	118.43	35.53	58.29

43	142.82	42.85	68.92	170.24	51.07	82.15	119.61	35.88	57.72
44	145.68	43.70	68.92	175.35	52.61	82.95	120.81	36.24	57.15
45	148.59	44.58	68.92	180.61	54.18	83.77	122.02	36.61	56.59
46	151.57	45.47	68.92	186.03	55.81	84.59	123.24	36.97	56.04
47	154.60	46.38	68.92	191.61	57.48	85.42	124.47	37.34	55.49
48	157.69	47.31	68.92	197.36	59.21	86.25	125.72	37.71	54.94
49	160.84	48.25	68.92	203.28	60.98	87.10	126.97	38.09	54.40
50	164.06	49.22	68.92	209.38	62.81	87.95	128.24	38.47	53.87
51	167.34	50.20	68.92	215.66	64.70	88.82	129.53	38.86	53.34
52	170.69	51.21	68.92	222.13	66.64	89.69	130.82	39.25	52.82
53	174.10	52.23	68.92	228.79	68.64	90.57	132.13	39.64	52.30
54	177.58	53.28	68.92	235.66	70.70	91.45	133.45	40.04	51.79
55	181.14	54.34	68.92	242.73	72.82	92.35	134.78	40.44	51.28
56	184.76	55.43	68.92	250.01	75.00	93.26	136.13	40.84	50.78
57	188.45	56.54	68.92	257.51	77.25	94.17	137.49	41.25	50.28
58	192.22	57.67	68.92	265.23	79.57	95.09	138.87	41.66	49.79
59	196.07	58.82	68.92	273.19	81.96	96.03	140.26	42.08	49.30
60	199.99	60.00	68.92	281.39	84.42	96.97	141.66	42.50	48.82
61	203.99	61.20	68.92	289.83	86.95	97.92	143.08	42.92	48.34
62	208.07	62.42	68.92	298.52	89.56	98.88	144.51	43.35	47.86
63	212.23	63.67	68.92	307.48	92.24	99.85	145.95	43.79	47.40
64	216.47	64.94	68.92	316.70	95.01	100.83	147.41	44.22	46.93

(continued next page)

TABLE 15A.1 **Weights of yearly contributions in the account balance at retirement for three typical workers (continued)**

Age	Individual wage growth = average wage growth			Individual wage growth = average wage growth + 1%			Individual wage growth = average wage growth - 1%		
	Wage	Contributions	Weight (AB_R)	Wage	Contributions	Weight (AB_R)	Wage	Contributions	Weight (AB_R)
65	220.80	66.24	68.92	326.20	97.86	101.81	148.89	44.67	46.47
66	225.22	67.57	68.92	335.99	100.80	102.81	150.38	45.11	46.01
67	229.72	68.92	68.92	346.07	103.82	103.82	151.88	45.56	45.56
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		AB_R	2,963.45		AB_R	3,663.98		AB_R	2,427.63
		First pension	164.64		First pension	203.55		First pension	134.87
		Replacement rate	0.72		Replacement rate	0.59		Replacement rate	0.89

NOTE: Table assumes an average wage growth of 2 percent and a contribution rate of 30 percent.

benefit (DB) systems, possibly based on last earnings rules, would produce more generous pensions for individuals with a slow and difficult entrance in the labor market.

Imagine that, for whatever reason, the three individuals whose career is synthesized in table 15A.1 miss two years of contributions and that, in line with Boeri and Galasso's concern about early discontinuity, the gaps in the contribution history occur precisely at the very beginning of each individual's career. The ensuing values for the account balance, the first pension, and the replacement rate of the three individuals are reported in table 15A.2.

To evaluate Boeri and Galasso's thesis, one can first run the same simulation with reference to a case of late discontinuity—a sort of forced early retirement. The ensuing values for the account balance, the first pension, and the replacement rate of the three individuals are reported in table 15A.3.

By comparing the three tables, one easily sees that for an individual whose wage grows in line with the average wage (the conventional return)—so that, according to equation 15A.2, all yearly contributions have the same final weight in AB_R —it does not matter when the gaps in the contribution history occur. In fact, for this individual, the first pension and the replacement rate would drop to the same level regardless of whether the two-year gap in the contribution history occurred at the beginning or end of the career.³ In contrast, the three tables show that for an individual whose wage growth exceeds the average wage growth, early discontinuity has a smaller impact than late discontinuity on the first pension and the replacement rate. The reverse applies for an individual with lower-than-average wage growth. In other words, the tables show that early discontinuity in the contribution history has a lower impact than late discontinuity

TABLE 15A.2 Account balance, first pension, and replacement rate for three typical workers with early discontinuity in contribution history

	Individual wage growth = average wage growth	Individual wage growth = average wage growth + 1%	Individual wage growth = average wage growth - 1%
AB_R	2,825.61	3,525.47	2,290.48
First pension	156.98	195.86	127.25
Replacement rate	0.68	0.57	0.84

TABLE 15A.3 Account balance, first pension, and replacement rate for three typical workers with late discontinuity in contribution history

	Individual wage growth = average wage growth	Individual wage growth = average wage growth + 1%	Individual wage growth = average wage growth - 1%
AB_R	2,825.61	3,457.35	2,336.06
First pension	156.98	192.07	129.78
Replacement rate	0.68	0.56	0.85

for the majority of members of an NDC scheme. Moreover, the tables show that the possible greater impact of early discontinuity does not arise from the circumstance that workers with a slow career start “cannot enjoy the beneficial compounding capitalization on contributions early in [their] working life”; rather, it is a specific problem affecting a minority of individuals whose “unfortunate” career pattern prevents them not only from enjoying a decent wage at the beginning of their working life but also from earning the average wage gains that normally accrue even to those who do not get any raise during their whole career.

THE OLD DB RULES

A second element to be considered for a clear understanding of Boeri and Galasso’s analysis of how the NDC rules cope with possible discontinuous careers is the relative performance in terms of pension generosity of the old DB, earnings-related rules under the same circumstances. Such a comparison is particularly relevant given the extremely high replacement rates that the NDC scheme grants to the unfortunate workers mentioned in the previous section, even if early discontinuity occurs in their career. In fact, as tables 15A.1 through 15A.3 show, with a contribution rate of 30 percent (lower than the Italian figure of 33 percent), the NDC rules ensure to those workers with a below-average career profile retiring at the age of 67, an 89 percent replacement rate in the case of a full contribution record and a reduced rate of 84 percent and 85 percent, respectively, in the case of early or late discontinuity.

Prior to the NDC reform, the Italian DB system, reformed by the so-called Amato law of 1992, was based on a rather simple rule according to which the first pension annuity was calculated through multiplication of 2 percent of the average of all yearly earnings—indexed at 1 percent in real terms—by the number of years in which the individual had paid contributions in the pension system. Prior to the 1992 Amato reform, the reference point for calculation of the first pension annuity was a much shorter average—namely, that of the last five years, indexed according to the consumer price index. One sees easily that none of those rules, which were also financially unsustainable, can offer to unfortunate workers with early discontinuity and very low final earnings better protection than the sustainable NDC scheme does.⁴ In other words, although for those few workers with below-average wage growth the NDC rules penalize early discontinuity more than late discontinuity, the high replacement rates that the NDC scheme grants to all workers with flat wage patterns constitute the best safety belt that a pension system can provide when the labor market fails to offer a quick start to a working career.

Social and Financial Sustainability of the NDC Scheme

One could argue that the typical careers reported in table 15A.1, together with the assumptions made to run the simulations, might overestimate the actual performance of the NDC in that (a) the 30 percent contribution rate is abnormally high; (b) even if two years of discontinuity are allowed for, many young workers entering the labor market today still could gather less than 41 years of contributions before reaching the age of 67; and (c) the 2 percent real rate of return might overestimate the actual figure of the sustainable rate of return.

THE CONTRIBUTION RATE

In most countries, the contribution rate to the compulsory public pension scheme is normally set at a much lower level than 30 percent, and the lower the contribution rate is, the lower will be both the first pension annuity and the replacement rate. More precisely, if one considers that the first pension annuity is obtained through division of equation 15A.1 by the annuity divisor and that, in turn, the replacement rate is equal to the first pension divided by the last wage, assuming for simplicity the steady state, one obtains the following equation:

$$\frac{P}{W_n} = \frac{\sum_{i=1}^n \frac{W_i}{W_n} \cdot (1 + \Pi)^{n-i}}{d} \cdot a. \quad (15A.3)$$

Equation 15A.3 expresses the individual replacement rate as a linear function of the contribution rate.⁵ The ratio on the right-hand side of equation 15A.3—that is, the slope of the function—measures how much the aspect of actuarial fairness must force the replacement rate to decline (increase) for a unit fall (increase) in the contribution rate. For the typical worker whose wage grows in line with average growth (supposedly equal to the conventional rate of return), the slope of the function becomes n/d , whereas it is lower for those workers whose wage grows more rapidly than the average and vice versa. In any case, the actual “shape” of function 15A.3 depends on the particular wage profile (W_i/W_n) of each individual.⁶ This different degree of responsiveness of the replacement rate to the contribution rate is one of the key features of the NDC scheme that ensures actuarial fairness precisely by awarding more generous replacement rates to flat-career workers (Gronchi and Nisticò 2006, 2008; Nisticò 2009).

The issue of what is the appropriate level of contribution rate for a compulsory public pension scheme touches on a political dimension that is definitely beyond the limits of this note. However, the simulations presented here show that a choice such as the Italian one to have a robust first pillar based on NDC rules can guarantee at the same time that (a) flat-career workers can be awarded a very high replacement rate; (b) the lower replacement rates awarded to the “steeper” careers leave room for a second, possibly funded, pillar intended to top up those lower replacement rates; and (c) the sustainability and actuarial fairness of the system ensure that those contributions can be rightly perceived as a form of compulsory saving rewarded with a fair and uniform rate of return, rather than as a tax on wages.⁷

PROBLEMS RAISED BY SHORT CAREERS

One could argue that many young workers who have just entered the labor market might reach age 67 with working careers much shorter than those imagined so far—perhaps with a record of contributions to the pension system of about 30 years. The relevance of these cases differs depending on whether (a) strong discontinuity is just a feature of a flexible labor market, wherein the individual worker goes back and forth from periods of work with a relatively high wage to periods of search or learning while being paid an average yearly wage comparable to that of the typical workers whose careers have been simulated previously, or (b) recurrent discontinuity is not compensated by an extra wage

during the work years, so that the average yearly wage approaches—or even falls below—a subsistence threshold.

In the former case, both the pension level and the replacement rate (with respect to the average of the last earnings) that the NDC scheme can ensure to its members are not affected by discontinuity; that is, they do not differ from those awarded to continuous careers with the same average yearly wage.⁸

In the latter case, the pension level might actually fall below the poverty line, thus creating a problem of social sustainability of the pension provisions. However, one should consider that (a) the replacement rate, computed with respect to an average of the last earnings, would still be unaffected by discontinuity; (b) strong discontinuity is socially unsustainable for low-income workers before they reach retirement age; and (c) if some other welfare institution is able to fill the gaps by providing income support gross of pension contributions, the NDC scheme will, in turn, ensure a decent pension level.

THE ASSUMPTION ABOUT THE RATE OF RETURN

Now resume the choice, already made in the first section, to express both the individual wage growth and the conventional rate of return in terms of a deviation with respect to the growth rate of the average wage of the economy. By doing so equation 15A.3 becomes

$$\begin{aligned} \frac{p}{W_n} &= a \cdot \frac{\sum_{i=1}^n \frac{W_i}{W_n} \cdot (1+\alpha)^{n-i} \cdot (1+\delta_\pi)^{n-i}}{d} \\ &= a \cdot \frac{\sum_{i=1}^n \frac{W_i}{W_i \cdot (1+\alpha)^{n-i} \cdot (1+\delta_W)^{n-i}}}{d} \cdot (1+\alpha)^{n-i} \cdot (1+\delta_\pi)^{n-i}. \end{aligned} \quad (15A.4)$$

Notice that, with reference to a steady state wherein the sustainable rate of return is the growth rate of the wage bill, α and δ_π express, respectively, the economic and demographic components of the awardable return. However, out of the steady state, δ_π can be given a different meaning—namely, that of a sort of arbitrary differential with respect to the average wage growth, which the sponsor or manager of the pension scheme can control to achieve social or financial sustainability.

As is well known, Sweden has chosen the latter option—that is, to ensure financial stability under all economic and demographic circumstances, thus achieving the important goal of isolating the pension system from the varying needs of the government's budget. The Swedish automatic balance mechanism operates by attributing a negative value to δ_π when the ratio between the assets and the liabilities of the system falls below one.⁹ In contrast, the former option could, in principle, be used to ensure the adequacy of the pension provisions—and hence social sustainability—by awarding an extra rate of return financed by the general tax revenue if the combination of the chosen contribution rate and the sustainable rate of return generates replacement rates that are too low.¹⁰

Close examination of equation 15A.4 shows that (a) the individual replacement rates are insensitive to any change in the economic component (α) of the rate of return, because it would affect the account balance at retirement (the first pension) and the last

wage in the same proportion;¹¹ (b) the individual replacement rates are positively (negatively) affected by any rise (fall) in the noneconomic component of the rate of return; and (c) flat careers are more sensitive than dynamic ones to any change in the noneconomic component of the rate of return.

Conclusion: What a Pension System Can and Cannot Do

Within the NDC scheme, the level of pensions for a given retirement age is positively related to the contribution rate and to the vector of yearly notional interest rates. In contrast, replacement rates are rather insensitive to (the economic component of) the rates of return yearly credited to the account balances. Moreover, equation 15A.3 shows that individual replacement rates are a linear function of the chosen contribution rate and are particularly generous for flat income profiles.

The virtual interest rate to be credited to the account balance of an actuarially fair NDC scheme could in principle be set at whatever constant level would also achieve intergenerational fairness. However, financial sustainability requires the interest to adapt to varying economic and demographic conditions. Once this is done, the NDC pension scheme becomes a powerful technical tool through which all income earners can transform a part of their claims on present gross domestic product (GDP) into claims on future GDP according to the chosen contribution rate.¹² To be sure that all pensioners will have a decent income, either the economic system alone or the appropriate welfare institutions must do their job: namely, securing for all individuals a decent level of income up to the end of their working age, gross of pension contributions.¹³

One cannot ask the pension system to remedy the possible inefficiencies rooted in the economic system. However, if one asks for a fair, sustainable, and transparent retirement scheme that is capable of ensuring high replacement rates precisely to those who—having earned lower wages during their working life—had fewer opportunities to save for retirement, the NDC scheme is definitely a good answer.

Notes

1. For a similar formula, see Palmer (2006, 21).
2. The first pension annuity has been determined by assuming a divisor equal to 18, a value that roughly corresponds to the existing forecasts about life expectancy at age 67 for the present generations of workers in both Italy and Sweden. Such a choice aims to mirror a hypothetical reformed Italian NDC scheme in which higher divisors, because of lower imputed interest rates, can give room to adjustment rates that can follow, at least in part, real wage growth. Also, the choice to assume a contribution rate equal to 30 percent fits this hypothetical scenario in which the present overall contribution rate of 33 percent could be split in two parts: 30 percent to finance old-age pensions and the remaining 3 percent to finance invalidity and a Swedish-style survivor scheme. For an explanation of the trade-off between the imputed interest rate and the pension adjustment, see Gronchi and Nisticò (2008). For a survey of all the shortcomings of the Italian NDC scheme, see Gronchi and Nisticò (2006).
3. Notice that for the average individual, the replacement rate drops by $1/43$ (2.33 percent) for each year of missing contribution. For the other individuals with a wage growth higher or lower than the average, the percentage drop for each yearly gap in contribution can be lower

or higher than the preceding figure, according to the exact position of the gap in the career pattern. However, in the presence of late discontinuity, the question arises whether the replacement rate should be computed with reference to the last wage or to a sort of average of the last or all yearly earnings. This point, touched upon in Swedish Social Insurance Agency (2010, 31–32) is discussed later.

4. One should also consider that the old Italian DB rules admitted a maximum of 40 years of “imputed” working career, regardless of its actual length, thus depriving those workers with early discontinuity of their principal defense—namely, that of postponing retirement age to get a better pension.
5. See also Bevilacqua (2009). Notice that in equation 15A.3, the assumption has been made that the returns on the account balance are credited only up to year $n - 1$.
6. Assuming that the rate of return awarded yearly on all account balances is the sustainable one, equation 15A.3 expresses a trade-off between the available wage (net of pension contributions) and the replacement rate. The extent to which the slope of all individual functions (equation 15A.3) depends also on the rate of return yearly credited to the account balance is discussed later.
7. On the nontax nature of the contributions paid in an NDC pension scheme, see Feldstein (2002, 7).
8. For an interesting discussion of the notion of replacement or compensation rate in the face of different income profiles, see Swedish Social Insurance Agency (2010, 31–32).
9. For the details about the working of the Swedish automatic balance mechanism, see Settergren and Mikula (2006). The Swedish choice to award a rate of return not greater than the average wage growth when the balance ratio is greater than one also ensures substantial intergenerational fairness.
10. Actually, awarding extra rates of return amounts to increasing the slope of all individual functions in equation 15A.3, thus ensuring higher replacement rates for each given contribution rate. Notice that the slope of the functions does not change in the face of a shift in the economic component of the rate of return.
11. The circumstance that the partial derivative of equation 15A.4, $\delta p / \delta W_n$, becomes (slightly) positive when the account balance is capitalized up to year n emerged in private conversation with Mirko Bevilacqua.
12. Therefore, the contribution rate to a newly funded NDC pension scheme can be set to ensure a predefined level of replacement rates for the various individual income profiles. Importantly, the possible existence within Europe of different countries with different preferences about the rates of contribution to compulsory pay-as-you-go public pension schemes would not constitute a problem in view of a possible convergence toward a pan-European NDC pension scheme. For a detailed analysis of the potentialities of such a convergence and the obstacles to its implementation, see Holzmann (2006).
13. Only Sweden has implemented this clear-cut separation with the reform that went into effect in 1998 after a long and careful discussion of the many details implied by the new scheme. In contrast, the rather messy way in which the Italian pension reform was hastily implemented in a few months in 1995 created a big gap between the potential of its design and its actual functioning. For a detailed comparison of the Italian and Swedish implementations, see Gronchi and Nisticò (2006).

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NDC Schemes as a Pathway toward Politically Feasible Pension Reform

András Bodor and Michal Rutkowski

Motivation and Framework for the Assessment of the Political Outcomes of Pension Reform Initiatives

Mainstream thinking about pension reform in the political economy is couched in median voter theory. In that paradigm, agents act rationally and promote their own interests. Public choice over pension reform options is explained in the paradigm in terms of groups—usually demographic groups—pursuing their own interests and of politicians catering to those groups.

This chapter challenges the rational agent assumption underlying the median voter paradigm in a manner potentially useful for pension reform practitioners. The chapter explores an alternative paradigm, based on the idea of collective intelligence, and develops the hypothesis that the role of stories as a driver of human behavior (Akerlof and Shiller 2009) is a much more powerful analytical tool for explaining the dynamics of pension reform than the median voter paradigm.

Following a discussion of the theoretical underpinnings of the collective intelligence thesis, this chapter uses the Polish nonfinancial (notional) defined contribution (NDC) reform to illustrate the role of collective intelligence in meeting the challenges of the political feasibility of attaining macroeconomically sustainable reform of a country's pension system. Collective intelligence, the chapter argues, works through commitment and coalition building. Using the Polish experience as an empirical example, it argues that politicians should use the power of stories (in the Akerlof and Shiller sense) to achieve successful reform. In this chapter, the political feasibility of pension reform is discussed in an environment of bounded instead of pure rationality. The thesis developed here is that the design of NDC reforms itself has specific communicative advantages over that of parametric defined benefit (DB), if judged in terms of political feasibility when the goal is to achieve a financially sustainable pay-as-you-go (PAYG) pension system.

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THE SCOPE AND LIMITS OF THE RATIONAL AGENT ASSUMPTION AND THE MEDIAN VOTER THEORY OF POLITICAL ECONOMY FOR PENSION REFORM

The standard tool of formal political economy is the median voter theory. Simply said, it claims that the preferences of the median voter determine the outcomes of political decision making under a wide range of circumstances. The median voter theory has been widely applied to pension reform as well, with quite a bit of success, if success is measured by the predictions of median voter models being consistent with the observed success of pension reform initiatives.¹ These models assume agent rationality; in the present context, individuals are assumed to assess or observe whether they would be among the winners or losers of particular pension reform proposals. They form their preference rankings and vote accordingly. These assumptions form the basis of the model, which will yield the result that the view of the median voter determines the political or reform outcome. For example, Selén and Ståhlberg (2007) show that the Swedish NDC reform was politically feasible because the value of contributions that would be paid under the reform proposal decreased more than the value of benefits for all age cohorts not older than 53 when the age of the median voter was 47.²

Median voter models are of limited value for policy makers and pension reform practitioners³ confronted with the challenge of PAYG DB pension schemes that are increasingly unsustainable because of deteriorating demographic dependency ratios. Eight key weaknesses of the median voter modeling environment and outcomes can be identified in particular. First, the median voter theory predicts that younger generations are the main beneficiaries and potential political supporters of pension reforms. This recognition may drive the framing of the political discussion and could support “stories” crucial for raising political support for reform proposals; however, this finding is not particularly original and has no connection to the content or logic of the reform model. Sophisticated voters might be right in asking what is new or unique about this reform that is presumed to be so good for them.

Second, the median voter literature on pensions tends to focus on the size of the PAYG system (Persson and Tabellini 2002). That is, the public choice environment determines the size of pensions, whereas the real issue is not the size of the PAYG system, but how to create an adequate and sustainable system of old-age income security.

Third, the median voter modeling environment assumes that benefit-related policy decisions impose a schedule of implicit change (typically an increase) of contribution rates to keep the PAYG financing intact. By now, experience has shown that governments often finance the deficits of the PAYG system out of general revenues, which often contributes to increasing budget deficits and a faster accumulation of the sovereign national debt. In other words, the process works through a mechanism that shifts the burden of the unfunded PAYG liabilities to future generations in a very nontransparent manner. The typical models on the political economy of pension reform do not account for this public choice outcome.

Fourth, most median voter models assume that homogeneous political participation occurs across generations and that all generations are similarly driven in their political preferences toward pension reform options. In fact, a lower participation rate in elections among younger generations is a widely observed phenomenon. Also, the expression

of political preferences toward particular public choice options rarely happens directly through referendums, but rather the political preferences are expressed over portfolios of public policies (and political values) that (feasible) political candidates bring to the political market. It is conceivable that the generations close to or already in retirement are more motivated in the expression of their political preferences by policies affecting the main source of income in their current or near-future life—that is, public pensions—than are younger generations, whose considerations may be dominated by their political preferences for policies affecting more pressing current life conditions in the areas of education, employment, housing, and so forth. In a way, this criticism that older people care more about pension policies than the young already leads to questioning of certain aspects of the rational agent assumption—at least questioning of the time consistency of rational forward-looking preferences. If people were forward looking and if they discounted future cash flows in a time-consistent manner—that is, if short-sightedness did not exist—there would not be a need for a mandatory pension system to begin with (Andersen and Bhattacharya 2010).

Fifth, the median voter models assume that there are no behavioral response options for the younger generations that could eliminate the increasing implicit tax imposed by the PAYG pension systems. In the real world, exit from the pension system is a real option that is often exercised through hiding income in the informal economy or engaging in international migration.

Sixth, the complex and often nontransparent parametric structure of typical PAYG DB pension schemes—including the dynamically changing and barely anchored parameters of contribution ceilings, revalorization of past wages, and income tax categorization of contributions and benefits—makes it hard to see how any individual could correctly estimate the net personal effects of certain reform proposals.

Seventh, the median voter models rely on the so-called full commitment assumption. In simple terms, the assumption is, on the one hand, that the decision-making environment is solid, and expressed preferences do not change on the side of the pension system participant and, on the other hand, that the government is committed to delivering on the promises of the pension system. Once again, in the real world, (a) governments in fact regularly default on earned pension rights and do so in the form of opaque parametric pension reforms; (b) such defaults are anticipated by plan members, who therefore discount the credibility of the government's commitment regarding the pension promises; and (c) plan members change their preferences conditionally, depending on the credibility level they associate with the government. In other words, pension reform proposals exist in the context of “repeated games,” and, therefore, commitments and credibility are endogenous.

The eighth and last criticism of the median voter paradigm as applied to pensions is that the models do not offer any guidance to policy makers on pension reform design and on how the choice of a particular parametric DB reform or an NDC reform that offers a paradigm change can be predicted to affect the political feasibility of the reform proposal.

Once again, the criticism of the median voter approach in this chapter is a practical one: the applications of the model hardly help pension reform practitioners who face a particular challenge of pension system sustainability in their search for politically feasible solutions. Predictions of median voter modeling applications for pension reform that are based on the age distribution of voters or the relative size and influence of winners

and losers remain useful in showing the potential magnitudes of political opposition and support. Some of the points mentioned on general criticism could also be addressed by improving the underlying set of modeling assumptions. But the argument in this chapter is neither about disposing of nor improving the median voter–based study of the political economy of pension reform; it is rather about broadening the perspective to encompass an alternative paradigm, “the power of stories,” which can also serve as a useful tool in the practical politics of reform.

The following section presents the arguments for augmenting the apparatus of political economy applied to the analysis of pension reform with the findings of the emerging field of behavioral economics in a manner that can guide pension reform practitioners in enhancing the political feasibility of sustainability to improve pension reforms.

THE ROLE OF STORIES AND FRAMING IN SUCCESSFUL POLITICAL ECONOMY OUTCOMES

This chapter is by no means the first in line when it comes to questioning some of the core, mainly behavioral assumptions of traditional economics and, in the present case, political economics. Leading figures of the behavioral sciences (i.e., psychology, and economics) held a high-profile conference to reconcile their differences in 1986 in Chicago. The emerging field of behavioral economics and its experimentation approach are getting more and more attention. A key, more recent symbol of how the economics profession is working on internalizing the behavioral critique—and even the associated alternative modeling approaches—is the 2001 Nobel Prize in economics awarded to Daniel Kahneman, a leading voice of the behavioral critique with primary training in psychology, not in economics.

A promising and potentially useful approach to discussing bounded rationality in the public choice process over public pension systems is through the metaphor of Akerlof and Shiller (2009) on the role stories play in driving human behaviors. George A. Akerlof, the 2001 Nobel Prize winner in economics, and Robert J. Shiller, a leading academic in financial economics, claim that the human mind was built in terms of narratives—that is, of sequences of events with an internal logic and dynamic that appear as a unified whole. Social psychologists Roger Schank and Robert Abelson (1995) argue that stories and storytelling are fundamental to human knowledge to the extent that people’s memories of essential facts are indexed in the brain around stories. Shiller’s (2000) book, *Irrational Exuberance*, details how a widely accepted belief (a “story”) about how the Internet revolutionized economic activities in most areas of life drove investor behavior and contributed to the stock market boom, which ran from the mid-1990s to 2000—a story that eventually proved to be a chimera with the bursting of the dot-com bubble. Akerlof and Shiller (2009) explain how the effects of another powerful story, which ultimately proved untrue, led to another crisis; that story—that real estate prices had and would always go up—resulted in the real estate bubble that, when it burst, led to the current global economic and financial crisis.

Akerlof and Shiller highlight the role of stories in politics as well; for example, they point to the research of Edward L. Glaeser (2005), which indicates that hatred of specific groups in society is an equilibrium outcome resulting from politicians supplying stories about past and future crimes, such as atrocities related to the “chosen” groups. Akerlof and Shiller also point to the spike in economic confidence in Mexico under the presidency of

José López Portillo (1976–82). This spike was based on the president’s exaggerated story that the country’s oil reserves, which were at the time unexploited, gave an economic power status to Mexico in the international community (Finnel 2006).

No specific theoretical framework within behavioral economics has been developed for pension issues. Neither has any experimental research been conducted on how the presentation of alternative paradigms might affect voting behavior. So the current state of the science does not support presenting a formal model in this chapter. It is important, however, to establish the substance of behavioral science’s critique of the rational agent assumption and the consequences for the median voter paradigm. To begin with, there are formal modeling approaches that can be applied as an alternative to maximizing the utility of rational agents. The formal approach of interest in the present context is prospect theory, as developed in Kahneman and Tversky (1979) and Kahneman (2003a, 2003b). Prospect theory distinguishes two phases in the decision process. The first phase is framing, referred to earlier. This phase is driven by the norms, habits, and expectations of the decision maker—in this case, an individual voter or a policy maker. The framing process also includes the elimination of decision alternatives seen to be dominated by others. In the second phase, the framed prospects—the remaining alternatives after the framing process—are evaluated, and the prospect of the highest value is selected. Selection among the prospects could happen through either detecting prospects that dominate others or comparing the subjective values of prospects.

Comparing the values of prospects is similar to the expected utility theory, but the subjective value of uncertain outcomes is not weighed by probabilities, but rather through a set of decision weights that overweight low-probability events and underweight high-probability events (Tversky and Kahneman 1986). The difference in weights is the ultimate deviation from the von Neumann–Morgenstern world. The selection of the highest-value prospect through this process is consistent with a property of preferences called *loss aversion*—that is, more intense behavioral response to potential losses than to potential gains. In the present context, prospect theory suggests that potential losers of earned pension rights are more motivated by pension policy in their voting behavior than are potential winners. Prospect theory could also provide an analytical framework capable of explaining why older generations tend to be more driven in their voting behaviors by pension policy positions than are younger generations.

The following section illustrates the existing evidence on the shortcomings of the rationality assumption for analyzing the political outcomes of pension reform initiatives. Later in this chapter, the role of stories in the Akerlof and Shiller sense and framing in the Kahneman sense are discussed with reference to the successful NDC reform experience of Poland.

EVIDENCE ON THE RATIONALITY OF PREFERENCES IN PENSION REFORM

There is now considerable empirical evidence that the rational agent assumption and the associated formal tools of political economy do not adequately model the public choice environment for pension reforms. This section presents examples of empirical research that call into question the rational agent assumption.

The first example of widely cited and known empirical evidence against the use of the rational agent assumption is the 401(k), an employer-administered, voluntary pension

saving mechanism in the United States that enjoys preferential tax treatment. Using data from a large U.S. firm that switched from an active enrollment requirement to automatic enrollment, Madrian and Shea (2001) found that automatic enrollment had a significant effect on enrollment and retirement savings behavior; an enrollment rate of 86 percent was achieved, compared to a rate of 36 percent prior to the policy shift. Simply framing the question as “Check this box if you would not like to have 3 percent of your paycheck put into a 401(k)” instead of “Check this box if you would like to participate in a 401(k) and indicate how much you’d like to contribute” led to this difference. Clearly, in the rational agent environment, the shift in savings behavior in the natural experiment cannot be explained.

Another example is the 2005 proposal by President George W. Bush for a social security reform that would have allowed social security contributors below the age of 55 to set aside 4 percentage points of their total contributions to invest in a “conservative mix of bonds and stock funds” (Bush 2005). The proposed reform would have shifted financing from PAYG to individual savings. Models of political economy on pension reform would predict that younger birth cohorts (winners) would support this proposal and older contributors and pensioners would see it as less favorable. In April 2005, the Fox News/Opinion Dynamics Poll asked, “Thinking about social security contributions, do you think people under the age of 55 should have the right to choose between keeping all of their contributions in the current system and investing a portion of their contributions?” (PollingReport.com 2005). Of the cohort below age 55 and those at or above 55, 84 percent and 74 percent, respectively, answered yes to the question. The findings represent a significant difference in the age-specific preferences in the theoretically predicted direction, but the 10 percentage point gap is small enough to consider the polling outcome as fairly homogeneous across the age groups.

Another Fox News poll in March 2005 was more revealing about the age-specific preferences (PollingReport.com 2005). In that case, the poll asked, “Do you favor or oppose giving individuals the choice to invest a portion of their social security contributions in stocks and mutual funds?” Overall, 60 percent of respondents answered in favor, with 76, 65, 54, and 56 percent being in favor in the below 30, 30–45, 46–55, and over 55 age groups, respectively. The difference in the age-specific political preferences is still less characteristic than how a median voter model would separate the “winners” and “losers” of the Bush proposal based on age. An ABC News/Washington Post poll, also in March 2005, associated the question with the name of the politically divisive president: “Overall, do you support or oppose Bush’s proposals on social security?” Behind the average 37 percent support level stood a small age-group-specific dispersion: 40, 44, 37, 34, and 31 percent supported the president’s proposal among the 18–29, 30–39, 40–49, 50–64, and 65 and older age groups, respectively. The association of the proposal with the president’s name radically reduced the support level, but the shape of the age-related dispersion was similar and remained moderate. However, the support for the proposal varied a lot, depending on the political affiliation of the respondents: 11 percent of Democratic Party supporters, 33 percent of independents, and 88 percent of Republican Party supporters endorsed the Bush policies on social security. The numbers suggest that political party affiliation matters more than age for preferences with respect to political issues such as pension reform. The range, in turn, suggests that there should be a better approach to analyzing political economy outcomes than the median voter theory. The

two polling outcomes—one when the question was asked without associating it with the president and one when the president was specifically referred to (hence opening the door for political affiliation to determine the result)—clearly bring into question the issue of agent rationality.

Other recent research also calls into question age-driven rational preferences in determining voter opinions on PAYG pension reform issues. Boeri et al. (2001) researched preferences regarding pension systems in France, Germany, Italy, and Spain in the context of surveys on the welfare systems. First, they showed that individual assessments of the net gains of various pension reform proposals are constrained by plan members' lack of knowledge on basic parameters of the pension system, such as the contribution rate assessed on wages: only 43, 42, 64, and 28 percent of respondents, respectively, could correctly identify the range of the pension contribution rate in France, Germany, Italy, and Spain, respectively. The authors then addressed preferences over partially opting out of the pension system in different ways. The first method of opting out would reduce the contribution burden by half; the reduction in contributions would show up in an individual's paycheck in exchange for a reduction by half in the pension benefits the individual would later expect to see had he or she not opted out. The policy of opting out then represents a pension reform that shifts away from PAYG financing toward a larger role for individual savings in old-age income, without consideration for the transition costs of such a reform. In France, Germany, Italy, and Spain, the percentage of respondents who would opt out are 24, 47, 47, and 19 percent, respectively, and of those who would opt out, more than 85 percent responded that they would either "save all" or "save most" of the extra pay in all four countries.

One can approach the rationality of the decision to opt out in multiple ways. If the individuals assume that pension contributions will need to cover pension benefits as the demographic dependency further deteriorates, and if they believe this outcome will be achieved primarily through increasing the contribution rate, then it would be rational for the younger generations to opt out. From that perspective, the ratio of respondents wanting to opt out seems low. In contrast, if individuals assume the internal rate of return of the pension systems will stay close to the current (generous) levels regardless of the financing issues (i.e., the contribution rate and benefit formula will remain stable and any revenue shortfall will be covered by general government revenues), then the rationality of the decision to opt out depends on the incidence of the overall tax burden funding the general budget and whether the PAYG pension deficits are financed through taxes or through the issuing of debt to be repaid by future generations.

In the same study, Boeri et al. (2001) also discuss individual preferences regarding a more restrictive version of opting out, similar to the previous one but with a relevant difference: the reduction in the contributions would be put in an investment fund of the individuals' choice. Hence, the shift toward a more individual savings-based old-age income allocation would happen through mandatory rather than voluntary saving. Contrary to the theoretical prior—that is, that the constraints on the use of individual funds should make this opt-out version less desirable—the ratio of respondent preferring to opt out under this version of reform increased by 20 to 44 percentage points to 50, 71, 67, and 63 percent in France, Germany, Italy, and Spain, respectively. The counterintuitive increase in support for the restrictive version suggests that many respondents were afraid of their own negligence toward saving for old age; they preferred

having a system in place that would force them to save without any cautious effort on their side. This phenomenon cannot be explained in the traditional agent rationality context; in fact, the result suggests that individuals are aware of their own bounded rationality, and they seek policy options that protect them from the consequences of their own shortcomings.

In one more layer of analysis on preferences toward pension reforms, Boeri et al. (2001) attempted to make the decision situation in the survey more realistic by notionally imposing the burden of the transition costs of the underlying reform. If covered pension plan members were able to opt out of the PAYG scheme, some other financial mechanism would be needed to cover the resulting revenue shortfalls to finance the pensions of current pensioners. To model such a pension reform decision, the survey asked an additional question of those who wanted to opt out under either the conditional or the unconditional versions discussed earlier. That question asked whether they would choose to opt out if they were required to absorb part of the transition costs in the form of a reduction in their own PAYG pensions. In particular, survey participants were asked if they would opt out if a 50 percent reduction in the contributions would be accompanied by a 55, 60, 65, 70, or 75 percent reduction of their PAYG pensions. Opting out, or in a broader sense, pension reform, is much less popular if one needs to participate in paying for the unfunded liabilities of the PAYG system. Of those who said they preferred to opt out if they did not need to contribute to the transition costs, now 63, 75, 74, and 48 percent would not opt out in France, Germany, Italy, and Spain, respectively, even if the contribution to the transition cost would be as low as 5 percent of the pension the individual would earn without opting out.

These results are consistent with the known difficulty in gaining political support for a pension reform intended to improve the financial sustainability of a PAYG scheme. The radically reduced interest in opting out if doing so also requires a contribution toward the unfunded liabilities of the PAYG scheme appears to be consistent with the loss-aversion decision making described under the prospect theory of Kahneman and Tversky (1979). Also, the Boeri et al. (2001) research provides an implicit argument for the NDC-style reform. If the pension reform design alternatives are not between parametric DB and paradigmatic NDC reforms that do not affect the PAYG financing and instead a DC design will be introduced through a funded or PAYG (NDC) scheme, the NDC reform would appear to be politically more feasible given that such a reform would not generate transition costs—or at least the transition costs would be significantly lower than under a similar financial defined contribution (FDC) reform.

The bottom line is that a large set of evidence undermines the applicability of the rational agent modeling environment and, indirectly, the usefulness of the median voter theory in assessing the political economy of PAYG pension reform. The rational agent assumption was contradicted by a natural experiment on 401(k) enrollment behavior in the United States. In addition, in the case of the Bush pension reform proposal, age-specific voter preferences were less dispersed than what the median voter theory would suggest; in fact, political affiliation seemed to be a better predictor of voter preferences than age. Furthermore, survey results from France, Germany, Italy, and Spain suggest that voters are aware of their bounded rationality when it comes to long-term savings behaviors, and, therefore, they tend to prefer constraining policies that protect them from the consequences of their own behaviors.

THE CHANGE PROCESS ANALYSIS FRAMEWORK AND THE EXPERIENCE OF SUCCESSFUL STRUCTURAL REFORMS

This section introduces the change process analysis framework of Isaacs (1999), which will be used later in this chapter to present the experience of the Polish NDC reform. That introduction is followed by a discussion of the key characteristics of successful reforms based on Organisation for Economic Co-operation and Development (OECD) publications, the links between policy change frameworks, the experience of successful reforms and the roles of framing and stories in reform attempts and outcomes, and the proposed new approach to assessing the political economy of pension reform. In essence, this section describes the links in the argument of the remainder of this chapter.

The key phases of a reform process include the commitment- and coalition-building phases (Isaacs 1999). The *commitment-building phase* of a reform is the phase before a government has made a firm commitment to a specific reform measure. Orenstein (2000) identifies two types of actors in the reform process: veto actors and proposal actors. *Veto actors* are parties and politicians who have the power to veto a proposal. *Proposal actors* are those who have ideas about different ways to reform. The two types of actors debate in a set of deliberatory forums, which include the group of reformers, the parts of the government, the media, the parliament, and other bodies. The commitment-building phase, roughly following the change process analysis of Isaacs (1999), consists of the subphases of initiation, discovery, and reform group formation. These general phases and subphases will be illustrated through the case of the NDC reform in Poland later in this chapter.

The *coalition-building phase* of the reform is defined as the stage between the choice of the model and the eventual implementation of reform by legislative act. The process involves a lot of bargaining with reform partners, generative discussions, compromise, legal and technical work, and public information campaigns. In the coalition-building phase, again following the logic of Isaacs, the subphases are reality check, generative dialogue, and identity commitment. The coalition-building phase and subphases will also be illustrated using the case of Poland.

In both the commitment-building and the coalition-building phases, following Orenstein's (2000) framework, different actors take part in the process as either proposal actors or veto actors. Beyond Orenstein's framework, it is worth noting that other actors also come into the process as followers or bystanders.

When one is analyzing the roles of commitment and coalition building, it is worthwhile to review what are generally held to be successful reforms in developed countries. An OECD study on the political economy of reforms summarizes the common features of successful structural reforms in OECD countries using methods that could be useful for pension reform practitioners (OECD 2009a). The study suggests that, in the political context, elections matter a lot. For example, reform architects who can claim an electoral mandate (i.e., those in a position of strength after an especially large election victory) are more successful in passing meaningful reforms. The state of the political opposition also matters, but to a lesser degree. Finally, the involvement of different levels of government in the reform (e.g., under a federal structure) tends to shape significantly the design of the reforms. Additional findings of the OECD study are that (a) effective communication and consultations pay off, including communication on the costs of inaction; (b) major reforms may benefit from institutions that foster consensus; (c) research capacity

to support the reform design development is important; (d) the government's ownership of the reform and the unity of the government in supporting the reform effort are crucial; (e) smart politics prescribes leaving (at least in the short run) acquired (pension) rights unaffected as much as possible (although the resulting long transition periods create the risk that later political interference will undo the reform); and, finally, (f) the potential losers of the reform are more likely to mobilize politically than the winners.

Commitment- and coalition-building tend to be important components of the reform process if they emerge organically and not under the influence of especially urgent pressure. The environment of an economic crisis changes the dynamics of policy development and also changes the environment of the political economy. In general, business cycles are less important than the long-term fiscal pressures. Another recent OECD study addresses whether crisis situations, in general, and the recent global economic and financial crisis, in particular, facilitate structural reforms (OECD 2009b). The general finding is that crisis environments create an intense pressure for politicians to do "something," which allows a greater degree of freedom to introduce otherwise politically unpopular measures but also may lead to fundamentally flawed reform measures.

An especially interesting aspect of the crisis response is the wave of parametric pension adjustments in Europe, including, but not limited to, reforms in France, Greece, Hungary, and Romania between 2009 and 2011. The common thread among these reforms is that they are all parametric adjustments to the existing PAYG DB schemes that attempt to immediately relieve the fiscal pressures borne in the PAYG pension systems (e.g., Nektarios 2012). Countries introduced increases in the retirement age, cut back on early retirement provisions, and reduced the generosity of pension indexation rules to lessen fiscal pressures and improve the financial sustainability of their PAYG schemes. However, these ad hoc interventions all fall short of complex pension reforms that would change the pension system comprehensively to address sustainability, benefit adequacy, and incentives simultaneously for the long run.

The crisis environment changes the political context and the framing of pension reform decisions. At times when investors are no longer willing to finance the increasingly unsustainable government deficits and debt accumulation, the alternative to enacting austerity measures (including pension reform) is a total collapse of government services, including a failure to pay wages to public servants and benefits to eligible beneficiaries of government programs. In such a situation, politicians cannot select a popular decision alternative, and inaction is also extremely unpopular. A stance supporting pension reform driven by fiscal pressure is no guarantee for any politician to get reelected, but it may prove to be the lesser of evils. In other words, the emerging story for pension reform at a time of crisis (in the Akerlof and Shiller sense) is that it is the price of avoiding the complete default on the government's obligations, including the severe consequences.

The recent wave of parametric DB reforms in Europe is by no means evidence suggesting that such parametric DB reforms are more feasible politically than paradigmatic NDC reforms. This chapter argues later that the NDC design has advantages in terms of political feasibility, but an NDC reform needs a longer period for organic design development than the hasty pension system adjustments of 2009–11 in Europe, which emerged with the single objective of improving the government's fiscal position. In other words, crisis times may be more conducive to less comprehensive parametric PAYG DB reforms, whereas at normal times, not only does NDC reform offer a more comprehensive

improvement for old-age income security, but it also may do so in a more politically feasible manner.

The remainder of the chapter is divided into two sections. The first argues why the power of stories in the Akerlof and Shiller sense and framing in the Kahneman sense make the NDC reform design superior to parametric DB reforms in terms of political feasibility when the goal is to improve the sustainability of a PAYG scheme. The second section illustrates those arguments for the superior political feasibility of NDC reforms using the experiences of the Polish pension reform and features how framing and the power of stories supported commitment building and coalition building.

Policy Characteristics: Why NDC Could Be Desirable for Political Leaders and Pension Reform Practitioners Interested in Simultaneous Problem Solving and Maintained Political Success

This section builds on the work of Akerlof and Shiller (2009), who claim that economic models of the behavior of human agents overemphasize rationality and underemphasize the role and strength of stories. The power of stories takes effect through a mechanism that makes the convoluted and multidimensional human decision environment sufficiently simple to allow individuals to impose a certain degree of rationality of their own type that drives their behaviors. For example, Akerlof and Shiller describe how the widespread belief in simple (and possibly untrue) stories—such as that real estate prices have always gone up and will only do so in the future—can explain the emergence of the recent global financial and economic crisis. This chapter argues that the unique characteristics of NDC schemes provide an opportunity to frame reform in terms of stories and that policy makers can develop and use such stories to present characteristic features of desirable pension reform to gain broad acceptance among voters, despite the predictions of median voter models. The argument is not that NDC reforms are necessarily popular; it is that the stories emerging around the desirable features of NDC schemes could reduce the political risks of pension reform for reforming politicians to a degree that will allow problem-solving political leaders to include it in their broader political aims.

The arguments on the political feasibility of NDC reforms in this chapter are not related to the suddenly improved feasibility of pension reform under the conditions of a severe economic crisis. In fact, crises are more conducive to (often hasty) parametric cost-cutting changes in PAYG DB rules that are void of the logic needed to create long-term public trust and acceptance. The best recent example is that of Greece (e.g., Nektarios 2012). Paradigmatic reforms such as NDC require a longer process of design development, which means that public communication must make the case for the paradigm change, and time has to be allocated to the implementation process. Those needs are beyond what can be effectively handled as a spontaneous response to an economic crisis. In the end, however, NDC reform is capable of responding to and overcoming the undesirable political economy equilibriums that often undermine parametric PAYG DB reforms.

The stories about the desirable features of NDC schemes in the following subsections are on (a) the flexibility of the retirement age, (b) the quasi-ownership rights of individuals over their own NDC balances, (c) the credibility of financial sustainability under

NDC, (d) the possibility of creatively reflecting social preferences in a transparent and consistent manner, and (e) the possibility of linking other social insurance benefits such as unemployment insurance to NDC accounts. Among the creative social benefits addressed are (a) benefits in conjunction with childbirth and care of younger children, (b) benefits for persons in the armed services, and (c) possible default rules for joint ownership of spousal NDC pension account balances. The chapter also discusses how NDC schemes can be an alternative to the existing (prefunded) FDC schemes in countries that have restricted access to international capital markets and do not possess a developed domestic capital market.

This list of the desirable features of the NDC design is by no means complete. In fact, it cannot be. The personal account scheme generic to NDC provides many opportunities to consider socially desirable extensions that in a creative implementation process can lead to what this chapter calls the power of collective intelligence—a dynamic political process that can emerge in the deliberations around designing a country's NDC scheme. That concept is discussed later using the reform in Poland as an example. The presentation of NDC policy characteristics in the chapter is topical, addressing some of the previously underemphasized NDC design opportunities that are associated with the political feasibility of desirable pension reforms.

FLEXIBILITY OF THE RETIREMENT AGE

One of the strong merits of NDC is that it provides a completely new framework for flexible retirement, allowing workers to combine any portion of work with various portions of a pension. The participant can even discontinue working for a period and then continue, with all new contributions leading to a commensurate increase in personal accounts and future benefits. So, how does this approach compare with DB schemes, the NDC political counterfactual?

The retirement age in DB schemes is also typically flexible, even though it is not perceived to be so. Flexible DB schemes allow retirement before the statutory retirement age (within limits), and they can also accommodate retirement beyond the statutory retirement age. Early or delayed retirement is typically associated with reductions or increases in pension benefits. However, a typical feature of many existing DB pension schemes is that too generous early retirement rules do not reduce the pension benefits in an actuarially fair manner. For this reason, many parametric pension reform attempts have introduced actuarial fairness into the creation of benefits within a certain age range. The expected dual outcome of such reforms is improved financial sustainability for the pension scheme and increased labor force participation in the overall economy.

The DB notion of the statutory retirement age suggests, however, that the decision about the time of retirement is a collective one that is determined through the political process. In this way, the notion of the statutory age sends a message to both workers and employers that it is the age at which people are expected to exit the labor force. NDC schemes are the counterfactual, where the retirement age is seen as the individual's decision. By design, an NDC (or, generally, a DC) scheme accommodates flexibility in the retirement decision in an actuarially fair manner.

In fact, (N)DC makes the notion of the statutory retirement age obsolete. The main reason to administratively constrain the time of retirement under a well-designed NDC

scheme is to limit irrational individual decisions to retire too early with a low pension, as such decisions can jeopardize income security in old age. The minimum retirement age, then, works toward creating adequate retirement benefits. In fact, the opportunity to retire with too small a pension imposes a moral hazard problem and would likely burden the social safety net (minimum pension guarantee) in a lot of cases. The age when an individual starts drawing pension benefits and the age when the same individual leaves the formal labor force do not need to coincide under a well-designed NDC system. A partial pension for any number of years simply constitutes a deduction from an individual's account, and continued work, whether full time or part time, constitutes an addition to the same account. Any period can comprise both a deduction and an addition to the account. This approach is more complex in a typical DB scheme, especially if the DB scheme also involves nontransparent intra- or intergenerational redistribution.

Prohibiting individual decisions that would risk old-age income security or would institute a moral hazard problem does not have to happen through the retirement age under an NDC scheme. Under the assumptions of rationality, full information, and absence of moral hazard, individuals should be free to determine their supply of labor. In an NDC scheme, the only age that is important is the age at which people are permitted to claim a minimum or guaranteed benefit. Whether an individual's pension is sufficient for that person to retire without the risk of poverty (possibly even considering the income needs of the entire household) before reaching old age is then contingent on the individual's NDC account balance and life expectancy at the time the individual contracts the annuity.

The guaranteed benefit age is the age that creates eligibility for low-wage or low-contribution-density individuals to access top-up subsidies to their NDC accounts. But it is also the age that people who have engaged in the informal economy (and have contributed less than they could have or nothing to the NDC scheme) must wait for to get a lifetime social benefit. Others can be allowed to choose to receive benefits any time after the general minimum retirement age. Of course, the eligibility age for accessing the top-up subsidy should be sufficiently high, marking a milestone age at which one cannot be expected to generate sufficient labor income.

An administrative test is necessary to determine whether the expected pension of a person who chooses to retire prior to the age at which a minimum benefit becomes available can be expected to be at or above the social minimum. This need raises the question as to whether individuals should actually be allowed to claim their (N)DC pensions at any age, because doing so gives them the opportunity to claim an NDC pension equivalent to the level of the expected minimum pension when they reach the minimum pension age. Hence, in developing countries—or even sectors in developed economies where informality may be widespread and it is difficult for the authorities to monitor compliance—this arrangement enables older workers to claim an NDC benefit and thereafter work informally for the rest of their working careers. Seen in this perspective, a case can be made for establishing a minimum pension age for claiming any NDC pension at all. That age could be lower than the age for the social guarantee. For example, in Sweden, one can claim a pension as early as 61 years of age, but eligibility for the subsidized minimum pension guarantee opens only at 65 years of age. What is unique for NDC schemes in comparison with PAYG DB schemes is that early exit does not affect the long-term finances of the scheme because of its actuarial nature. Early exit does, however, affect short-term financial liquidity, because opting out of the formal system early deprives the system of money.

Because the process of determining at an early age whether an individual will be able to reach the guarantee age without having to claim a guarantee is difficult—the determination has to depend on an assumed future income stream—a case can be made for both a minimum age and a higher age at which the social guarantee kicks in.

Next, how does the flexibility of the retirement age under the NDC design give rise to a story that can be used by problem-solving politicians and pension reform practitioners to make this aspect of a desirable reform salable or politically feasible? The story is about taking the retirement decision away from the political system and empowering individuals to make informed decisions about whether they want to retire early with lower pension benefits or later with higher pensions. Inevitably, there are life situations in which a lower retirement age is expected to give a greater lifetime benefit than a higher retirement age (e.g., in the case of life-threatening sickness). The power of this flexible retirement story takes effect through the symbolic and effective abolishment of the institution of the statutory retirement age. The abolishment of the statutory retirement age also symbolizes the discontinuation of the opportunity for politicians to alter ad hoc the generosity and age range of early retirement provisions.

Finally, note that this chapter does not argue that the spectrum of an individual's retirement decision under an NDC scheme is necessarily broader than it is under a closely equivalent DB scheme. What is argued here is that abolishing the statutory retirement age and eliminating the opportunity for ad hoc political interventions that limit or expand the generosity and the age range of early retirement under a DB scheme credibly shift the power of the retirement decision from the political arena to the individual.

Accounts and the annuity factor are the key ingredients of NDC that distinguish them from the DB counterfactual. Together they provide effective incentives that can influence retirement behavior through the combination of (a) the changing individual NDC account balance and the age of retirement needed to achieve the targeted pension level or (b) the changing NDC account balance and the age of retirement necessary to reach the pension threshold allowing retirement. The former mechanism forces changes in the retirement behavior of those (rational) individuals who optimize their age of retirement and their old-age income trade-off through the public pension system. The latter mechanism forces changes in the retirement behavior of people who for some reason (e.g., moral hazard, short-sightedness, or lack of trust in the public pension system) would like to start accessing their pension wealth as early as the system allows.

In sum, first, the story in conjunction with the retirement question shifts the responsibility from ad hoc and often nontransparent political adjustments to a logical, transparent system where individuals can choose, within certain limits, what best suits their own life situation. Second, NDC, with the design features described here, takes the burden off the political system to process unpopular regular adjustments to the parameters of the pension system. Responsible players in the political system should welcome such changes, which eliminate political decision-making obligations about the pension age that, at worst, foster irresponsible political behavior focused on maximizing political popularity. The case of Poland illustrates how the reformers consciously worked with stories. One of the stories of the reform was the creation of transparent acquired rights in closing the old system. The logic of the story was strong enough to gain popular support for reform even though the value of acquired pension rights was reduced. Finally, the power of the story on the individual's autonomous choice in the timing of retirement has the same potential

in the market of ideas framing the political discussion on pension reform. Pension reform practitioners who plan to exploit the popular flexible retirement notion associated with NDC need to be aware that the flexibility offered through the pension system can be harvested only to the extent allowed by the underlying labor market flexibility in terms of altered labor market exit patterns.

THE EMERGENCE OF QUASI-OWNERSHIP RIGHTS OVER NDC BALANCES

The terms *acquired pension rights* and *pension wealth* are widely used by pension experts but are obscure concepts for the average pension contributor. Because of the convoluted interaction of the parameters of typical PAYG DB pension schemes, it is important to predict what pension a midcareer contributor would enjoy at various ages of retirement if he or she stopped contributing to the system now. It is hard in typical DB schemes to calculate the expected present value of the corresponding pension payment flow: the individual's earned pension right. In fact, one of the key challenges of an NDC reform is how to value acquired rights and convert them into NDC account balances (Palmer 2006b). However, once an NDC system is in place, following the evolution of pension rights for each individual is extremely easy. It is simply the individual's account balance. There is great potential to frame the public debate about the pension system around the psychological effects of knowing the value of one's pension wealth at earlier stages in one's active life and around the advantages afforded if one can predict and prepare for the income replacement the pension system is likely to provide given an individual's feasible future career paths. A well-designed NDC system that makes good information about individual pensions available to plan participants fulfills this role and can be a part of the story.

The experience of the Latin American FDC reforms has caused many to question the existence of such psychological effects, because the reforms, which also made the value of the pension wealth promptly available and known, have to date failed to attract people working in the informal sector to contribute and, by doing so, to enroll in the pension system. A discussion of labor market developments resulting from the pension reforms in Latin America is beyond the scope of this chapter. However, likely factors driving the observed labor market outcomes are the widespread nonvoluntary exclusion in the informal sector; the fact that enrollment in the pension system makes income observable to other government agencies (e.g., the tax authority); and general distrust in both public and private institutions, inherited from a history of widespread corruption and unstable governments.

In contrast to the picture coming from DC reforms—primarily those in Latin America—Disney (2004) presents results that make the existence of NDC-related psychological effects plausible. Using a cross-country empirical study, Disney shows that the stronger the link between contributions and pension benefits (i.e., the higher the weight of an individual saving component in the contribution rate) and the weaker the role of redistribution within the pension system (i.e., the smaller the weight of a tax component in the contribution rate), the higher the (formal) labor force participation rate will be. Disney's result suggests that pension plan members respond to incentives even if the mechanisms through which the incentives take place are nontransparent. The regular and transparent feedback about the evolution of the individual pension wealth in the form of an NDC balance (especially in an economy where informal sector participation is rather rare or is associated with a stigma, such as in many of the OECD countries in Disney's

dataset) represents the benchmark case for the “right incentives” and can thus enhance the political feasibility of an NDC design-led reform.

Governments frequently default on earned pension rights under a typical PAYG DB scheme. In fact, governments often limit the implicit pension debt by modifying system parameters in a way that reduces the value of individual pension rights in a *nontransparent* manner. These often unavoidable parametric reforms are by no means politically popular, but the loss incurred by specific social groups and individuals is opaque. Frequent changes in DB pension parameters and the associated devaluation of pension rights contribute to diminishing public trust in the government’s ability to deliver on the pension promises that may even pervade over decades, leading to suboptimal individual saving decisions. The transparency of the individual account balances in NDC limits the government’s ability to default on pension promises once the NDC scheme is in place. NDC schemes are rule based and explicit. Therefore, any political deviation from the rules entails an attack on individual accounts and can be regarded as cheating on the part of the government. Given that the NDC scheme is appropriately designed, NDC offers thus a first line of defense for earned pension rights.

The value of NDC balances is protected from undue political interference by the simplicity and transparency of the design. This openness could induce increased trust in the pension system’s ability to deliver on its promises, especially if all the rules are specified explicitly in the law, as is the case in Sweden. A paradox in the implementation of NDC is that the initial NDC reform allows for a one-time (quite possibly nontransparent) devaluation of pension rights, but once the NDC system is in place, any attempt to devalue earned pension rights becomes extremely difficult.⁴ The second paradox of NDC reform is that a series of parametric adjustments may be less severe in reducing earned rights than the conversion of DB rights into NDC balances at the time of an NDC reform, but the NDC reform may still be politically more popular. Beyond arguments about transparency, the other explanation of the second paradox is the popularity of allowing individuals more control over pension wealth accumulation, resulting in the emergence of quasi-ownership rights over NDC balances.

Finally, from the perspective of individuals, NDC individual account balances can be viewed as financial assets that individuals cannot access during the accumulation phase. Once the quasi-ownership over NDC balances and the corresponding emergence of the special NDC account balance asset are understood in their true nature, this recognition can give rise to a large set of pension system innovations and stories. Granting quasi-ownership over the individual pension wealth in a public pension system through NDC can also be a powerful story, which could contribute to framing the public debate over pension reform.⁵

LEVERAGING OF PENSION WEALTH FOR BETTER PROTECTION AGAINST UNEMPLOYMENT RISK

The creation of individual accounts makes it possible for individuals to transfer the future entitlements embodied in current pension accounts to current rather than future consumption needs. Under certain circumstances, such leveraging of the pension wealth could be welfare increasing over the life cycle. Vasoo and Lee (2001) describe some innovations in the Central Provident Fund of Singapore that allow participants to exploit the harmonized and integrated provision of various social insurance benefits, such as old-age,

disability, and survivor pensions and work injury, unemployment, and health insurance benefits. Stiglitz and Yun (2005) show that the joint integration of several social insurance programs with a pension program through individual accounts is desirable unless the risks are perfectly correlated with each other. Building on the same argument, Robalino, Vodopivec, and Bodor (2009) discuss one specific innovation in the integrated provision of social insurance benefits that leverages the individual pension wealth for better protection against the risk of unemployment.

Recent innovations in unemployment insurance emerging from Latin America responded to the inherent problem of moral hazard in unemployment insurance mechanisms that pool risks. That problem is especially dire in environments where the true labor market status is hardly observable. The innovation, so-called unemployment insurance savings accounts (UISAs), shifted the underlying mechanism toward mandatory (precautionary) saving. The savings in an individual's UISA are accessible if the individual becomes unemployed; the UISA balance then finances income replacement for a reasonably long job-search period.

The weakness of the UISA design is that many people who become unemployed have not generated sufficient savings to finance the benefits during the unemployment spell. Increasing the contribution rate to address this problem may lead to oversaving and an excessive burden, unnecessarily raising the cost of labor.⁶ Until recently, the benchmark solution to this problem was the Chilean UISA mechanism under which the mandatory saving component was augmented with a smaller component of risk pooling to top up the UISA account balances of those who become unemployed before saving sufficient amounts. Although this solution has proved an adequate response in the Chilean environment, the introduction of risk pooling may not be feasible in countries where the moral hazard induced by risk pooling is a larger problem.

The recently enacted legislative proposal of the government of Jordan establishes a UISA scheme without a risk-pooling component. Under the scheme, people who become unemployed with insufficient savings can borrow against their pension wealth within certain limits. Amounts borrowed from the UISA accounts can be repaid through the contributions that restart once the individual finds a job. Alternatively, if the individual retires with a negative UISA balance, the repayment happens through deductions from the pension benefits.

Leveraging the pension wealth for better unemployment insurance protection should be possible only if the related borrowing does not jeopardize old-age income security. The existing overall income replacement pattern of the Jordanian pension system is sufficiently protective against old-age poverty even if plan members retire with negative balances on their UISA accounts. In fact, a direct reduction of the replacement rate of the pension system to a level that is justifiable from the old-age income security and affordability viewpoint is hardly politically feasible in Jordan. The newly introduced UISA mechanism, however, in effect reduces the net replacement rate of the pension system for people who, because of unemployment, use the option to draw on accounts, and it pays out the saving balance at retirement to people who are unaffected or hardly affected by unemployment. The problematic issue in the Jordanian case is how to define the borrowing limit against pension wealth. Ideally, the borrowing limit should be a function of pension wealth. However, the Jordanian scheme is a PAYG DB system under which the calculation of individual pension wealth is convoluted.

At the middle-income level of a country's development path, the coverage of the social insurance system should be enriched to include protection against a broader set of social risks, including the risk of unemployment. Pension systems are typically already in place in countries that are considering the introduction of unemployment insurance. In developing countries that risk a massive moral hazard problem, introducing UISAs with borrowing against the pension wealth not only is logical, but also quite possibly will prove politically popular. The argument here is not for a general shift from insurance to savings in managing unemployment risk, but rather for facilitating the right combination of mandatory saving and risk pooling as a function of the severity of the moral hazard problem, which in the governance conditions of many developing countries could be extremely high. In other words, in some countries, the political popularity of the measure comes from simply making the management of the unemployment risk feasible. Designing a UISA scheme that allows borrowing in general and that sets a borrowing limit in particular can be done more precisely to achieve the optimal amount of pension wealth leveraging if the accumulation of pension wealth is easy for a person to follow throughout his or her career.

This potentially politically popular social insurance feature provides an additional argument as to why the PAYG pension component of the social insurance system should be set up in the form of mandatory individual accounts—which, when combined with NDC, provides an account balance the individual can draw on up to the UISA borrowing limit. The bottom line is that the UISA in the NDC framework can be viewed as an attractive feature by workers, thus promoting the NDC design of a PAYG pension scheme, a potentially useful “frame” for the policy maker. This combination of saving tools in the social insurance design could strengthen a psychological relationship to the notion of pensions and broader social insurance, wealth that is hardly possible in objective ways under DB pension design. In addition, the relevance of the pension wealth is improved through the NDC-UISA with borrowing link from the perspective of plan members because, in justified cases, the opportunity to borrow against it provides an important use of this otherwise abstract construct during the active life cycle. The NDC-UISA link can thus improve the life-cycle consumption-smoothing support in a manner that is also politically popular.

FISCAL SUSTAINABILITY AND INTERGENERATIONAL EQUITY

Financial sustainability has been the main driver of pension reform during the past two decades in high-income OECD countries and the European Union. Expressed in another way, reform has been driven by the demand for intergenerational equity; that is, reform has been undertaken on behalf of the younger generations that would have to pay increasing contribution rates in the absence of reform. NDC presents an order for dealing with this issue that appeals to a popular conception of fairness. NDC provides a technical means of achieving intergenerational fairness since the fixed contribution rate is a *sine qua non* of NDC. A fixed contribution rate is a desirable feature of a pension scheme in the eyes of the public and is one of the stories emerging from the shift to the NDC paradigm.

What is interesting in this context is the number of countries that have chosen the NDC paradigm. To begin with, according to Chłoń-Domińczak, Franco, and Palmer (2012), financial sustainability was a main driving force for the first wave of NDC countries reforming in the 1990s—Italy, Latvia, Poland, and Sweden. Financial sustainability

has also driven the most recent reforms in Germany (Börsch-Supan and Wilke 2006) and Norway (Christensen et al. 2012). In all of these countries, the demand for intergenerational equity—clothed in the public discussions of what would be left for the younger generation of workers—turned the question of long-term financial sustainability into an issue of equity for younger generations of workers. Financial sustainability and the burden of the underfinanced PAYG DB scheme on the sovereign debt in Greece was also the reason a strong parametric reform was rushed into legislation in the summer of 2010 (Nektarios 2012).

Depending on the extent to which a particular PAYG DB pension scheme functions as an intergenerational Ponzi scheme, certain groups of contributors may feel that the pension system will be unable to deliver on the promises made to them.⁷ The recurring devaluation of existing pension wealth, in the form of parametric reforms inherent in the Ponzi-game-like construction of some DB schemes may also serve to validate this fear. This experience may explain why FDC reforms have been popular within certain social groups. FDC schemes are financially sustainable by design, as are NDC schemes if augmented by an adequate balancing mechanism. Therefore, NDC reforms can attract the support of those who would like to ensure the government's capability to deliver on its pension promises in the distant future.

People's trust in the government's ability to deliver on its obligations differ from country to country, and they are not necessarily directly correlated to the government's actual ability to deliver on its promises. For example, large groups of voters in the United States express their worries about the social security system's capability to pay pensions in the future even though the increase in the contribution rate needed to achieve unsustainability of the U.S. social security system is very modest by most standards. Given social attitudes favoring long-term sustainability, DC design in general—and, therefore, NDC in particular—may have an important latent, if not openly active, supporting constituency.

For NDC schemes to receive FDC-level support from the sustainability hawks, the NDC model to be introduced must be properly designed so that future contributions, which can be called the *contribution assets*, cover liabilities. There is now considerable evidence based on modeling of long-term flows of payments and contributions under various extreme assumptions of how well-designed NDC schemes maintain financial sustainability—for example, Latvia (Palmer et al. 2006); Norway (Christensen et al. 2012); Poland (Chłóń-Domińczak and Góra 2006); Sweden (Swedish Social Insurance Agency, various years); and stochastic simulations for U.S. data (Auerbach and Lee 2009). Robalino and Bodor (2009) also show that the sensitivity of PAYG financing to demographic and economic shocks is handled by NDC reform. Evidence also suggests that poorly designed or poorly implemented NDC schemes will not maintain financial stability under less favorable economic demographic conditions, as for Italy, especially prior to legislative changes finally introduced in 2012 (Chłóń-Domińczak, Franco, and Palmer 2012), and Russia (Hauner 2008).

It is beyond the scope of this chapter to assess the existing NDC balancing mechanisms. Nevertheless, there is room for improvement: even the widely acknowledged best existing mechanism being used in practice, the Swedish automatic balancing mechanism, has its flaws. Conceptually, the Swedish system is not based on a unique definition of assets (see chapter 19, in this volume). In addition, the Swedish system has no planned accumulation of reserves to accommodate short-term downfalls in the contribution base or the value of the reserve funds, which under some circumstances can lead to unnecessary (usually temporary)

reductions in benefits (Barr and Diamond 2009). Robalino and Bodor (2009) show how the estimation of the PAYG asset as used in Sweden would be problematic if applied in other countries with less favorable fertility patterns. Holzmann, Palmer, and Robalino (in chapter 20 in this volume) show how reserves can be used to smooth the effects of temporary demographic and economic shocks. These are fringe issues, however, and on the whole, the Swedish mechanism can be regarded as best practice for estimating assets and adjusting liabilities with a solvency ratio of assets to liabilities when the ratio falls below unity.

In sum, the financial sustainability story, which is a major pillar in FDC reforms, can be developed to support NDC reforms as well.

LINKING OF SOCIAL BENEFITS TO NDC PENSION ACCOUNTS

The main mechanism of an NDC system is that it is tantamount to a mandatory individual saving scheme on the microlevel, supported by an underlying PAYG financing mechanism. Consequently, pure NDC has no redistribution across plan members. This characteristic does not mean that NDC cannot accommodate distributional policy, however. As discussed earlier, the NDC scheme must have an externally (general revenue) financed guarantee level that tops up the NDC pension for individuals with small or no capital balances. Alternatively, the NDC scheme could be placed on top of a universal flat-rate scheme. In addition, the government could pursue social policy by creating rights that are financed by government contributions into individual accounts. NDC schemes facilitate transparent redistribution, thus augmenting the main saving function of the NDC pension scheme, which is to redistribute consumption from the time an individual begins working to retirement. The transparency of redistribution in social policy–augmented NDC schemes contrasts the lack of transparency and often regressive redistribution in PAYG DB schemes. This chapter provides two examples of how social policy can be integrated into the NDC account framework to improve the political feasibility of pension reform given country-specific social preferences, with possible framing of the associated political communication.⁸

Social policy in conjunction with childbirth and child care. Government or social insurance programs often provide income replacement, in the form of maternity benefits, for an extended period of intensive child care when one of the parents—usually the mother—is at home without formal labor income following childbirth. Other family benefits that replace income may also exist. For example, in Scandinavian countries, parents can receive income replacement for days spent at home caring for sick children, and parents with children who are severely disabled can receive an income subsidy for the extra work involved in caring for such children. This idea can also be extended for care of sick parents in the latter years of working life. Chłóń-Domińczak, Franco, and Palmer (2012) discuss what the original four NDC countries have done in this respect.

Some DB schemes also recognize maternity leave as a service period to be taken into account in calculating DB pension benefits. Once again, however, the true subsidy for the recognition of child-care leave in conjunction with childbirth as a service period is often unknown and clearly nontransparent. NDC schemes provide an alternative way of expressing social support toward child-care activities—through general revenue–financed contributions to the NDC accounts of parents who are away from work for child care for a specified time and under specified conditions. This contribution revenue can, at least to

a degree, replace the lost earnings-related contributions to individual NDC accounts. This support makes it possible to compensate temporary exit from the labor market for child care, both with direct income support for loss of labor income and with associated NDC pension rights.

Once again, augmenting NDC schemes with contributions from general revenues (a) can reflect social preferences, thus helping to frame the discussion on the broader desirable pension reform, and (b) makes the social cost of the preferential treatment transparent. An important note is that for these types of NDC-augmenting benefits to be credible, the government actually needs to make the augmenting payments to the pension system; simple accounting entries increasing the NDC balances would emerge as unfunded liabilities, thus blurring the otherwise simple and transparent use of NDC accounts for social policy.

Extra rights for armed services personnel. There is a long tradition all over the world of creating separate pension schemes for armed services personnel that usually offer special privileges for such individuals. A typical privilege is a lower retirement age to be eligible for drawing a full pension. In the past, the justification for such special privileges was the demanding nature of the work and the reduced ability of armed services personnel to work effectively at an age still considered to be a normal active age outside of the armed services. In addition, military services are not sold on the market. Setting a value on the risk is difficult, and once the cost has been calculated, it cannot be passed on to the consumers of military services (i.e., the country's citizens) other than through taxes.

In today's world, justifying early exit from the labor market for all armed services professionals is more difficult, especially given that a large portion of the work they perform is administrative, operational, technical, or managerial. However, pension reforms attempting to eliminate the privileges of armed services personnel often run into the tough political opposition of a well-organized interest group. In fact, social preferences often justify preferential treatment to those who volunteer to bear and use weapons in the military and law enforcement services. However, there is little justification for the preferential treatment to be offered in the form of a lower retirement age, and this treatment is not necessarily in the interests of those who are affected.

In essence, the line of reasoning just presented suggests that armed services personnel are underpaid in relation to the risks some of them may be expected to take with their lives, even if the probability that they may actually participate in combat is small. As participants in the NDC scheme, armed services personnel should fall under the same contribution requirements to the NDC scheme as all other wage earners and should be required to follow the same retirement rules. If there is a social preference for remunerating the armed services with higher remuneration than today, the most straightforward way to resolve this issue is to offer higher wages and salaries, with the associated contributions for pension rights.

However, path dependency in pension system development quite possibly will not allow such a solution to emerge. Governments may find it very hard to move from an existing DB system that provides special treatment for the armed services to an NDC system that does not provide some sort of replacement benefit to this well-organized interest group. Accumulation of pension wealth in the form of NDC account balances offers the opportunity to express the supporting social preferences toward armed services professionals through the pension system in a different way than DB systems typically do.

Instead of offering the preferential treatment in the form of lower retirement age, the benefit could be defined as an additional government-financed contribution to the NDC pension account. One could call this benefit a “matching contribution” from the government. This reform avenue does not necessarily impose an additional fiscal burden, because existing preferential retirement age policies have potentially large costs as well. What this NDC-augmenting mechanism does is to make transparent the social spending for the preferential treatment of the armed services professionals through the pension system. Also, this proposed reform policy offers more ways for armed services professionals to enjoy their benefits. In accordance with the NDC principles, they could use the accelerated accumulation of their NDC pension wealth for earlier retirement (as the typical preferential treatment does in PAYG DB schemes), or they could opt for longer careers and higher pension benefits.

In summary, reforming the preferential treatment of armed services professionals through an NDC-augmenting mechanism (matching contributions) allows for (a) gaining political support for the reform within a strong interest group that often opposes pension reform, (b) expressing social preferences toward the support of armed services professionals in a manner that offers them more flexibility in using their benefits, and (c) making the social costs of the preferential treatment transparent.

JOINT OWNERSHIP OF SPOUSAL NDC BALANCES

Although female labor force participation has increased in both the developing and the developed regions of the world in recent decades, the old family model is still widespread: the male has the role of income-generating head of household and the wife is the cohabitant with the role of household production, possibly along with other female adult family members. A problem associated with this family model is the vulnerability of the household member performing relatively more household production if the household arrangement breaks up as a result of death or divorce. Family laws defining joint spousal assets in a marriage are designed to assuage this vulnerability. However, the coverage of these laws is usually not complete and generally excludes public pension rights. One can claim that an implicit component of the couple’s contract for the division of time between formal and informal labor activities also is a plan to share old-age income earned through the pension deriving from formal market work.

This line of reasoning suggests that pension rights in NDC and other forms of pension schemes should be shared if the partners separate. If spouses or partners shared pension accounts, it would be a simple matter for each spouse to retain half of both accounts upon divorce. The shared accounts could also form the foundation for a joint annuity at retirement, when both spouses survive to this point and beyond. One difficult issue concerns whether sharing of accounts upon divorce should be mandatory or voluntary; if voluntary, then both partners have to agree to opting in and out.⁹ The alternative is to take NDC accounts into consideration as an asset in the normal process of separation.

Use of this family model could be motivated by the fact that NDC account balances are at least quasi-financial assets for many practical purposes, and they could be defined as joint spousal property if the related reduction of spousal vulnerability is in line with social preferences.¹⁰ Of course, the details of such an arrangement would have to be worked out in the particular country context. For example, the policies could be mandatory or

optional, or variations of paternalistic libertarianism could be introduced through default spousal sharing of NDC assets with the possibility of individual or joint opting out.

The point here is that sharing of accounts can enhance the political feasibility of pension reform. In such cases, the personal account feature of NDC offers an opportunity to frame the political discussion in this direction. In sum, not only do the simplicity and flexibility of NDC design permit augmentation of redistributive social policy, but also such a design is consistent with serving other types of social preferences by managing the ownership rights of the NDC account balance asset.

THE CASE FOR NDC, GIVEN LIMITED ACCESS TO CAPITAL MARKETS

NDC can be thought of as an intermediate stage on the road from PAYG DB to FDC. The idea is that NDC could be used not only as a mechanism that exhibits most of the advantages of the DC design (without the transition costs of FDC reforms), but also as a mechanism that immediately induces desirable incentives and allows the funding-related transition costs to be absorbed over a longer period. Notably, arguments also can be made for a reverse reform direction in certain country contexts: from FDC to NDC.

For example, the existing main pension scheme in West Bank and Gaza was developed using the FDC design. Because the domestic capital market in West Bank and Gaza barely exists, the scheme is forced to invest its funds abroad. However, the political relationship between the Palestinian Authority and the international community, which changes often and sometimes very sharply, severely affects the scheme's operation. In this case, the risk of international sanctions constrains the FDC scheme from accessing its international investments, making the FDC design inadequate in the absence of domestic investment instruments. Under these circumstances, a transition from FDC to NDC becomes a reform option. A transition to NDC is expected to receive wide political support because the desirable features of the FDC scheme could be preserved through an NDC reform without any radical change on the side of plan members and beneficiaries. The NDC scheme emerging after such a reform could use the accumulated FDC assets (which are strategically used during times of access to international capital markets) as partial (reserve) funding. Of course, the same logic that has been employed here can justify the implementation of NDC instead of FDC where domestic capital markets are limited or nonexistent and where foreign investments are not considered feasible for other reasons.

The Policy-Making Process: The Case of the NDC Reform in Poland

This section reflects on the NDC reform experience of Poland, focusing in particular on the commitment-building and coalition-building stages of the reform process. These two key stages take place when governments are deciding which policy reform model should be implemented. The concepts of framing and stories are used to explain the political response of the Polish population. As this example demonstrates, the framing and stories have the power to influence the decisions and behavior of parties involved in the policy-making process.

THE PRECOMMITMENT PHASE

According to Orenstein (2008), Poland was the only country in Central and Eastern Europe where there was any evidence of expert consideration of pension reform prior to 1994. As early as 1991, a partially funded pension system was proposed for Poland. However, despite this early consideration of pension reform, politicians in Poland perceived pension reform as too controversial to tackle. Instead, as pension spending increased from 8.6 percent of gross domestic product (GDP) to 15.5 percent of GDP between 1990 and 1994, the Polish government used ad hoc measures to control spending by changing benefit formulas, indexation levels, and rules on additional allowances. When the Polish Constitutional Tribunal put an end to these practices by issuing decisions that declared ad hoc changes illegal, the government was forced to repay lost benefits. With this result, the mood shifted and the necessity to work toward a comprehensive overhaul of the pension system became obvious. In a way, the Polish experience confirms the general findings on the impact of a crisis environment, as discussed earlier. The financial crisis of the pension system, which peaked in 1994, induced hasty parametric adjustments instead of a complex reform approach, and it was the interference of the ultimate veto actor, the Constitutional Tribunal, that created an environment for organic and comprehensive pension reform in Poland.

COMMITMENT BUILDING

Initiation. The commitment-building stage started in 1994 as actors began to see the opportunities and potential for meaningful change. Initially, four distinct proposals were elaborated. The proposals of the Ministry of Finance and the Ministry of Labor and Social Policy were the most important. However, two civil society actors formulated their own proposals: the Solidarity trade union and the Institute of Labor and Social Affairs.

The two government proposals were not in agreement. The Ministry of Finance proposed the introduction of a mandatory funded pillar, whereas the Ministry of Labor and Social Policy essentially proposed a parametric modification of the existing system (see table 16.1). In terms of the process, the Ministry of Finance strongly opposed the program of the Ministry of Labor and Social Policy.

The Ministry of Finance was helped by the fact that extensive public opinion research showed that Poles found the Ministry of Labor and Social Policy's proposal too timid and wanted more radical reform, though what that meant was unclear. In the fall of 1995, the government changed course and recommended preparing a program that would include mandatory, funded individual pension savings accounts. Now on the defensive, the Ministry of Labor and Social Policy exercised its veto power, and the reform process remained at a standstill.

Discovery. In January 1996, the Institute of Labor and Social Affairs convened an expert conference to discuss and reconcile the competing government and nongovernment proposals. The main principles of each concept are presented in table 16.1. Two striking conclusions emerge in the table:

- In terms of the degree of pension privatization, the Ministry of Finance and the Ministry of Labor and Social Policy proposals are at two extremes, with those formulated by the nongovernmental organizations falling between them.

TABLE 16.1 Pension reform proposals in Poland, 1995–96

	Ministry of Finance	Solidarity trade union	Institute of Labor and Social Affairs	Ministry of Labor and Social Policy
First pillar	Flat pension of 20% of average wage	Basic pension with two elements: flat pension financed from taxes and earnings-related pension from contributions	Based on contributions from employer and employee with maximum limit; benefit depending on length of contribution and amount	Based on contributions from employer and employee with maximum limit of 250% of average wage and state subsidy
Second pillar	Mandatory saving in private pension funds	Mandatory saving in pension funds supplemented by privatization bonds given to all employees	Voluntary savings in pension funds by people earning more than average salary; tax preferences	Voluntary savings in private funds for people with the highest income
Transition	Mandatory participation for new entrants; choice between systems for employed; high transition costs	Expected transition period for forming pension funds; social security contribution divided between systems; budget subsidies	Immediate changes; lower replacement rate in pension system when contributions to voluntary private system start	Gradual implementation; no reduction in costs of basic system

SOURCE: Orenstein 2008, 116.

- None of the proposals even mentions NDC as a possible organizing principle for the first pillar of the Polish pension system.

The conference ended with the recognition that each of the programs had its flaws and that a new approach was needed.

In terms of the history of the Polish NDC system, the conference was a turning point. It was there that the new Swedish and Latvian pension reform legislation and implementation were presented as a relevant path forward; hence, for the first time ever, the concept of NDC was mentioned in the Polish policy dialogue. The reaction of the varied audience (e.g., researchers, politicians, and trade unionists) was surprisingly positive, especially given the strong polarization among the participants, most of whom arrived at the conference with very strong views for or against a funded pension system pillar.

The conference suddenly made the audience aware that pension reform extends beyond pension privatization. The lines of the debate so far were very much drawn between two camps that could be labeled “funding hawks” and “PAYG hawks.” Funding hawks fought for introducing a private funded pillar to the pension system. In the extreme version, the funding hawks wanted to replace entirely the PAYG pillar with the funded pillar. For the most part, they argued that the funded pillar should be as large as possible; however, in their view, some funding was nevertheless better than no funding. PAYG hawks, in contrast, did not want to hear about any degree of funding within a mandatory pension system. They wanted to maintain a PAYG system as a sign of intergenerational

solidarity.¹¹ As a fallback position, however, they might accept some funding, as long as the PAYG pillar remained dominant.

In terms of proposals (table 16.1), the Ministry of Finance and the Solidarity trade union proposal clearly belong to the funding hawks camp, because both envisaged mandatory saving in private pension funds. At the other extreme, the proposals of the Institute of Labor and Social Affairs and the Ministry of Labor and Social Policy clearly belonged to the camp of the PAYG hawks, as both retained an almost intact redistributive PAYG pillar, without envisaging any mandatory saving in private pension funds.

What emerged in the discussions during the conference was a first recognition of a possible compromise in which each of the sides could save face. The funding hawks realized that an NDC system actually has all the microeconomic advantages of funding. It has no macroeconomic advantages, but even for funding hawks, the macroeconomic advantages were then and still are less obvious. In addition, the macroeconomic advantages need to be seen in the context of transition costs, which can be significant. From the perspective of the PAYG hawks, despite the transformation into an NDC scheme, which they saw as not really necessary, the system would remain predominantly PAYG, because NDC would be the dominant pillar in the new system. NDC is often believed to be introduced to avoid the transaction costs of moving into funding. However, even without transaction costs, NDC is preferred by PAYG hawks as a sign of social (intergenerational) solidarity, as was witnessed by the Polish pension dialogue.

It became obvious at the conference that there was no instinctive opposition to NDC from any side. Also, the conference launched a number of intellectual inquiries into the economic and social merits of NDC schemes, producing over time an impressive outcome in Poland and worldwide (see Góra and Palmer 2004; Holzmann and Palmer 2006), as well as the support of international institutions (see Holzmann and Hinz 2005). The beauty of NDC, previously unknown, emerged in the context of Poland very much fueled by ongoing work in Latvia and Sweden.

In a sense, NDC reconciled the stories (in the Akerlof and Shiller sense) that motivated the funding hawks and the PAYG hawks and brought them together. The emerging NDC compromise could be more easily understood as a compromise among the actors, whose behavior in the policy-making process was driven by certain stories as opposed to a compromise among the proposals summarized in table 16.1. This process was, in fact, very similar to the process in Sweden in 1992–94 (Palmer 2002; Könberg, Palmer, and Sundén 2006).

Reflections on the discovery. A few aspects of the discovery should be realized, having to do with the properties of NDC schemes and the decision process. The most important is the framing of the decision problem (i.e., the procedure used to elicit preferences). Because they were confronting each other directly through the process, both the funding hawks and the PAYG hawks needed to find a face-saving compromise. NDC allows each of the sides to claim partial victory; they learned to like the NDC “story” as one that easily reconciles with their own. In other words, the apparent simplicity of NDC allowed both groups to tell stories to their audiences about the merits of the compromise. The second notable aspect of the debate is that it took place in relatively good times in Poland’s recent economic history, which allowed the discussion to be motivated by future gains rather than by the need to avert a crisis inherited from the past. That experience was important,

as prospect theory demonstrates that the response to potential losses is consistently more intense than the response to gains (Kahneman and Tversky 1979). The third important aspect of the debate is its length: it appears to have lasted so long that an increasing number of participants realized that their way was not conclusively the “one best way.” Hence, their demands on the reform became less categorical. This long process made the participants more susceptible to good stories and powerful framing. Of course, participants in the policy-making process tended to be insiders, who were aware of the costs of inaction, which could also have affected their increased willingness to compromise after a lengthy period of unproductive debates.

Reform group formation. An end to the stalemate finally came in 1996. The appointment of a pro-reform prime minister, the reassignment of the former labor minister, and the nomination of a new labor minister, along with the creation of a single government office for pension reform, reduced the number of veto actors within the government, indicated strong commitment to reform, and allowed the process of technical drafting to move swiftly ahead.

COALITION BUILDING

Poland is somewhat unique in that pension reform legislation was passed by two successive governments and parliaments, representing most major parties at one time or another. The first phase of coalition building lasted from April 1996 to August 1997 and resulted in (a) the passage of three pieces of legislation that regulated the organization of the new second and third pillars and (b) the use of privatization revenues to finance the transition. The key proposal actors at this stage were the reform team and the Solidarity trade union, whereas the veto actors were the same, along with the prime minister, the Democratic Left Alliance (the senior partner in the ruling coalition), and the parliament. The second phase lasted from September 1997 to December 1998, under a new center-right government, which approved laws overhauling the first pillar and withdrawing special pension privileges. Support of partisan actors across the political spectrum is particular to Poland and demonstrates an especially democratic reform dynamic.

Reality check on the ground: Education, polls, and focus groups. The coalition-building phase started with an intensive communication campaign. In its first stage, until September 1998, the campaign focused on creating a general image of the reform and on informing the main groups involved—unions, employers, and public opinion leaders (politicians and media)—about the main principles of pension privatization. Journalist education seminars and materials were supplemented by study tours to Argentina, Chile, and Sweden for journalists, parliamentarians, and government leaders selected by the Office of the Plenipotentiary. Public relations activities in the first stage included conducting opinion polls about the old pension system; creating a reform logo and graphic informational materials; training Office of the Plenipotentiary and Social Insurance Institution (Zakład Ubezpieczeń Społecznych, or ZUS) employees in communication techniques; and preparing a pension reform web page for the Office of the Plenipotentiary. Those general communication activities—along with the training provided to journalists and parliamentarians and the relationship building with those individuals—can be looked at as an effort to use the Office of the Plenipotentiary to frame the political discussions on the pension reform.

The process of polling and conducting focus groups was particularly intensive. The results were communicated back to the reform team, and the emerging picture showed surprisingly strong commitment to a direct link between pensions and contributions. In fact, the inherited system was disliked primarily because of the absence of this link. The polling process provided knowledge about public preferences regarding the existing system in contrast to a more desirable pension system. This process allowed the reform team to reframe public communication around the reform efforts, with the story about the strong link between contributions and pensions central to that framing effort.

Also, during continued internal consultations on the new pension system with officials from other ministries, representatives of trade unions, members of parliament, journalists, lawyers, and officials from international organizations, the principles of NDC, including transparency, predictability, and political robustness, were often brought up as highly desirable for the new system. Even in meetings with the Catholic Church (which negotiated issues regarding coverage of clergy through the new system), the emphasis on individual accounts was quite high.

In retrospect, this period was clearly formative. Radio and television appearances, articles, and so forth helped disseminate certain messages so that the reaction could be observed. The key objective was to get a 360-degree view of the proposed NDC pillar. Therefore, the messages issued were presented differently, even though they were essentially delivering the same contents. For instance, a morning article written by one of the reform team members would say that “our pension system needs much more transparency and predictability,” a radio appearance the same day would emphasize the need for a “close link between contributions and pensions,” an afternoon press conference would talk about “bringing the private sector in so that pensions could be higher,” and an evening television discussion would emphasize the need “to have a system that automatically adjusts to changing demographics.” An interesting advantage of the process was that a reform group was able to draw on a large number of friends of very different origins (including the funding hawks and PAYG hawks described earlier) and from very different professions (e.g., academics, lawyers, journalists, workers, politicians, artists, and representatives of international organizations). A day spent communicating different, but coherently linked, public messages about the pension reform is in fact an example of Kahneman-style framing of the public choice environment of a reform.

Generative dialogue and the emergence of security through diversity. After the results of focus groups and opinion polls became known to the reform team, it also became clear that there was a big challenge ahead. The results quite clearly indicated that the relationship between pensions and contributions was at least as important to the people as the level of pensions. These findings led to a new round of engagement with trade union leaders, opinion makers, representatives of think tanks, government officials, and parliamentarians.

The NDC concept was, at this stage, fairly well accepted by the team of reformers. The team was less certain, however, about how well the NDC concept would lend itself to broader discussions. It still seemed too odd. The results of the “check on the ground” allowed the team to look at the idea once again and realize that, in fact, the fundamental objective of NDC (the proportionality of wages and pensions and the good incentives produced by such proportionality) was very much shared by the population. The concept

was not at all odd when compared with various flawed NDC-like versions that had been promulgated in Europe, such as the point system.

At some point, the reform team observed that the dynamics of collective intelligence emerging from—perhaps—hundreds of meetings led to a “trap of understanding”—that is, an illumination among the people in the room that a pension system can actually be very simple, and because it is so simple, anybody can tinker with it. People were thinking, “I understand this system, and I can contribute.” In a way, the demystification of pension systems that occurred through the NDC revolution started to create a backlash of newly educated experts who suddenly realized that the complicated inherited system was a result of a pattern of unintended obfuscation facilitated by social security lawyers.

Among the intense discussions that followed, the most important were probably those with the representatives of the Solidarity trade union, by far the most powerful and influential group representing workers. The union representatives cared deeply about pension reform, but from a very specific angle. They wanted the system to transform itself from a collectivist system—as they saw a traditional PAYG DB managed by the social security institution—to an individualistic system, in which participants would have their own personal accounts to save for retirement. For this reason, Solidarity’s original proposal presented in the January 1996 Warsaw conference firmly belonged to the funding hawks camp. This unconventional stance of a trade union is easier to understand if one considers the historic role of the Solidarity trade union in moving against the communist regime; Solidarity was more influential in its individualist, or rather, anticollectivist, stand than is usual for trade unions. Therefore, the NDC story was consistent with the political identity of the Solidarity trade union.

At the same time, the Solidarity representatives developed an understanding of the transition costs posed by a switch from PAYG to funding. They knew, therefore, that the size of the funded pillar would have to be limited and decided in the context of those costs.

Hence, the NDC alternative emerged in the discussions as an interesting option to introduce an individualistic system without the pain of transition costs. In a series of discussions with the unionists, the reform team observed a shift of the trade union’s attention from an initial exclusive focus on a funded pillar to a much broader engagement on what the term *individual* really means and whether personal savings accounts could also be thought of in the form of NDC accounts. A set of illustrative examples drawing on the idea of NDC and funding as conceptual twins was developed. For those who were still concerned that the funded pillar would get the short end in the decision process, an argument was made that an NDC pillar makes it easier to introduce funding in the future, because the boundary between NDC and the funded pillar is like a partition between business and economy class on short-haul European flights.

On a parallel track, many discussions were taking place among various types of social security professionals. The public’s view that the link between contributions and pensions is of primary importance could not remain unheard. This realization mellowed the positions of both funding hawks and PAYG hawks and made them more open and accommodating. A search for a common platform started, and the reform team, seeing this movement, became very active in promoting an NDC pillar as a counterpart of a funded pillar.

An interesting aspect of these discussions was that, in contrast to the funded pillar, or for that matter, the traditional PAYG DB pillar, the NDC pillar had no track record

to speak of. Even though NDC had been legislated in the spring of 1994 in Sweden, the implementation process was drawn out. NDC had been discussed in Latvia as a spin-off of the Swedish 1994 legislation and had been implemented in 1996, but it was too early to evaluate the consequences of the Latvian design. And in Italy, where NDC components of reform were implemented in 1995, there was little public recognition of what had actually happened and still considerable work left to do. So despite the activities in those three countries, NDC reform was still in an early stage of development, with no proven examples. Moreover, the point systems of France and Germany were versions too distant to be relevant.

Paradoxically, the lack of a track record turned out to be a strength of the NDC proposal. The proposal was elegant, transparent, and cohesive, and there was no way to throw any negative empirical arguments at it. Moreover, in further studies undertaken by the reform team, important historical conceptual antecedents were found, primarily in what has become a seminal paper by Buchanan (1968).

Notable for the success of the Polish reform process was the fact that the NDC concept appeared attractive to journalists because of its elegance and transparency. At the time, most journalists were worried about the leverage held by the social security institution and social security lawyers, because they were the only ones who really understood the old system. The NDC alternative seemed like fresh air, bringing a desired equilibrium back into people's ability to understand the intricacies of the pension system.

Fueled by this new positive energy coming out of the dialogue that followed the focus groups and opinion polls, the reform team firmly decided that NDC should be a key component of the reform package. This decision was not necessarily easy, because it had already been decided that Polish pension reform would be promoted under the slogan "Security through Diversity." Having a PAYG pillar in an NDC form, rather than a PAYG DB form, could have been viewed as reducing this diversity, because in the final proposals both pillars of the mandatory pension system would be of a DC nature. Nevertheless, the team had very few doubts that it was the right thing to do.

During legislative drafting, the reform team engaged in deliberation within the government on a wide spectrum of issues. The Ministry of Finance was involved in discussing methods of financing the transition to a funded system and the use of privatization revenues. The state treasury was consulted on privatization-related issues. Poland's social insurance institution, ZUS, did not oppose a multipillar reform, because it would make ZUS the central administration for the new pension system. In addition, the reform plans in Poland gave the institution a substantial new role as the clearinghouse for all pension payments. Therefore, in contrast to the situation that arose in Hungary and other Central and Eastern European countries, ZUS was not threatened by the pension reform plans in Poland.

Identity commitment. The Office of the Plenipotentiary's Security through Diversity program was tacitly approved by the government in March and April 1997 as an amendment to its previously introduced plans. According to the program, the new pension system would be multipillar, with a large NDC pillar; a new private pillar funded by approximately one-third of total contributions; and a reformed, voluntary third pillar.

As in all pension reforms, an age for inclusion in the new system was determined. The new system, including both NDC and FDC components, was mandatory for all

cohorts younger than 50 years of age in 1999. Workers younger than 30 years of age would be required to join the new FDC scheme, whereas those between 30 and 50 would have the choice of switching part of their contributions to the FDC scheme or being covered only by the NDC scheme.

Security through Diversity won general support from Poland's Tripartite Commission in April 1997, including representatives of business associations and trade unions, some of whom were persuaded to give up their opposition to reform. A Polish election took place in late 1997, so the reform laws that were passed by the parliament from 1997 to 1998 were introduced by two different governments of different political orientations.

The introduction of the FDC pillar of the reform placed the administration of the mandatory FDC scheme in the hands of private companies. Why did the trade unions support partial pension privatization in Poland? Part of the answer has to do with the individualistic instincts of the Solidarity trade union, described earlier, and another part relates to the division of Polish trade unions between the center-right Solidarity and the former communist All-Poland Alliance of Trade Unions (Ogólnopolskie Porozumienie Związków Zawodowych, or OPZZ). The Solidarity trade union had actually supported individual pension accounts from the beginning; its political wing had drafted reform proposals that called for the establishment of a private funded pillar. Although the former communist OPZZ was initially opposed and supported the Ministry of Labor position, leading officials of OPZZ were ultimately convinced to support NDC, precisely because it meant that a PAYG pillar would remain dominant; that is, the reconciliatory story of the NDC was successful with the trade unions as well. Also, reform advocates in Poland convinced trade union officials that the trade unions would be able to form their own pension funds, a move that gave the trade unions a clear business interest in the reforms. Although neither OPZZ nor Solidarity was a formal veto actor, each was closely allied with leading political parties, and the voices of both trade unions were critical to attaining the high degree of parliamentary and public support needed on both the government and the opposition sides.

President Aleksander Kwaśniewski, a former leader of the opposition Democratic Left Alliance, signed the law on December 29, 1998, and on January 1, 1999, Poland's new pension system entered the implementation phase.

The pension reform in Poland illustrates a number of points made in the early part of this chapter:

- *The power of stories.* The Polish NDC scheme emerged in the process through collective intelligence. The NDC story was elegant and persuasive. It was the key to creating cohesion among contingencies with opposing views of *the* best reform model.
- *The facilitating power of undertaking a reform in good times.* The NDC story probably could not have emerged and, even if it had, would have been less likely to get a foothold in the conditions of crisis, because it would have been crowded out by the urgency of immediate parametric adjustments of the existing system.
- *The power of positive framing.* The NDC story allowed negative messages (e.g., relative benefits reeducation in the long run at the same retirement age) to be overpowered by the positive general message of a just and equitable system. As a result, many of the losers of the reform (in the sense of the models of a formal political economy) willingly supported it.

- *The power of bounded rationality.* The length of the pension debate in Poland, with its early start in 1991, allowed the participants and the public to become responsive to stories and framing, and it also allowed the actors of the policy-making process to reconcile in the NDC story.

In addition, evidence so far indicates that the sustainability of NDC-type reform may exceed that of an FDC-type reform. During the wave of pension reform reversals in 2009–10, the Polish funded pillar was cut from 7.2 percent to 2.2 percent, while the NDC pillar remained intact. This evidence suggests that the notional nature of the pillar may make it immune to political raiding. More support for this notion is that the funded component of the NDC scheme, the so-called Demographic Reserve Fund, was also reduced.

Conclusions

The proponents of NDC pension schemes have always argued that their design is superior to the traditional PAYG DB schemes. They have pointed to the transparency, intra- and intergenerational fairness, actuarial design, flexibility of the retirement decision, and the ease at which accounts can be used to create subsidized noncontributory rights. However, in practice, NDC is still a rare animal, with applications limited to Italy, Latvia, Poland, Sweden, and, most recently, in a quasi-version in Norway. Notably, it took until the entrance of the market run on Italian sovereign debt for Italy to finally introduce near-full NDC. This slow advance is not surprising in light of the mainstream literature on the political economy of pension reforms, which indicates that reforming pension systems in response to demographic changes is equally difficult through paradigmatic NDC-type reforms as it is through parametric PAYG DB adjustments.

However, following the framework of Kahneman and the arguments of Akerlof and Shiller about the role of framing and stories in driving behaviors under bounded rationality, this chapter demonstrates how paradigmatic NDC reforms have advantages over parametric DB reforms in terms of political feasibility (at least if the reform does not take place in crisis times). In the case of Poland, the reform team discussed the evidence on the rationality of preferences over pension reform and the characteristics of NDC design to demonstrate what can make the NDC design-process package a winning proposition for pension reform and, indeed, a pathway toward a politically feasible reform. Among the success factors, the power of the NDC story—achieved both through content and through a process of collective intelligence (i.e., generative thinking among the policy makers that yielded a result potentially more whole and sustainable)—appears to be the most important. Along with that factor, the timing of the reform, its positive framing, and the length of the pension debate emerged as correlates of success.

In addition, this chapter presents two main conclusions: one methodological and one related to policy. The methodological conclusion is that governments need to further develop a new political economy of pensions and to support the evolution of pension systems that are not based on the rational agent assumption. This chapter demonstrates that applying bounded rationality that, therefore, allows for “framing” (in Kahneman’s vocabulary) or “stories” (in Akerlof and Shiller’s vocabulary) is a potentially powerful way to help agents understand the pension reform process. Experimental techniques in behavioral economics offer promising options for developments along this suggested path.

The policy conclusion emphasizes the role of the design-process package such that both the design and the process are able to lend themselves to a powerful framing of the reform and stories, as the NDC package did in the case of Poland. The characteristics of both design and process would differ from country to country, but in many countries, NDC has the potential to form a pathway to pension reform, especially if the reform is assisted by good timing (i.e., it should not be introduced in a crisis situation and sufficient time should be spent on debate) and by positive framing.

Notes

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1. Galasso and Profeta (2002) provide a comprehensive survey of the political economy of social security. Bodor and Rutkowski (forthcoming) organize the relevant literature on the political economy of pension reform in a manner closely related to the argument developed in this study.
2. There is rich literature on the political economy of pension reform applying the median voter principle to particular countries. Selén and Ståhlberg (2007) is referenced in the text because it discusses an NDC pension reform that actually took place. Another interesting example is Sinn and Uebelmesser (2003), with an application for Germany. Breyer and Craig (1997) take an empirical approach to test a wider range of public choice models beyond the median voter model—for example, benevolent dictator, family choice, and income redistribution in an overlapping generations modeling environment—and cannot reject the explanatory power of any of those approaches. They find, however, a positive trend in the Organisation for Economic Co-operation and Development for pension systems that represent an increasing share of the economy; this trend is unexplained by any of the controls offered by the alternative public choice models.
3. The term *pension reform practitioners* refers to politicians, senior policy makers, and pension experts. The discussion on the Polish NDC reform later in this chapter illustrates that, to make the reform happen, pension experts not only develop the policy design of the reform, but also play a symbiotic role with politicians in the broader political arena.
4. Palmer (2006a) explains how Latvia, Poland, and Sweden designed transparent conversions of pension rights into NDC balances, whereas Italy constructed a very nontransparent conversion. The fact that Italy failed from the outset to create a transparent conversion—with the consequence that Italians did not know they were gradually moving into the NDC framework—is also a main point in Chłoń-Domińczak, Franco, and Palmer (2012).
5. See the related discussion in chapter 19 in this volume on creating NDC with individual shares.
6. It is beyond the scope of this chapter to address the conditions under which social insurance contributions show up in the labor costs of employers.
7. For a discussion on reforms to improve the capability of pension systems to deliver on their promises see Holzmann and Hinz (2005).
8. Addressing social preferences in the NDC context is also discussed in other chapters of this volume; in particular, chapters 10, 11, 13, and 14 on the gender aspects of NDC also feature this line of thought.

9. Obviously, voluntary NDC asset-sharing arrangements should primarily be established at the time of marriage.
10. A Swedish reform group proposed this latter idea to parliament along with other proposed legislation in 1994, but it was never acted on. More recently, other authors have made similar proposals (Banyár and Mészáros 2004; Holzmann 2004).
11. It has been argued in the case of Sweden as well that the PAYG nature of NDC as a signal for solidarity worked in favor of the political support for the reform. More generally, PAYG financing is often interpreted as an intergenerational social contract. This view of the pension system as a political construct is beyond the scope of this chapter. However, Kruse (2010) claims that the political stability of a pension scheme requires majority support that is based on the perception that the system is reasonable and fair in terms of both outcomes and procedures.

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CHAPTER 16

COMMENT

Agneta Kruse

The importance of this chapter—and its contribution to understanding political reforms and reform processes—is the application of a framework that includes collective intelligence and stories of coalition building. András Bodor and Michal Rutkowski’s main contribution is to show how information can be presented in a pedagogical and convincing way, and how important doing so is in the framing of pension reform. They maintain that a nonfinancial (notional) defined contribution (NDC) design is especially suitable for this purpose, and they use the Polish pension reform to support their story.

A rather long introductory discussion of the median voter model blurs the main purpose of the chapter. Bodor and Rutkowski maintain that the standard tool of political economy is the median voter theory, and their intention is to show not only that the model does not give solid and useful results, but also that their analytical model is more fruitful.

Now, if the median voter model is the standard tool, it is a pity that Bodor and Rutkowski are so unfamiliar with the model. They disregard assumptions necessary to reach conclusions. Hence, they draw wrong conclusions about predicted outcomes. It is necessary not only to specify under what assumptions the theory gives firm results, but also to specify the alternatives, the counterfactual on which the voters are to take a stand. Both Selén and Ståhlberg (2007) and Sinn and Uebelmesser (2003) carefully specify the counterfactual. In none of these articles do the authors maintain that this kind of proposal would be presentable in an election. The lesson—for experts and politicians—is the importance of how the alternative is specified. That is one of the messages of Selén and Ståhlberg. Another point in Selén and Ståhlberg is the importance of transitional rules—that is, how to make the transition from A to B to gain support for the pension reform.

In my view, traditional political economy, including the median voter model, provides fairly adequate explanations of pay-as-you-go (PAYG) pension systems, and, in particular, Breyer and Craig (1997) do a good job of underpinning the median voter model in the context of pensions. However, the median voter model has its limitations, and Bodor and Rutkowski’s efforts to use an alternative model are most welcome.

Bodor and Rutkowski use the idea of stories and of framing, including coalition building and commitment building, as alternative explanations for successful pension reforms. They focus on a number of specific design features of an NDC scheme. Its defined contribution (DC) character facilitates provision for a flexible retirement age. NDC schemes give quasi-ownership rights to the individual accounts as well as credibility to financial stability; they also allow for the possibility of using the system for redistribution in accordance with social preferences.

The “story” of NDC as a very transparent system, easy for the insured to understand, is told rather convincingly using Poland as an example. However, the story is probably not true in general; Swedes—rightly or wrongly—seem to think that the old defined

benefit (DB) system was easier to understand, and they seem to find it more difficult to forecast the level of the annuity in the new system, despite the individual report they receive once a year. However, this situation may, in fact, indirectly support Bodor and Rutkowski's thesis. Swedes were convinced—albeit also misinformed—for a long time by the political rhetoric that the old DB scheme would give a replacement rate of 65 percent, even though the facts clearly showed that the normal full benefit at age 65 would replace only about 55 percent of final salary, with a not so unlikely *de facto* rate of real wage growth of 2 percent. This fact was well known by a handful of experts and was discussed, for example, in Eriksen and Palmer (1994), in referring to the then-forthcoming NDC legislation in Sweden. But Bodor and Rutkowski are right: the NDC story was told in the same manner in Sweden (e.g., Könberg, Palmer, and Sundén 2006) as in Poland and may have convinced people—especially people in influential positions (politicians, labor leaders, employer representatives, academics, mass media, etc.)—of the superiority of the NDC design.

Bodor and Rutkowski also maintain that the NDC has the advantage of not needing a crisis as a driving force in the reform process. This statement seems plausible even if it is hard to prove such a hypothesis. For example, it is well known (e.g., Chłóń-Domińczak, Franco, and Palmer 2012) that both the Italian and Swedish reform processes were facilitated by economic crises in the early 1990s. However, for both countries, it was a matter of national honor at the time to meet the Maastricht criteria, which required reducing overall debt. Immediate economic crisis was certainly a facilitator, but the long-term financial impossibility of rules that supported short working careers and the pressure of demography rendered the pre-1995 pension systems in both countries unsustainable. And in Sweden, the public discussion was dominated by the realization that it was impossible to retain the old system at a reasonable cost for future generations. Indeed, the old pension system not only was financially unsustainable but also gave rise to perverse redistribution—that is, from blue-collar, low-income workers to white-collar, high-income workers (Ståhlberg, Kruse, and Sundén 2005).

Generally speaking, the same arguments around long-term financial stability and, implicitly, intergenerational equity have supported reforms all over Europe since the early 1990s on both sides of the old Iron Curtain. This fact seems more in support of the “power of stories” paradigm argued by Bodor and Rutkowski than of the median voter paradigm.

An advantage mentioned in the storytelling model is that personal accounts in the NDC system can be used not only for old-age pensions but also for redistribution in accordance with social preferences. Personal accounts are based on contributions that are based on earnings. In addition, however, the government can use those account balances for explicit and transparent distributional purposes. External transfers that function as contributions can be made by the government from the budget to cover periods of early child care; care of children with disabilities and close relatives who are severely ill; periods when the worker is home from work because of sickness; and periods of exclusion from the labor force following disability, unemployment, and so forth. All the NDC schemes introduced to date have used this possibility, albeit in varying degrees.

Another advantage, according to Bodor and Rutkowski, is that the personal accounts in the NDC system can be used not only for old-age pensions but also for protection against other risks. Bodor and Rutkowski focus on the possibility of using the notional

capital on the individual's accounts for financing spells of unemployment. Their discussion is far from convincing, however. First, they do not consider the merits of insurance. To pool the risk of unemployment in a separate insurance means that the precautionary buffer can be kept low. Without insurance, risk aversion will lead people to keep too large a buffer, thus preventing them from maximizing utility over the life cycle. This is a general argument for insurance. Second, they disregard distributive aspects. Those with high unemployment risk—who are usually more vulnerable—will receive lower pension benefits with Bodor and Rutkowski's proposal, all other factors being equal. Third, they bring forward the problem of moral hazard as a major reason for not having unemployment insurance. Moral hazard is, of course, a problem, but abandoning the idea of insurance instead of using co-insurance and control seems rather drastic.

They also find it easy to stipulate that the individual accounts will be treated as marital property, thereby protecting the spouse with the smaller account (usually the woman) in case of divorce, or that couples will be required to provide for joint annuities. This alternative, however, is not used in any of the current NDC schemes (e.g., Chłoń-Domińczak, Franco, and Palmer 2012).

A flexible pension age, an important feature of the NDC design, is welcome, because it permits the individual to choose between consumption of leisure time and consumption of goods and services. More working hours and a delayed retirement means less leisure and more goods; the individual's preferences determine the trade-off. However, it is important to realize that the choice is not all that free. A flexible pension age puts pressure on the labor market to be flexible as well, for example, by accepting older workers. So far this process has been slow or not forthcoming at all in the more advanced Organisation for Economic Co-operation and Development countries and can hardly be observed elsewhere. That said, this process still must be the way of the future.

Another central characteristic is that with NDC the PAYG feature is retained. At least in Sweden, this feature was an important part of the storytelling, because PAYG is perceived as maintaining the principle of solidarity. Whether the design shows solidarity or not, there is the advantage that a reform in the direction of a funded system means not only double payments for a generation, but also the concentration of all the risk to the capital market. The rate of return—and thus the risk—in an NDC scheme is the growth rate in total earnings. Keeping at least a part of the pension system as a PAYG scheme means spreading the risk between growth and capital market returns.

An NDC scheme is financially stable because the system is autonomous and closed. However, political stability may not automatically follow. NDC is a PAYG scheme, based on an (implicit) social contract between generations. For political stability to follow, a majority of individuals in coming generations must perceive the system as reasonable and fair. Fairness can be analyzed from at least two viewpoints: fairness in outcome and fairness of procedures (Kruse 2010). The NDC scheme focuses on fair procedures, exemplified by the close connection between contributions and benefits and by the annuity determined by the individual's pension wealth and expected remaining lifetime at retirement. But a procedure can be perceived as fair only if there is equality of opportunity. NDC makes it at least possible to compensate partly for inequality of opportunity by crediting extra amounts to personal accounts. Increases in longevity will lower the annual benefit, all else being equal. This effect can be counterbalanced by increasing working hours and the number of working years. As noted earlier, however, this response requires

a flexible labor market. Also, it is, of course, easier for people with good health and not overly strenuous work to adapt to such a situation. Blue-collar workers may thus end up with lower annual benefits.

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The Challenge of Reaching Participants with the Message of NDC

Annika Sundén

Recent trends in pension reform around the world are likely to increase individuals' need for information about pension plans as well as the need for general financial literacy. Many countries are moving from defined benefit (DB) plans to defined contribution (DC) plans in both their public and their private systems. In reforms of DB plans, the choice of retirement is becoming more flexible; for example, countries with a fixed retirement age are introducing the possibility of early withdrawal. Multipillar systems, with pensions from different sources, are becoming more common and increase the need for information on the total level of benefits. Furthermore, because of the increased financial pressures of aging populations, pension reforms often result in a reduction in replacement rates and hence could compel individuals to save on their own for retirement unless they are willing to accept lower pension benefits.

Compared with other products, pensions exhibit a set of characteristics that make it more difficult to provide information about them. Pensions are long-term contracts: contributions are made throughout a person's lifetime, and benefits are paid much later in life. That long time horizon makes it difficult for participants to understand the product. In most countries, the average time between contribution and payment of pension benefits is about 33 years. Thus, benefits are a function of long-term economic and demographic developments—such as earnings growth, life expectancy, inflation, and return on assets—that are difficult to predict in several respects.

Pensions are the single largest assets of most individuals, but they are seldom perceived as such. One reason that pensions are not considered an asset could be that public schemes in general are likened to forced savings, adding to the difficulty of providing pension information. Furthermore, pension benefits often come from several sources. In many countries, the retirement income system is described as a three-legged stool: public, occupational, and private plans. Thus, information and education about pensions involve several actors, but total benefits are not known by any single actor. For example, the value of pension information is severely diminished if information is available on only two of three plans.

It is well documented that individuals often have limited financial knowledge and know little about the characteristics of their public and occupational pension plans

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or how much to expect in retirement benefits (see, e.g., Mitchell 1988; Gustman and Steinmeier 2004; Lusardi and Mitchell 2007b). As a consequence, workers run the risk of reaching retirement with inadequate resources and may have to postpone retirement or accept lower consumption in retirement. Several studies have suggested that financial literacy and planning have a positive effect on savings and retirement outcomes (e.g., Ameriks, Caplin, and Leahy 2002; Lusardi and Mitchell 2006, 2007a). Individuals who approach retirement without planning have lower savings. Similarly, individuals with little financial knowledge are less likely to be successful planners and savers. Studies have also shown that knowledge about pension benefits affects retirement behavior. For example, workers who underestimate their benefits are less likely to retire early than those who overestimate their benefits (Gustman and Steinmeier 2001; Chan and Huff Stevens 2008). The experience with 401(k) plans in the United States provides evidence that prefunded individual accounts introduce further difficulties for workers and that financial illiteracy can negatively affect outcomes (see, e.g., Munnell and Sundén 2004; Beshears et al. 2006).

A possible reason for the lack of financial knowledge is that learning about pensions is difficult. The complexity involved makes the costs of collecting information appear to be greater than the benefits of understanding the plans. The retirement process is something individuals only go through once, and they, therefore, cannot learn from their mistakes. In addition, for some individuals, retirement can be viewed as something unpleasant and a cause for worry, which means that learning about pension systems and retirement can involve psychological costs. Furthermore, participants may not appreciate the benefits of collecting pension information because they expect that the public pension system will provide adequate benefits.

This chapter examines the challenges for disseminating pension information to participants in view of recent pension reforms. The focus is on the experience in Sweden following the introduction of the mandatory nonfinancial (notional) defined contribution (NDC) plan and prefunded individual account plan, and the chapter will review some recent evidence on the effects of the Orange Envelope, the individual statement that, since 1998, has been sent out annually to all participants in the public plans.¹

What Is Individual Pension Information?

To make decisions about retirement and savings, individuals need information about the salient features of pensions. Many pension schemes require workers to make decisions about participation, level of contributions, investment allocations, and ways to withdraw funds at retirement. When considering how various pension characteristics affect information needs, one must keep in mind that different plans involve different types of risks. For example, the level of future benefits will depend on a pension scheme's ability to meet its obligations. On the one hand, pay-as-you-go (unfunded) schemes and partially prefunded DB plans are sensitive to demographic changes, and many of these systems have projected financial deficits. These financial pressures can be remedied by reducing benefits or increasing contribution rates, either of which creates uncertainty about the level of future retirement benefits. On the other hand, individuals who are covered by prefunded DC schemes are subject to financial risks because benefit levels will depend on the rate of return in capital markets.

Pension information can be defined as data on what a participant can expect to receive from a pension plan that he or she has contributed to or contributes to. Also important are data on contributions (taxes) paid by or on behalf of the participant. Both pension benefit and contribution amounts are accounting information that is necessary but rarely sufficient to guide the participant or insurer in making well-informed decisions. To make decisions on work and savings, participants also need information on the effects of a course of events or of actions on the expected level of pension benefits. For example, a participant would need to know how a change in income would change the size of pension benefits and how a change in retirement age would change the size of pension benefits. Furthermore, pension information needs to include information on the expected variation in benefits attributable to variation in the rate of return or indexation, for instance. Thus, pension information includes three levels of information, which can be summarized as (a) accounting information, (b) course-of-event information, and (c) uncertainty (risk) information.

Most existing pension information deals with all three levels. The focus is generally on the first level, accounting information, whereas information on the uncertainty or risk in pension income is less common. However, many countries provide a mix of accounting information and information about how pension benefits vary with different actions or courses of events. Although this type of information appears straightforward, it could be difficult to convey or present, for example, because it often involves presenting information on different scenarios. For pension information to be successfully conveyed, it must be easy to communicate to a large and diverse group of consumers.

The Content of Pension Information

This section discusses the three levels of pension information, as described earlier: accounting information, action or course-of-event information, and uncertainty (risk) information. The type of pension scheme—defined benefit, defined contribution, or a hybrid plan—as well as the financing of the scheme will affect the information needs on each level.

ACCOUNTING INFORMATION

The most basic information for participants to have is about coverage: participants need to know whether they are covered by a pension plan and how much they have contributed. An annual statement to participants, like that included in the Orange Envelope in Sweden, is a straightforward way to provide such information. Account information includes information on the components that affect participants' pension rights, such as contributions, rate of return, and administrative costs. Account information helps make a pension system transparent, which can contribute to building trust in the system. Furthermore, account information helps communicate that pensions, to a large extent, are savings—by presenting the account balance (in a DC plan) or contributions and earnings history (in a DB plan). Thus, account information shows clearly that pension rights and pension capital are built up continuously.

Account information needs to be comprehensive. People often have coverage from public systems as well as occupational schemes. To get a full picture of the level of benefits

at retirement, workers need information from all sources, and knowing how to assemble such information is a legal and technical challenge. Therefore, in multipillar systems, participants commonly receive several statements.

ACTION AND COURSE-OF-EVENT INFORMATION

In addition, participants need to know how various actions and events affect future pension benefits. Knowledge of the level of benefits and the way it can vary with the choice of retirement age is maybe the most important information required for making decisions about how much to save and when to retire.

The first challenge is how to present the level of benefits. In a traditional DB plan, benefits are often determined by some combination of earnings and years of service. The benefit formula makes it possible to express the projected benefits as a replacement rate—specifically, how much of the final salary the pension benefit will replace. The advantage of providing a replacement rate is that it is relatively easy to compare with the type of information financial planners often provide about how much of preretirement earnings should be replaced to maintain living standards in retirement.

In contrast, in a DC plan, benefits depend on the total amount contributed to the plan and the rate of return on those contributions. At retirement, the account balance is converted to an annuity or, in some cases, is paid out as a lump sum. Because benefits are not defined but will depend on contributions and their return, the benefit, both in absolute value and relative to the contributor's final wage, depends on more uncertain factors. Thus, the uncertainty of the projection increases.

To plan for retirement, participants need to know how expected benefits vary with retirement age. Defined benefit plans usually specify a normal retirement age at which workers are eligible for full benefits and an early retirement age at which workers can leave with reduced benefits. The benefit formula, combined with the specified retirement ages, means that DB plans usually provide information such as that benefits will be 60 percent of earnings if retirement is at age 65 and they will be 42 percent if retirement is at age 60. Furthermore, the formula sometimes provides strong incentives to retire at certain ages.

In principle, such information makes it easy for workers in DB plans to understand how much they will receive and at what age. In practice, however, this certainty is not always the case. One problem is that it may be difficult to convey that the replacement rate at the early retirement date depends on the normal retirement age and that increasing the normal retirement age will affect benefits if drawn early. For example, in the United States, a large share of workers starts withdrawing benefits as soon as possible at age 62. The normal retirement age was 65 until 2000 but has been gradually increased since then and will be 67 for people reaching age 62 in 2022. For those who reached age 62 in 2004, the normal retirement age was 65 and 10 months. The early retirement age will continue to be age 62. The gradual increase in the normal retirement age is equivalent to a benefit cut, and those who retire early will receive a lower monthly benefit.²

Defined contribution plans need to specify a minimum retirement age but need not specify a normal retirement age. However, because of the difficulty of converting the account balance to a monthly benefit, it may still be difficult for participants to figure out how the benefit will vary with the choice of retirement age. Furthermore, in converting the benefit to an annuity, life expectancy matters. In Sweden, for both the NDC scheme

and the prefunded individual account scheme, called the *premium pension*, benefits are computed using life expectancy at retirement. Hence, when the account balance is converted to a benefit, the annuity depends on the remaining life expectancy, at the participant's chosen age of retirement, for the beneficiary's cohort. Thus, for a given retirement age—say 65—annual benefits will decrease as individuals live longer. To receive the same replacement rate, an individual has to work longer.

How job mobility affects pension benefits is another important factor in estimating the expected benefit at retirement. The benefit formula in a DB plan often replaces earnings just prior to retirement, which means that a job change could have a negative effect on benefits. In a national scheme, this scenario is less of a problem because workers are covered by the same scheme regardless of where they work, but many traditional DB plans base benefits on earnings just prior to job termination. DC plans do not have this problem.

UNCERTAINTY (RISK) INFORMATION

Making projections about retirement benefits is difficult. On the one hand, projections should include enough detail to provide the best possible projection, and on the other hand, they should be simple enough to communicate to participants. Furthermore, because projections provide a single amount, they give an appearance of certainty, although outcomes are very uncertain. A stochastic projection would convey the uncertainty but would be difficult for participants to interpret.

In prefunded DC plans, individuals manage their own financial accounts and make decisions about investment allocation and about changes in the allocation over time. Thus, participants bear the entire risk of their investments. They, therefore, require knowledge about financial markets and how to balance risk and return—something that can be difficult to understand.³ To make investment decisions, participants need to understand how future benefits will vary with their choice of risk, in particular; therefore, pension information needs to convey the variability of benefits.

Most public pension schemes operate on a pay-as-you-go basis, and many countries face long-term financing deficits in their pension schemes. For DB plans to meet their obligations, benefits will have to be reduced, retirement age increased, or contributions increased. For example, as mentioned earlier, the retirement age in the U.S. Social Security system is gradually being increased, and despite the decision to improve the financial balance of the scheme, discussion of Social Security reform has been on top of the political agenda for more than a decade. In the case of financial imbalance in a pension system, pension information needs to convey that benefits or contributions have to change for the system to be sustained. The Swedish system is constructed to automatically maintain financial balance through a mechanism that reduces indexation in case of financial deficit. Consequently, benefits may increase less or even decrease under certain economic and demographic developments.

Information in the Swedish Pension System

The new Swedish pension system puts additional demands on participants. To make decisions about what age to retire age and how much to save, participants need information

about how the level of benefits varies with labor supply and retirement age. Because benefits in the new system are not defined—they will depend on contributions and the rate of return on those contributions—expressing the expected benefit in terms of a replacement rate is difficult. Projections that help participants estimate how their “retirement wealth” will translate into monthly payments are, therefore, an important component of the information that Swedish participants need.

In the Swedish pension system, retirement is flexible, and benefits can be withdrawn from age 61. When the benefit is converted to an annuity, life expectancy matters. In the Swedish system, the automatic adjustment of benefits in response to changes in life expectancy means that younger cohorts of workers will need to postpone their retirement to achieve the same replacement rate as older cohorts. For example, with current projections, the annuity divisor for the cohort born in 1940 is 15.7 compared to 17.9 for the cohort born in 1980. Thus, those born in 1980 need to postpone retirement a full two years compared with those born in 1940 (who could retire at age 65) to neutralize the effect of increased life expectancy. The crucial message is that successive cohorts have to work longer to maintain similar replacement rates.

An implication of the NDC design is that all adjustments to maintain financial stability take place on the benefit side. In addition to automatically adjusting benefits to life expectancy, the system includes an automatic balancing mechanism that will ensure that the NDC system’s assets always cover its liabilities by adjusting the indexation of earned pension rights and benefits.⁴ The financial crisis in fall 2008 produced a decline in Sweden’s pension reserve funds and triggered a first-time automatic reduction in pension indexation in 2010 (see chapter 21 in this volume). A challenge for the communication strategy is to convey that the automatic balancing is a regular component of the indexation of earned pension rights.

The lion’s share of benefits in the Swedish pension system is determined by the NDC and, thus, by how much an individual works; only a relatively small share of retirement income depends on investment behavior and asset returns. In contrast, the premium pension puts additional demands on workers. Participants are expected to put together a diversified portfolio suitable for retirement savings from a menu of almost 800 funds. The funds in the system allow workers to take on very large risks, so poor knowledge of how to balance risk and returns could have dire consequences.

The Orange Envelope was introduced in 1999 in connection with the Swedish pension reform and has been the cornerstone of communication to participants about the pension system. The pension reform changed the provision of public pension benefits in a fundamental way and redefined the benefit promise.⁵ In the new system, benefits are closely linked to contributions, and lifetime earnings will determine benefits. The reform recognized the impact of increased life expectancy on the financial stability of the system and built in an automatic adjustment of benefits in response to changes in longevity. The design increased the responsibility that is put on participants to plan for such changes. The new system also puts increased responsibility on individuals to plan for retirement through the introduction of a prefunded individual account component.

The Orange Envelope is sent out annually and includes account information as well as a projection of benefits. In addition to providing information about expected benefits, the Orange Envelope summarizes how the new pension system works and tells participants that their benefits are determined by their lifetime earnings.

Around the world, personal statements are a relatively new phenomenon. In Chile, statements were introduced in 1981, but most automatic statements were introduced in the late 1990s or early 2000s. In many cases, the individual statements have been introduced in connection with a pension reform.

Pension benefits are determined by participants' lifetime careers, yet the benefits system is rarely something individuals think about throughout their lives. The need for and interest in planning for retirement varies with age. A young person, for example, is likely to focus on finishing school, choosing a profession, planning for a family, and buying a house. However, decisions made early in life could affect benefits; for example, in many schemes, lifetime earnings determine benefits, so entering the labor market late could have negative consequences.

One question of particular interest is whether all participants should receive annual pension information or whether the information should be targeted to certain groups. Different solutions are found across countries when studying which "customer groups" are considered important to target. Some administrations send statements to all participants, whereas others choose to target specific age cohorts or life events. The reasoning behind the different choices is typically connected to the type of scheme and the information presented in the statement.

The Orange Envelope is sent to all participants as soon as they have started to contribute to the scheme. The Orange Envelope also provides information to retirees about their benefits. In the Swedish system, participants can withdraw partial benefits. For example, a participant can withdraw 50 percent of his or her benefits and can continue working at 50 percent; for this group, the Orange Envelope continues to provide information on how benefits vary with labor supply.

INFORMATION GOALS

The overall information goals are similar across pension schemes: to provide information on contributions to the system and expected benefits. An important information objective is to trigger participants to think about retirement, consider how their life choices affect benefits, and make informed choices regarding the need for additional savings to provide for an adequate retirement income.

A personalized pension statement can also fulfill many information objectives in connection with a reform, such as informing a participant about the new scheme and establishing trust. Similar to the Swedish case, personal statements have been introduced in connection with pension reform in many countries. In Sweden, the choice of using the Orange Envelope as messenger has successfully branded the color orange and the envelope as an ambassador for the new scheme and for pensions in general. The success of the Swedish information in this respect has inspired other countries to follow suit. In France, the envelope is blue, and in Germany, it is yellow. Finland feared that a brightly colored envelope would be mistaken for advertising and chose white because it has an official connotation (Kindahl 2007).

In addition to providing account information and information on projected benefits, statements typically include information on the pension system and how it works. The Orange Envelope presents the system's main principles and also points out that retirement income comes from several sources. In the U.S. statement, the system information

includes a description of the projected financial shortfalls and the remedies necessary to restore the balance so that individuals can gauge their benefits.

Sweden has a legal requirement to provide information on earnings and contributions, so part of the Orange Envelope is also a legal document. One page includes a statement of the yearly contribution; participants are expected to check that the contribution is correct, and if it is not, they must make a formal complaint within a certain period.

INFORMATION ON EARNED PENSION CREDITS

In creating the Orange Envelope, Sweden's public pension system has put some effort into providing transparent account information. The statement therefore includes separate account information on the NDC and the premium pension accounts. The account information shows the beginning balance, the contributions made during the year, the rate of return, the administrative costs, and the ending balance. For the premium pension plan, information is provided on the selected funds; however, the Orange Envelope does not provide information on how to pick funds. This information is made available through other channels.

Thus, participants are given a full picture of their pension accounts to date. The presentation clarifies each participant's claim on the system. By comparing the pension account to a bank account, the Orange Envelope helps communicate to participants that the public pension system is their savings for retirement.

Anecdotal evidence in several countries shows that participants often mistrust the ability of the pension system to fulfill its obligations. By making the connection between pension contributions and savings, the individual statement can contribute to the understanding that the pension system is a contract between generations and that participants have a claim on the system.

INFORMATION ON EXPECTED BENEFITS

A projection of future pension benefits and how benefits vary with retirement age is necessary information for participants to make decisions about work and savings. In DB plans, the benefit formula usually specifies the level of benefits as a replacement rate, so participants may have a fairly good grasp of the level of benefits through general knowledge about the pension system. However, benefit formulas can be complicated, and in many DB schemes, the retirement age is being raised. In a DC plan with fixed contributions, a projection is necessary to inform participants about expected benefits.

In the Orange Envelope, two scenarios are presented: a 0 percent wage growth and 2 percent wage growth. The rate of return on the prefunded individual account is assumed to be 3.5 percent higher than earnings growth. In the 0 percent scenario, the projected benefit can be interpreted at the current price and wage level; participants can compare the projection with their current earnings to get an estimate of the replacement rate. The projected benefit in the 2 percent scenario has to be compared with future earnings, and although final earnings are presented at age 65, a common mistake is to compare the projection in the 2 percent scenario to current earnings. By providing different scenarios, the statements indicate that benefits will vary with economic growth, but because all projections are static, they do not convey the uncertainty involved.

The Orange Envelope presents projections that show how benefits vary with retirement age. Pension benefits for participants under the age of 60 are shown at age 61 (the

earliest age they can be withdrawn), age 65, and age 70. The purpose is to show that working longer will result in higher annual benefits. The statements for participants age 60 and older show benefits for additional ages between 61 and 70, depending on the participant's age. In that way, the Orange Envelope provides detailed information on how benefits will vary with retirement age for individuals in the process of planning their retirement.

Because benefits are automatically adjusted to life expectancy, younger cohorts have to work longer to receive the same replacement rates as older cohorts (table 17.1). For example, a person born in 1965 needs to stay in the labor force for an additional 2 years and 5 months to receive the same replacement rate as a person born in 1930. The cohort-specific retirement ages could be used to convey how life expectancy affects benefits, for example, by presenting them in the Orange Envelope. Similar information is available in the U.S. statement, and anecdotal evidence indicates an effect on retirement behavior.

INFORMATION ON OTHER BENEFITS

In some countries, such as Canada, Germany, and the United States, pension statements provide information on related benefits, such as disability benefits and survivor benefits. Typically, statements provide information only on public benefits, although retirement income generally comes from several sources. This incomplete picture is a disadvantage; participants may wrongly conclude that retirement benefits are lower than they actually are. In the past couple of years, an additional information sheet has been included in the Orange Envelope to direct participants to the website that includes information on both their public and their occupational benefits (<https://www.minpension.se>).

TABLE 17.1 **Life expectancy and retirement age, 1930–90**

Cohort	Life expectancy at age 65	Retirement age required	Time spent in retirement
1930	82 years, 5 months	65 years	17 years, 5 months
1938	83 years, 4 months	65 years, 8 months	17 years, 10 months
1940	83 years, 7 months	65 years, 9 months	18 years
1945	84 years, 3 months	66 years, 3 months	18 years, 3 months
1950	84 years, 10 months	66 years, 7 months	18 years, 6 months
1955	85 years, 3 months	66 years, 11 months	18 years, 8 months
1960	85 years, 7 months	67 years, 2 months	18 years, 10 months
1965	85 years, 11 months	67 years, 5 months	18 years, 11 months
1970	86 years, 3 months	67 years, 7 months	19 years, 1 months
1975	86 years, 7 months	67 years, 10 months	19 years, 2 months
1980	86 years, 10 months	68 years	19 years, 3 months
1985	87 years	68 years, 2 months	19 years, 4 months
1990	87 years, 1 month	68 years, 2 months	19 years, 5 months

SOURCE: Swedish Social Insurance Agency 2008.

SYSTEM-LEVEL INFORMATION

The Orange Envelope gives a short description of how the pension system works. The focus is on highlighting the type of information that is most relevant to participants to make decisions about work and savings. In connection with the reduction in benefits attributable to automatic balancing in January 2010, the 2010 Orange Envelope included information on the decrease in benefits. The information explained why the decrease occurred and provided examples on the effect on benefits. The balancing in January 2010 was also preceded by extensive media reporting.

In some countries, the pension statement provides information on the financial stability of the pension system. The U.S. statement informs participants that the system needs to be changed (a cut in benefits or higher taxes) for it to be financially sustainable in the long run. The accompanying text clearly spells out that the benefits presented in the statement are not guaranteed. The German statement informs participants that public pension benefits may not be sufficient in the future to maintain their standard of living and advises participants to consider private and occupational pension plans.

INFORMATION ON TOTAL RETIREMENT INCOME

The Orange Envelope provides information only on public benefits, so to get information on total benefits, participants in Sweden need to combine information in the Orange Envelope with information from their occupational plans and possible private pension savings. Occupational pension plans represent approximately 15 percent of retirement income for individuals with average earnings in Sweden, so to judge whether benefits will be adequate, participants need projections of their total retirement income. The demand for comprehensive information was clear from the reactions of participants when they received their first statements. Therefore, in 2004, after about four years of negotiations and work, the Swedish Social Insurance Agency and the Premium Pension Authority, together with the insurance companies for the occupational plans, launched the website <https://www.minpension.se>. The website presents individual projections of both of the public pension and the occupational pension benefits and the total projected pension as well as its components.

Since its inception, [minpension.se](https://www.minpension.se) has attracted more than 1 million registered users, and as of March 2008, the number of visits per day ranged from 10,000 to 20,000. The site is marketed in several ways to draw traffic and raise awareness of the three-tier pension system. To that end, a sheet describing the website has been included in the Orange Envelope on several occasions. Furthermore, the collaborating partners display a link to the [minpension.se](https://www.minpension.se) page on their websites. For the new Swedish Pension Agency, [minpension.se](https://www.minpension.se) will be the main channel to provide information on total retirement income.

Does the Information Work?

Since 1999, the Swedish Social Insurance Agency has conducted an annual survey of the Orange Envelope to examine how participants use it and how well it communicates information about the pension system. The sample is 1,000 individuals between the ages of 18 and 62, and interviews are conducted by telephone. The survey asks respondents to rate their knowledge of the pension system and to indicate the extent to which they read the

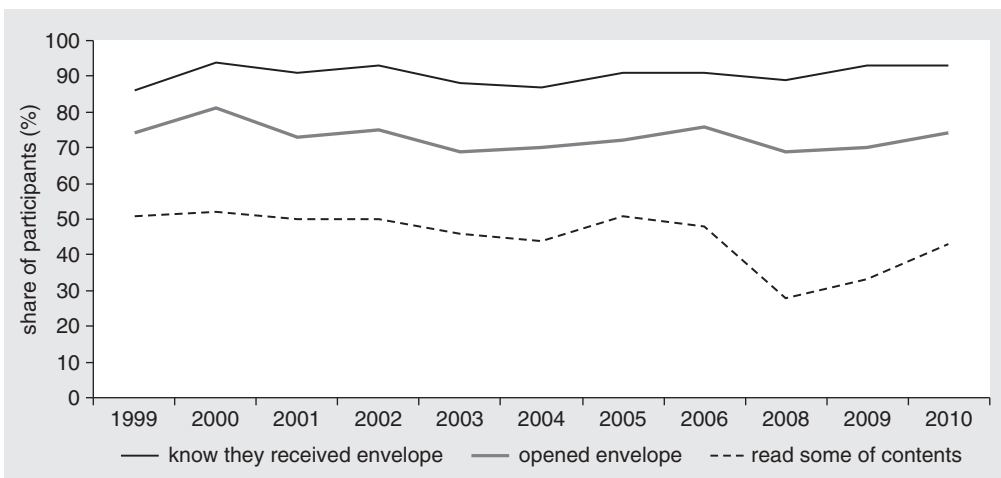
information provided in the Orange Envelope. The survey also includes questions to test respondents' knowledge of the system. The survey includes demographic and economic background variables such as age, gender, marital status, education, and income. In 2009, the average age of respondents was 41, and slightly more women than men answered the survey. About 35 percent of the respondents had a college degree, and most respondents had monthly incomes in the range of SKr 20,000 to SKr 29,000 (one U.S. dollar equals about seven Swedish kronor). Slightly more than half have private pension savings.

Most people know about the Orange Envelope. Figure 17.1 shows that the share of participants who know that they have received the envelope has held steady at about 90 percent. But those who made use of it constitute a much smaller percentage. Roughly three-fourths of all survey participants say that they have opened the Orange Envelope, and about half report reading at least some of the content, with a dip to about 30 percent in 2008. Evidence from the most recent survey in 2010 shows that the share of respondents who open the envelope has held steady.

Not surprisingly, a greater share of older participants read the contents of the Orange Envelope than younger participants, but the differences are quite small, with the exception of those younger than 25. The data also show that low-income individuals are less likely to examine the Orange Envelope's contents. Participants who have private pension savings, such as an individual retirement account, are more likely to open and read the envelope. Only 20 percent of all survey respondents had compared the information in the current Orange Envelope with previous years' content. Thus, the group of pension system participants who are most likely to read and examine the contents corresponds to the group who are most likely to already have some financial literacy. The pattern has changed little since the introduction of the Orange Envelope, so it is not clear whether the program has attracted less interested participants.

To help participants translate their account balances to monthly benefits at retirement, the Orange Envelope includes a benefit projection. The benefit projection calculates

FIGURE 17.1 Share of survey participants who know about the Orange Envelope, 1999–2010



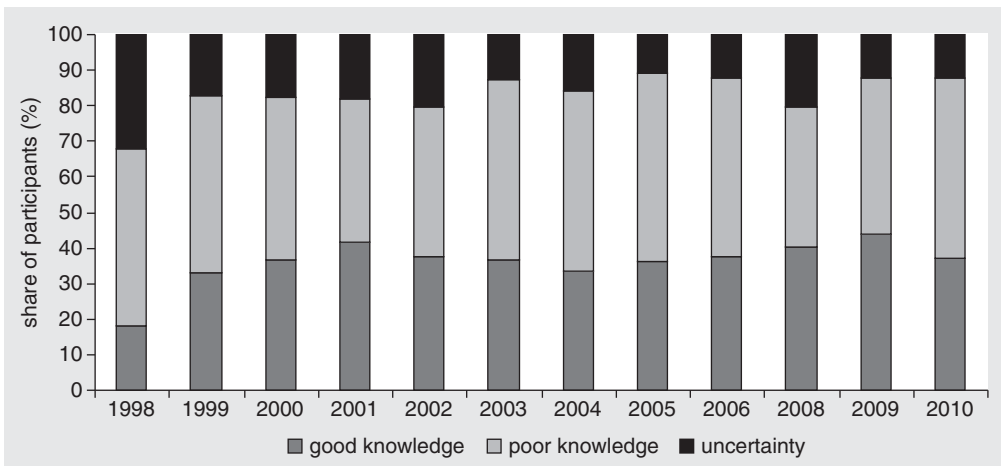
SOURCE: Annual Orange Envelope surveys.

the expected monthly benefit at three different retirement ages: 61, 65, and 70. Because making these kinds of calculations on their own is difficult for participants in a DC plan, having the benefit information is clearly important to assess whether retirement benefits will be adequate. The results of the annual surveys show that among those who opened the envelope, about 70 percent looked at the benefit projection during the first years the envelope was sent out. By 2005, the share had increased to almost 80 percent; in 2009, the share had fallen to 75 percent. The older the pension system participant, the more likely he or she is to look at the projection; the share is lowest in the age group 18–29 years.

The Orange Envelope has been successful to the extent that almost everyone knows about it and also reads at least some of its content. The question is whether the Orange Envelope has improved knowledge about the pension system to the extent that it helps individuals make decisions about work and savings. Because the survey is a cross-section and does not reflect information on respondents' level of understanding about pensions before the envelope was introduced, it cannot link the use of the Orange Envelope to changes in understanding of the pension system. However, in addition to self-reported knowledge, the survey includes some questions that try to elicit respondents' actual understanding, which may indicate how well participants understand the system and to what extent the Orange Envelope has contributed to that knowledge.

Self-reported understanding about the pension system has increased since the Orange Envelope was introduced, and in 2010, almost 40 percent of survey respondents reported that they had a good understanding of the system, compared with 20 percent before the system was introduced in 1998 (figure 17.2). The share of respondents who report that they do not understand the new system at all is persistently less than 10 percent, compared with 30 percent in 1998, and it has decreased somewhat in the past few years. Most important, the figure suggests that the encompassing information campaign at the outset of the reform, when the Orange Envelope was sent out for the first time in the initial months of 1999, had an important effect on knowledge, and that the share of individuals with good knowledge has gradually increased.

FIGURE 17.2 **Self-reported knowledge of the pension system, 1998–2010**



SOURCE: Annual Orange Envelope surveys.

Men view themselves as being more knowledgeable than women do, and formal education and income appear to be positively correlated with understanding of the pension system. One measure of financial literacy could be previous experience with saving for retirement. About half of the respondents in the Swedish survey have private pension savings such as an individual retirement account, an indication that they have spent at least some time thinking about retirement savings. Having a private pension appears to be correlated with slightly higher self-reported knowledge about the public pension system. About 50 percent of respondents who have private pensions report that they have poor knowledge of the system, compared to 60 percent among those without such savings. Among those who have read at least some parts of the Orange Envelope, the fraction that reports having good understanding of the system is about 13 percentage points higher than among those who have not read the contents.

The survey also includes a set of questions to gauge actual knowledge of the pension system. Perhaps the most important piece of information about the pension system for participants is that benefits depend on lifetime labor supply. The share of participants who know that lifetime earnings determine benefits peaked in 2000, the year after the new pension system was introduced and an extensive information campaign was conducted, when slightly more than half of participants correctly answered a survey question to gauge this knowledge. Among those who read at least some of the Orange Envelope contents, the share is only slightly higher and follows a similar pattern over time. Overall, men are somewhat more likely than women to know about the basic principle of the pension system. Not surprisingly, income and education are also important determinants of actual knowledge. Participants in the highest income class and those with college degrees have better understanding of the system than participants with low incomes and fewer years of education.

Much of the public debate about the pension system has evolved around the premium pension—that is, the prefunded component—and investment decisions. Anecdotal evidence indicates that participants have a skewed view of the importance of the premium pension and believe that investment decisions will determine most of the benefits. This view is confirmed by the survey of Orange Envelope recipients: participants are much more likely to know about the premium pension than about the NDC component. This finding is perhaps not surprising, given that the premium pension plan has operated during a period with two financial market crashes and subsequent upturns, which easily captured the attention of the media. Again, participants who have read the contents of the Orange Envelope are slightly more likely to be aware of the different parts of the pension system. A possible explanation is, of course, that the individuals who open and read the Orange Envelope are the ones who are interested in knowing more or who have previous knowledge of the pension system.

In summary, most people know about—and about half read—the contents of the Orange Envelope.⁶ Still, only about 40 percent understand that lifetime earnings determine benefits, one of the most important characteristics of the pension system. Although self-rated and actual understanding could be viewed as somewhat low, participants have confidence in the system. Almost half of participants responding to the survey were confident or very confident about the system in 2009, and the share that has no confidence has decreased markedly. The level of confidence could indicate that, overall, the information has been successful in communicating that pension reform has created a financially stable system.

Thus, the Orange Envelope has been successful. It has been established as the trademark for the Swedish pension system and always attracts media coverage when it is mailed out. It is also used by other actors, such as financial advisers, as a way of promoting pension information. The contents of the envelope have continuously been developed so that it is easier for participants to understand. The obvious drawback of the envelope is, of course, that it contains information only on public benefits. To develop and provide pension information, including information on total benefits, was one of the objectives of the recent merger of the parts of the Swedish Social Insurance Agency that administrate pensions and the Premium Pension Authority into the new Swedish Pensions Agency. Compared with the functions of previous public agencies, the Swedish Pensions Agency's mandate has been expanded, and the new agency will work with other actors to develop the website that presents an overview of public and occupational benefits together (<https://www.minpension.se>). The agency also will examine the possibility of including information on occupational pensions in the Orange Envelope.

Conclusions

Swedish pension reform replaced the public defined benefit plan with a defined contribution plan. Most of the scheme is still pay as you go, but it also includes a small component of prefunded individual accounts. One of the most important objectives of the Swedish pension reform was to design a pension system that would be financially stable over time, even when faced with adverse demographic and economic developments. The DC design was chosen to provide increased work incentives and to give participants an opportunity to control some of their pension funds.

The DC plan redefines the benefit promise and puts more responsibility on participants to plan for retirement. The automatic adjustment of benefits to life expectancy means that individuals will have to either work longer or save more to maintain the replacement rates of the preceding generations. Reliable projections of expected benefits and an understanding of how benefits vary with retirement age are crucial for participants. Furthermore, the broad investment choice in the prefunded individual account requires that participants be familiar with general principles of investing. Therefore, an instrumental component of the reform has been information and education. In particular, a large effort has been put into the development of the annual account statement, the Orange Envelope.

The information and education efforts have paid off. Almost everyone knows about the Orange Envelope, and most individuals have at least opened it. Self-reported knowledge of the envelope has increased since 1998. When the Orange Envelope is mailed out in the spring, news media regularly report about the pension system and expected benefits. Self-reported understanding about the pension system has also increased since the envelope was introduced, and in 2010, about 40 percent of respondents reported that they had a good understanding of the system.

The outcome of the Swedish pension reform's educational efforts should be viewed in light of the fact that the new Swedish pension system has been in effect for 14 years and that most people who will depend fully on the new system are still far from retirement. Nevertheless, participants report that they would like more information and, in

particular, would like more help choosing funds in the premium pension. Also, until the information on the website is complete, many participants still lack sufficient information on total pension benefits. They would benefit greatly if they were provided with information on public and occupational pensions from one source. Thus, the challenge for the new Swedish Pensions Agency is to improve information on total benefits and to consider alternative ways of communicating with participants so that they have the tools they need to plan for retirement.

Notes

1. This chapter builds on “Learning from the Experience of Sweden: The Role of Information and Education in Pension Reform” (Sundén, forthcoming) and “Pension Information: The Annual Statement at a Glance” (Sundén, Larsson, Ole Settergren 2008).
2. In the United States, the replacement rate for an average worker retiring at age 65 is projected to decrease from 41 percent in 2000 to 36 percent in 2030.
3. Participants often face a large number of investment options in DC plans. In the Swedish premium pension plan, participants have almost 800 funds to choose from. In the United States, workers in large 401(k) plans have, on average, 38 different investment options.
4. The assets in the NDC are equal to the capitalized value of contributions.
5. For an overview of the Swedish pension reform, see Sundén (2006).
6. In 2008, the Swedish National Audit Office evaluated the information in the Orange Envelope and the efforts by the Swedish Social Insurance Agency and Premium Pension Authority. They concluded that the Orange Envelope contained too much information and recommended that the government review its contents. In particular, the Audit Office thought too much information was provided on details that are not directly associated with decisions on work and savings, such as administrative costs.

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CHAPTER 17

COMMENT

Florian Léger

Annika Sundén's chapter discusses an issue that is very important and that seldom attracts the attention it should. Pension information is a fundamental part of any pension system. Whether they are defined benefit (DB) or defined contribution (DC), funded or pay as you go, publicly managed or privately managed, pension schemes should be understandable by the participants.

Sundén rightly says that making schemes understandable is not easy because pensions are long-term contracts. She also mentions that recent trends are likely to increase individuals' need for information because more and more schemes require decisions that contributors (and pensioners) must make.

I am not a fan of systems in which individuals have to make some decisions about their pensions—not only because of the well-known myopia of individual participants, but also because even well-informed people can have difficulty making rational decisions under certain circumstances. Often, for example, such decisions must be made at an early stage of a person's career, when the contributor has no idea what his or her professional and family situations will be at retirement. How can such contributors decide what to do for their elderly days? Therefore, I do not believe individuals should have any choice with respect to participation, level of contribution, investment instrument, and withdrawal of funds at retirement. At the very least, the options should be as limited as possible, and a well-designed default option should be in place.

Pension schemes are complex; hence, any reform should be designed so that participants will have an understanding of the reform that is as comprehensive as possible. The knowledge that people have of a pension system should be one of the main measures of its success. Reforms should be focused not only on ensuring financial sustainability.

That being said, one must also recognize—and Sundén mentions this dimension in her chapter—that in many countries, the complexity of the pension system is increased by the often necessary and complementary coexistence of several pillars with sometimes very different rules.

Now, are nonfinancial (notional) defined contribution (NDC) schemes more or less complicated to understand than other types of schemes (DB or DC)? What is certain is that countries that have undertaken systemic pension reform and, in particular, have implemented NDC schemes must generally go through a long transition period that is difficult to explain to contributors because so many different rules apply at the same time (for instance, different rules for different cohorts). But this same problem often arises with parametric reforms.

In addition, I would agree with Sundén that pension formulas are increasingly complex, even in DB schemes. The time when the accrual rate was constant is (regrettably) over.

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In the case of NDC plans, it is easy for everybody to understand that the later the worker retires, the higher the pension will be. But one of the technicalities that is not so easy to understand is how the annuity factor works. Dividing the balance of an individual account (notional or financial) by an annuity factor might be a calculation that is too difficult for many people. Actually, on this particular issue, a point system might be easier to understand. If a person earns 1,000 points and the value of the point is 5, the pension will be 5,000. Everybody can understand such a system. It can be much less straightforward to explain to participants that because they have 100,000 in their account and the annuity factor is 20, they will receive a pension of 5,000. And then, one must further explain that the pension will increase if participants retire later because the numerator will be higher (because of interest credited and new contributions) and because the denominator will be smaller (because remaining life expectancy has decreased).

I have three final comments:

- First, the automatic balancing mechanism is one of the most important characteristics of the Swedish NDC. Sundén says that it is challenge to convey to contributors that automatic balancing is a regular component of the indexation of earned pension rights; a first-time application of reduced pension indexation occurred in 2010. However, was it not clear to the public before the crisis started that pensions could actually decrease?
- Second, regarding the annuity factor (divisor), I understood that the Orange Envelope presents two balances for each participant: the balance for the NDC component and the balance of the premium pension. The expected pension benefit is also differentiated for the NDC component and the premium pension, but it is not clear from the Orange Envelope what annuity factor is used for each component. For the few participants who will try to understand how their pension is calculated, this information is key and should be included. Including this information would add only two figures to the Orange Envelope, which already contains many more figures.
- Finally, Sundén could have said a bit more in the last endnote in her chapter, which mentions that the Swedish National Audit Office evaluated the information in the Orange Envelope and concluded that the Orange Envelope contained too much information. Therefore, it recommended that the government review the Orange Envelope's contents. Is that the best way to be transparent?

PART V

**Solvency, Liquidity, and Stability
of NDC Schemes**

Addressing the Legacy Costs in an NDC Reform: Conceptualization, Measurement, Financing

Robert Holzmann and Alain Jousten

When a pension reform is undertaken, the new system typically aims at improving financial sustainability through a variety of measures, including an increase in (future) retirement age and a reduction in (future) benefits. Both measures may also aim at a reduction in (future) steady-state contribution rates and better alignment between the scheme's contributions and benefits. But the legacy of existing commitments (from previously acquired rights) to current and future retirees may not allow these aims to be accomplished directly. Such commitments may need to be partly or fully honored for social and political reasons, thus raising the issue of how these legacy issues should be best addressed and financed.

Keeping the contribution rate unchanged for the time being to keep the system financially afloat taxes current and future generations because they receive fewer benefits per unit of contribution. This (additional) tax element under parametric reforms has led to requests for financing this tax overhang, or legacy cost, through other public revenues that are less distortionary, thereby helping to create the tighter link between contributions and benefits that such reforms typically want to establish.

The argument for explicitly financing the legacy cost becomes even stronger under a nonfinancial (notional) defined contribution (NDC) reform that fixes the contribution rate at the future steady-state level. If such a decision is not made, other approaches need to be applied that are akin to legacy cost financing of parametric reforms: introducing an explicit tax element above the recorded contribution rate, making an unspecified increase in public transfers to the pension scheme, using existing financial reserves, or reducing benefits beyond long-term financial needs. Such measures are typically not transparent and contribute little to enhance the credibility of the reformed scheme; such an approach is in sharp contrast to the very objective of the reformed system.

Although the arguments for explicitly financing the legacy costs of pension reform seem strong, the actual practice looks bleak and unimpressive. No recent parametric reform

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has undertaken even a partial explicit financing of the legacy costs; the same applies to the NDC reforms introduced in Italy, Latvia, Poland, and Sweden (see Chłoń-Domińczak, Franco, and Palmer 2012). Although many good political economy arguments may explain such behavior, it may also be the result of lack of interest in and guidance by the pension reform community on the topic. Hardly any writing exists on how to define, measure, and finance such legacy costs. Filling this gap is the purpose of this chapter, which is structured as follows. The next section outlines why explicitly addressing legacy costs is important in pension reforms in general and for NDC reforms in particular. The chapter then investigates alternative possibilities for conceptualizing and defining the legacy costs. It then proposes alternatives for estimating legacy costs and reviews approaches and issues of financing them. The penultimate section illustrates the measurement approach with broad estimates for a hypothetical NDC reform in China. Key conclusions are summarized in the final section.

Why Is Addressing Legacy Costs in an Explicit Manner Important?

What are the key arguments for identifying the legacy costs of a reform and financing them separately and outside the social security scheme through general revenues? What are the key implications and considerations to take into account?

A key objective of pension reforms is typically to put the reformed system on a financially sustainable basis while adjusting the benefits system and its link to contributions to render the reformed system more equitable, more affordable, and less distortionary. This objective applies to parametric reforms as well as to the move toward an NDC scheme. In many (or nearly all) cases, such reform implies a move from a more generous scheme toward a less generous benefit structure and a lower cost-covering contribution rate for the future steady state. Simply keeping the inherited contribution rate for the new scheme to finance both the inherited higher (old) pensions and future lower (new) pensions means that the contribution rate will for some time contain an implicit tax component that will gradually diminish over time. Keeping such a tax element purely implicit, however, contradicts the very objective of the reform.

An alternative is to separate both elements explicitly. The new NDC system, with its fixed contribution rate, expects the fiscal adjustment to take place through the benefit level and retirement age; levying contributions at the old contribution rate would make the tax element explicit. Only the NDC part of the contribution rate would be credited to the individual (notional) account; the remainder would be used to prevent a cash deficit for many years. Although feasible, such an approach risks robbing the new NDC scheme of many of the expected better incentives, of higher credibility, and thus of increased formal labor force and system participation. Separating the costs of the older system from those of the reformed new system and financing the legacy costs through alternative budget revenues thus seems strongly advisable, but such alternative financing needs to be less distortionary in economic terms and to be feasible in fiscal terms to be a worthwhile undertaking. In addition, such separate financing of legacy costs raises a number of issues of its own that are not addressed in this chapter.

For example, intergenerational aspects are heavily influenced by the way transition costs are evaluated and financed. Any specific transition option will lead to different burden sharing across generations—at least when generations are not linked in a way that generates a Barro equivalence-like result. Put differently, the level of explicit and implicit debt shifted forward onto each younger generation depends heavily on the way the transition is organized and financed. For example, Feldstein, Ranguelova, and Samwick (2001) provide a nice model that explicitly recognizes the intergenerational burden sharing of an individual accounts reform in the U.S. context. One interesting implication of these authors' model is that it also indicates the heavy dependence of outcomes for various generations (and thus the political acceptability of the reform) on the specifics of how the transition is implemented.

Similarly, any reform will affect intragenerational distribution. Such effects play out on at least two levels, in terms of the reforms of the systems themselves and in terms of the financing of the transition. At the level of the system change, the shift from the existing system toward an NDC (or other) type of retirement system will almost inevitably lead to a change in the distributive characteristics of the pension system. For example, a shift from a more Beveridgean system toward NDC will likely benefit higher-income earners in relative terms. Similarly, a risk-group-specific calculation of annuities will likely run counter to the interests of longer-lived people as compared to the common risk pool in conventional defined benefit systems. At the level of the transition, various tax (or, more broadly, policy) instruments are not neutral with respect to the intragenerational outcomes. For example, value added tax (VAT) is often seen as a regressive tax instrument, despite being riddled with exemptions and reduced rates that mitigate the regressivity (see European Union 2007).

Conceptualizing the Legacy Costs

Legacy costs can be defined in a first approximation as additional financing needs, beyond those of the reformed and financially sustainable new system, that reflect prior commitments. For this reason, the legacy costs are also sometimes called *tax overhang*, because such costs reflect financing needs beyond the contribution revenues of the reformed system. Although useful as a first approximation, this definition is too broad and unspecific to guide policy decisions and cost estimations. What is in and what is outside the definition need to be better understood.

To conceptualize legacy costs, this chapter follows a stepwise approach. It starts out with a simple three overlapping generations (OLG) model, moving from sustainable to unsustainable schemes to explain the key components of the legacy costs and key adjustments in contributions and benefits. The considerations within a model-type context should help better explain the critical but limited options for defining legacy costs and the difference from other costs. Those issues often get blurred when looking directly at real-country situations. Readers not interested in this thought process and the math involved can move immediately to the summary at the end of the next subsection. From there, the chapter moves toward conceptualization in a more operational accounting framework that is more accessible for use in a country context, and it investigates alternative approaches and indicators.

LEGACY COSTS IN A SIMPLE OLG SETTING

Beginning with an OLG model with three generations,¹ this section focuses on the financial situation of the pension scheme, assuming that each generation works for two periods and is retired in the third. N is the size of the generation, b the benefit level, c the contribution rate, w the wage level (differentiated between old and young workers), and t the respective period considered.

Steady state: No deficit. The model starts out with a steady state without deficit in which in each period, two generations of workers (one old = o , one young = y) finance the benefits of the retired generation that was the old workers one period and the young workers two periods before (table 18.1).

From the balancing condition (equation 18.1), one can calculate the benefit level and simplify the expression (equation 18.2) by inserting constant generational growth rates for wages (g) and size of generations (n). Differentiating by time and after some simplification gives an approximation for the growth rate of benefits (or internal rate of return, IRR). In expression 18.3, the well-known result about the IRR being equal to growth rate of wage (i.e., productivity) plus growth rate of generation size (i.e., labor force) has an additional item: the change in turnover duration.² This is the money-weighted average time a contribution unit stays in the system before getting disbursed. In the steady-state model, the turnover ratio is constant, and hence the change (δ) is zero. In reality and in multigeneration OLGs, turnover ratio is not constant, and this fact has some bearing on measuring and financing the legacy costs.

$$b_t N_{t-2} = c w_t^o N_{t-1} + c w_t^y N_t. \quad (18.1)$$

$$\begin{aligned} b_t &= c w_t^o (N_{t-1} / N_{t-2}) + c w_t^y (N_t / N_{t-2}) \\ &= c(1+g)(1+n)[(1+g) + (1+n)] w_{t-1}^y. \end{aligned} \quad (18.2)$$

$$b\% \approx g + n\{\delta\}. \quad (18.3)$$

TABLE 18.1 **Steady-state model without deficit**

	$t-1$	t	$t+1$	$t+2$
E (expenditure)	$b_{t-1} N_{t-3}$	$b_t N_{t-2}$	$b_{t+1} N_{t-1}$	$b_{t+2} N_t$
R^o (venue)	$c w_{t-1}^o N_{t-2}$	$c w_t^o N_{t-1}$	$c w_{t+1}^o N_t$	$c w_{t+2}^o N_{t+1}$
R^y (venue)	$c w_{t-1}^y N_{t-1}$	$c w_t^y N_t$	$c w_{t+1}^y N_{t+1}$	$c w_{t+2}^y N_{t+2}$
B (alance)	0	0	0	0

SOURCE: Authors' compilation.

Moving from a higher to a lower benefit level. Without loss of generality, a static model is next considered in which g and n are zero. Because wages and derived benefits are constant, the time index of the variables can be dropped, except for N , which indicates the cohorts across time.

This model assumes that society wants to move toward a lower contribution rate and benefit level (half of the original one) while respecting acquired rights. Starting the reform in year t means that the benefit and expenditure levels are unchanged, whereas contribution revenues are already reduced. Reducing the contribution rate immediately for all working generations leads to a shortfall of half the original expenditures or revenues in period t . This shortfall is halved in period $t - 1$ because the benefit levels could already be reduced without infringing on acquired rights (based on contributions, not promises). In period $t - 2$, the new steady state is reached. A reverse time profile of the balance would be achieved if only the generation of labor market entrants received a contribution cut (table 18.2).

The legacy costs of this pension reform are the present values of the balances in the transition period, $cwN(3/2)$ or $bN(3/4)$, which equal the reduction of the implicit pension debt (or accrued-to-date liabilities).³ The pension debt at the beginning of period t consists of the liabilities to the generation of retirees in this period ($N_{t,2}$) and to the generation of older workers ($N_{t,1}$) that have accumulated rights in period $t - 1$.

If the government were to decide to replace the reduced contributions under the unfunded scheme with contributions to a funded pillar, the legacy costs would simply be renamed as the transition costs of such a reform.

TABLE 18.2 **Halving contribution rate and benefits**

	$t-1$	t	$t+1$	$t+2$
E (xpenditure)	bN_{t-3}	bN_{t-2}	$b(3/4)N_{t-1}$	$b/2 N_t$
R^o (evenue)	cwN_{t-2}	$c/2 wN_{t-1}$	$c/2 wN_t$	$c/2 wN_{t+1}$
R^y (evenue)	cwN_{t-1}	$c/2 wN_t$	$c/2 wN_{t+1}$	$c/2 wN_{t+1}$
B (alance)	0	$-bN/2$	$-bN/4$	0
	or	$-cwN$	$-cwN/2$	

SOURCE: Authors' compilation.

Eliminating an inherited deficit of the pension plan. As a next step, this section considers the elimination of an inherited imbalance in period $t - 1$ and investigates the policy options and implications in period t and beyond.

The imbalance is first assumed to be constant (e.g., half of expenditure) and to exist in all future periods. Under these assumptions, the actuarial deficit of the pension scheme is infinite if measured across all future generations.⁴ The actuarial deficit for all generations that have already contributed to the scheme is finite and amounts to $b_t N_{t,2}/2$ $b_{t-1} N_{t-1,1}/4$ at the beginning of period t .

The size of implicit pension debt that is to be reduced (and hence the legacy costs to be financed) depends on the commitment the government wants to honor. If the government wants to honor the committed benefit level (independent of how much own contributions this reflects), the commitment is equal to the time period actuarial deficit $b_t N_{t,2}/2$ $b_{t-1} N_{t-1,1}/4$. If the government wants only to honor the commitment on the basis of own contributions, it is less—and in this case, 50 percent (table 18.3).

TABLE 18.3 Addressing an inherited permanent deficit

	$t-1$	t	$t+1$	$t+2$
E (xpenditure)	$b_{t-1}N_{t-3}$	b_tN_{t-2}	$b_{t+1}N_{t-1}$	$b_{t+2}N_t$
R^o (evenue)	$cw_{t-1}^o N_{t-2}$	$cw_t^o N_{t-1}$	$cw_{t+1}^o N_t$	$cw_{t+2}^o N_{t+1}$
R^y (evenue)	$cw_{t-1}^y N_{t-1}$	$cw_t^y N_t$	$cw_{t+1}^y N_{t+1}$	$cw_{t+2}^y N_{t+1}$
B (alance)	$-(b_{t-1}N_{t-3})/2$	$-(b_tN_{t-2})/2$	$-(b_{t+1}N_{t-1})/2$	$-(b_{t+2}N_t)/2$

SOURCE: Authors' compilation.

Under these assumptions, the elimination of the deficit for period t and beyond is limited to three key options:

- *A reform that cuts the benefit levels that are out of sync with the level of contribution rates by 50 percent.* This can be done (a) by renegeing on the benefits for individuals of generation N_{t-2} when they retire in period t without allowing them the possibility of preparing for the reduction through more own saving and (b) by partially renegeing for generation N_{t-1} , which retires in period $t-1$, because such individuals have the opportunity, as the generation of older workers in period t , to compensate for the lower future benefit level. In both cases, no legacy costs would emerge from the reform, and the burden would fall on the pensioner generations of periods t and $t-1$.
- *A reform that cuts the future benefit level by 50 percent but shelters the generation of pensioners in periods t and $t-1$.* Only as of period $t+2$ would the reform fully take hold. In this case, the generation of workers in periods t and $t-1$ would already have their benefits aligned with their contribution efforts (including those from employers). The deficit sequence would be $(b_t N_{t-2})/2$, $(b_{t-1} N_{t-1})/4$, and 0 for the periods t , $t-1$, and $t+2$, respectively, and these amounts would equal the legacy costs the government would have to finance. The legacy costs are cheaper than the present value of the deficits for these periods.
- *A reform that doubles the contribution rate for the workers as of period t while keeping the benefit level as before.* Such an approach would generate no legacy costs; they would be paid by the current generation of workers, and all current and future workers would have their future pensions aligned with their contributions.

Eliminating an inherited deficit of the pension plan and moving to lower benefit levels.

Most pension reforms constitute a mixture of both addressing an inherited deficit and moving to a benefit and contribution level that is more sustainable. This reform can be conceptualized in the previous model as a temporary deficit resulting from too high promises and benefits to generations $t+2$ and $t+1$ with no further future deficits from period $t+2$ onward as the benefit level would be reduced. In this case, the government can pay the deficits for period t and $t+1$ (i.e., pay for the legacy costs or actuarial deficit) or set a higher contribution rate for the working generations in periods t and $t+1$ that will not translate into higher benefits. If the labor supply is not fixed (as in this model), such a scenario is likely to create labor market distortions with lower levels of overall and formal employment.

Summary. Assessing the fiscal implications of pension reform in a simple three-generation OLG model brings a number of simple but important conclusions. They may not come as a surprise and should help in the next steps of conceptualizing the legacy costs.

First, the elimination of a permanent deficit of a pension scheme (unsustainability) needs to be dealt with through a reform with measures on the revenue or expenditure sides—or both. As the system is reformed, securing the acquired rights (expected benefits) of current retirees and contributors leaves a transitory deficit (legacy costs) that is much smaller than the deficit that would arise had the scheme not been reformed; the actuarial deficit of the unreformed scheme could be infinite.

Second, for a shift from a nonfinancial defined benefit (NDB) scheme to an NDC scheme with a fixed contribution rate that is sustainable in the long term, the legacy costs amount to the actuarial postreform deficit, which is equivalent to the reduction of the implicit pension debt and is finite. The two key sources of the legacy costs are the *inherited legacy costs* reflecting prior reforms and benefits above the steady state under the old scheme, and *reform-induced new legacy costs* caused by the shift toward a lower, sustainable contribution rate.

Third, a temporary deficit (as the result of too much generosity toward prior generations) can be eliminated by reducing the acquired rights (e.g., for expected benefits that may not be based on equivalent contributions), by burdening the working generation (with higher contributions), or by paying for the deficit with general revenues. Burdening the working generation through higher contributions instead of paying the transitory deficit out of general revenues does not change the overall fiscal requirement but may be more costly for society once labor supply and demand are endogenized.

Fourth, reducing further benefit and contribution levels in a sustainable scheme leads to additional transitory deficits, and their actuarial value is equivalent to the reduction in the acquired right or accrued-to-date liability. Although the overall amount is fixed, the time path of the deficit will depend on the speed of transition that ranges from new entrants to the labor market to all current workers. These legacy costs are equivalent to those known when moving toward a funded system (see Holzmann 1998, 1999).

LEGACY COSTS IN A MACROECONOMIC ACCOUNTING FRAMEWORK

Pension reforms typically try to address a multitude of issues simultaneously, such as handling the financing of prior generations' excessive acquired rights, bringing different schemes into one system, and reducing the future benefit (and contribution) level of a more harmonized system. Each of them contributes to an overall transitory deficit that differs from the aggregated baseline deficits of the unreformed schemes. The difference between the actuarial deficits before and after reform is not the overall legacy costs but an amalgam of changes across assets and liabilities. If the present value of deficits over the next, say, 50 or 75 years is calculated (as a proxy of the respective actuarial deficits) and prereform and reform values are compared, this exercise gives a useful indication of the overall fiscal savings but not the legacy costs that should, perhaps, be financed by general revenues.

However, making such multiple reforms within an NDC framework has the objective of putting the system on a long-term financially sustainable basis and hence making the actuarial deficit finite and best zero. Furthermore, because no revenues are available

other than contributions, this very actuarial deficit of the reform scheme constitutes the (aggregate) legacy costs that need to be financed. Analytically, the sources of the legacy costs can be differentiated depending on the scope of reform, such as follows:

- *Any acquired and honored rights of current retirees and contributors reflecting leftovers of prior reforms that have not previously been addressed through explicit legacy financing—hence surpassing the steady-state benefit level of the current system.* Such old legacy costs exist in any case but were typically financed by contributions and rarely by general revenues.
- *The acquired and honored rights of current retirees and contributors in excess of the sustainable benefits under the new contribution rate.* These amounts are new legacy costs that result from the transition from the old contribution rate to the new and lower contribution rate equivalent to the (partial) move from an unfunded to a funded system. Hence, the scope of these legacy costs is a political decision determined by how much the contribution rate and future benefits should be adjusted downward.
- *The acquired, honored, and, perhaps, noncontributory rights of additional groups brought into the NDC scheme (such as civil servants).* Such rights are already in the system and do not reflect new financial engagements, so they would have to be financed in any case, but their inclusion makes these costs explicit. Because the benefits of such groups have typically been higher than the future NDC benefits provided, the overall fiscal costs are likely eventually reduced.⁵

These components of the legacy costs can be individually estimated and should provide useful information: *ex ante* for reform design and *ex post* for the magnitude of gross versus net fiscal costs. Doing so requires an actuarially based projection model, discussed later.

A more aggregate approach is proposed and presented here that is directly based on the move toward a country's (perhaps harmonized) NDC scheme. Such a calculation is based on the following components that need to be individually estimated and on the following equilibrium condition for an NDC (or any unfunded or funded pension) scheme:

$$K_t + P_t = L_t \leq A_t = FA_t + PA_t + LC_t. \quad (18.4)$$

The left-hand side of equation 18.4 is the liability of the reformed pension system on day 1 (L_t) and differentiates between the two key components: the liability toward the current working generation and that toward those already retired. The latter (P_t) is easily calculated as the present value of benefits in disbursement; although respecting the rights of existing retirees with the reform, the value may reflect changes in indexation rules through the reform. The liability toward the current generation (K_t) reflects that generation's accrued rights, and in the case of an NDC system, the aggregate value of the individual accounts. At the beginning of the reformed system, these account values reflect the initial capital that has been recorded and is derived from a calculation that transformed acquired future rights of the unreformed system into an "equivalent" monetary amount in the reformed system.

The right-hand side reflects the assets side of the reformed pension system on day 1 (A_t) and differentiates between the three key components: the financial asset that the scheme has inherited (FA_t). In most cases, this amount may be small or zero; in some cases (such as in Sweden), it amounts to a major share of gross domestic product (GDP) inherited from the prereform scheme. The pay-as-you-go (PAYG) assets of the pension scheme (PA_t) is defined and estimated as the present value of future contributions minus the present value of the corresponding benefits (see Valdés-Prieto 2005). If the future scheme were to be perfectly actuarially fair, the PAYG assets would be zero (and all liabilities would need to be covered by the financial assets). Hence, any positive value results from giving the future beneficiary a lower remuneration on his or her accounts than derived under an actuarially fair funded system. The assumed underlying positive difference between funded and unfunded rate of return (i.e., $r \geq g - n$) is akin to a tax and creates the PAYG assets. The last asset—the residual—is the legacy cost: LC_t . Without such an asset (and the financing by general revenue), the system would need to adjust the liability side to respect the equilibrium condition (equation 18.4).

This (residual) definition of legacy costs can be used very handily at the time of starting the reform to compare the changes in the components in equation 18.4 before and after the reform:

$$\Delta LC_t \geq \Delta K_t + \Delta P_t - \Delta PA_t - \Delta FA_t. \quad (18.5)$$

Although each of the four components on the right of the equation may change, the financial assets are quite likely to remain unchanged as a direct result of the reform (i.e., $\Delta FA_t = 0$). A second component that is likely to exhibit little change concerns the present value of benefits to existing retirees, albeit the reform may introduce changes, such as modified indexation, for example, by moving from mixed wage-price indexation to mere price indexation (i.e., $\Delta P_t \leq 0$). The third component is more likely to display some changes. It represents the present value of accrued rights of the working generation. Although an actuarial translation of the acquired rights should keep them unchanged, their often not fully defined nature and the strategic choice of a discount rate may allow for some reform gains (and hence $\Delta K_t < 0$). Last, the PAYG asset as the fourth component has the highest probability of change and exerts most influence on the size of the legacy costs (except, perhaps, the existing legacy costs of the unreformed system, LC_t^u). For the PAYG asset, both size and sign need to be assessed. The unreformed scheme may exhibit a low (or even highly negative) PAYG asset if the scheme is fiscally unsustainable (e.g., providing a rate of return in excess of the sustainable IRR), thus resulting in implicit financial liabilities. Moving to an NDC scheme under the prevalent contribution rate makes the scheme financially sound for new contributors and makes the PAYG asset and its change positive and large, thus contributing to a reduction of the legacy cost. This change in the PAYG asset eliminates any existing implicit financial liability of the old scheme for future generations but will still leave old legacy costs. If, in addition, the system moves toward a lower contribution and benefit level, the tax base for financing the liabilities is reduced (even if the new system is in fiscal balance), and this change increases the legacy costs. The stronger the reduction, the higher in absolute terms ΔPA_t will be if the level of contributors remains unchanged. However, the reduction in the contribution rate and

the alignment with future benefit levels are expected to increase coverage, and the overall effect may be very strong in countries where coverage has been low. This effect not only may compensate for part of the negative change, but also may actually create negative legacy costs (a reserve), as discussed later. Finally, expression 18.5 covers only the change in the legacy costs to the reformed scheme. Hence, for the full costs at the beginning of reform, the legacy costs of the unreformed system need to be added (LC^u). Because the permanent elements of unsustainability are addressed by the change in PAYG asset, they include only the temporary elements of unsustainability (i.e., the inherited legacy costs of prior reforms that were not properly addressed). To illustrate the considerations above, figures 18.1 to 18.4 present examples of the changes in the balance sheet of the pension scheme before and after reform: the origins and the resulting legacy costs.

The total costs to be financed are summarized in equation 18.6:

$$LC_t = LC_t^u + \Delta LC_t. \tag{18.6}$$

FIGURE 18.1 **Balance sheet: No legacy costs**

a. Unreformed scheme		b. Reformed (NDC) scheme	
Liabilities	Assets	Liabilities	Assets
Acquired rights: AR	Financial assets: FA	Initial capital: K	Financial assets: FA
Pensions: P	PAYG asset: PA	Pensions: P	PAYG asset: PA
			$LC = 0$

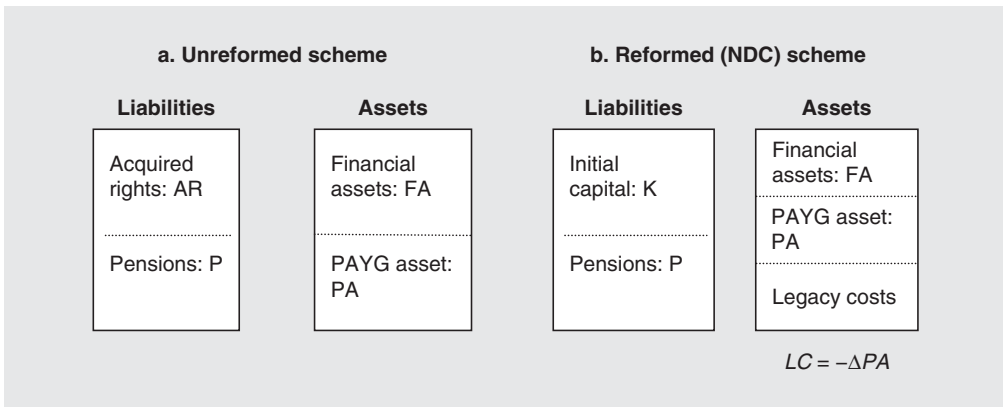
SOURCE: Authors' representation.

FIGURE 18.2 **Balance sheet: Inherited legacy costs**

a. Unreformed scheme		b. Reformed (NDC) scheme	
Liabilities	Assets	Liabilities	Assets
Acquired rights: AR	Financial assets: FA	Initial capital: K	Financial assets: FA
Pensions: P	PAYG asset: PA	Pensions: P	PAYG asset: PA
	Implicit financial liability		Legacy costs
			$LC = LC^u$

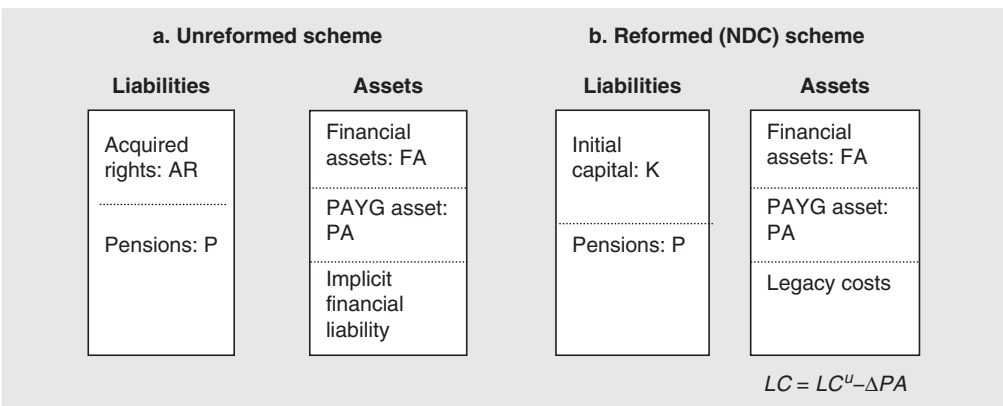
SOURCE: Authors' representation.

FIGURE 18.3 **Balance sheet: Reform-created legacy costs**



SOURCE: Authors' representation.

FIGURE 18.4 **Balance sheet: Inherited and reform-created legacy costs**



SOURCE: Authors' representation.

Equations 18.5 and 18.6 substantiate the starting definition of legacy cost based on the introspections of the OLG model that highlighted the basic cases that need to be differentiated. With this background, one can move toward measuring these costs. The discussion made clear that the concept and definition of legacy costs for an NDC reform do not differ materially from those of a (parametric) NDB reform or any other pension reform applied to a funded or unfunded scheme of the defined benefit or defined contribution type. What will change are the size and sometimes the sign of the various components.

How to Measure Legacy Costs?

In principle, the best approach to measuring the legacy costs of a pension system is to use actuarial methods to estimate the financing gaps (tax overhang) for the new and reformed systems both as an overall amount and for the time path of financing requirements. Although such an approach has methodological merits, it also has a number of

drawbacks and raises a number of conditions that may not be easily met (e.g., on data) in low- and middle-income countries. For this reason, other more rule-of-thumb methods are discussed that should allow one to get first magnitudes before venturing into more sophisticated methods.

ACTUARIAL METHODS: BENEFITS AND CHALLENGES

Actuarial methods are the best approach for measuring the legacy costs and should be undertaken when possible. However, using them well poses major requirements as well as conceptual and political issues for which good solutions are not always available. More specifically, an actuary can calculate everything, given a price and quantity structure. In reality, however, a number of these data are not known and need to be approximated. Equally important, the concept of actuarial studies is more easily applied to company schemes than in the case of countrywide schemes, where it requires the introduction of macroeconomic considerations to render the assumptions consistent. Selecting the appropriate interest rate to be applied for discounting poses a special challenge for countrywide schemes. Although the use of the term structure of government bonds may be a valid approach, only in the most developed countries with a full-blown financial market are bond interest rate term structures for 30 years available. And even if such structures are available, their use may not be fully embraced because they do not necessarily reflect all future information but rather current conditions of fiscal and monetary policy. For this and other reasons, a number of economists propose using the projected GDP growth rate (with or without a markup of, say, 100, 150, or 200 basis points) as a more appropriate and pragmatic approach—a proposal that is typically not embraced by actuaries.

A related issue concerns the existing actuarial capacity in countries, which is often weak. Calling in foreign experts to undertake the actuarial work is possible but typically quite expensive, and the results may not have the same buy-in because the external experts may be considered less able to model the intricacies of the old and reformed systems. In addition, countries typically adjust the reform once they see the price tag, changing the actuarial (fiscal) outcome without undertaking a reestimation. For this reason, the World Bank some time ago developed the Pension Reform Options Simulation Toolkit (PROST) and trained government officials in its application. Although not an actuarial model, PROST is fully consistent with actuarial methods, allows more flexibility with regard to missing data and assumptions in a transparent manner, and offers ways to ensure macroeconomic consistency of parameter assumptions. It does not yet have a module for legacy costs, but both the overall amount and the time path of these costs can be easily calculated.

All estimation models are confronted with political gaming that results from data provided by social security institutions, and this issue gets very protracted in a decentralized setting. Because such institutions have an interest in maximizing the estimated legacy costs as they define the future public transfer to the reformed system, the data and information supplied may be biased and not directly verifiable. This situation makes the use of simpler and rule-of-thumb methods even more important.

RULE-OF-THUMB METHODS

The essentials of rule-of-thumb methods are threefold: (a) use to establish quantitative relationships between pension aggregates (e.g., between stocks and flows); (b) use of

quantitative information about individual aggregates (e.g., the cost-covering contribution rate); and combination of information and cross-checking (or the best triangulation of the estimate). As must be clear, the discussion in this section must move from science to art.

As a starting point, one can use expression 18.7, which combines equations 18.4 to 18.6 and expresses the legacy costs of the reformed system as those of the unreformed scheme plus the identified elements of change brought about by the reform. Available information and considerations such as the maturity of the unreformed system determine which side of the identity is used.

$$\begin{aligned} LC_t^r &= K_t^r + P_t^r - PA_t^r - FA_t^r \\ &= LC_t^u + \Delta LC_t \\ &= LC_t^u + \Delta K_t + \Delta P_t - \Delta PA_t - \Delta FA_t. \end{aligned} \quad (18.7a)$$

A reform that fully honors acquired rights makes ΔP and ΔK equal to zero, and a reform also should not change the financial assets (i.e., $\Delta FA = 0$). This simplifies equation 18.7a to

$$LC = LC^u + \Delta LC = LC^u - \Delta PA. \quad (18.7b)$$

The inherited legacy costs (LC^u) reflect the current cost-covering contribution rate (CR^u) in excess of the steady-state contribution rate (CR^{su}) of the unreformed scheme, and the change in the contribution asset (ΔPA) reflects the reduction of the contribution rate from this steady-state level to the new and politically determined steady-state level, CR^r . Both old legacy costs and reform-induced legacy costs, and their sum, can be presented in terms of the implicit pension debt (ignoring financial assets and making use of equation 18.4)—that is, that liabilities are the measured implicit pension debt (IPD) and are equivalent to PA plus LC . This approach provides easy estimators for the total legacy costs, inherited legacy costs, and reform-induced legacy costs, respectively:

$$\text{Total legacy costs:} \quad IPD^u (CR^u - CR^r) / CR^u. \quad (18.8a)$$

$$\text{Inherited legacy costs:} \quad IPD^u (CR^u - CR^{su}) / CR^u. \quad (18.8b)$$

$$\text{Reform-induced legacy costs:} \quad IPD^u (CR^{su} - CR^r) / CR^u. \quad (18.8c)$$

Here are a few examples of how to “questimate” the legacy costs:

Countries often have estimates (even if at times dated) of the accrued-to-date liability, perhaps differentiated between that for active population and that for pensioners (i.e., K_t^u , P_t^u). Expressed in percentage of GDP, even dated estimates can be used as a starting point for estimating the magnitudes for the reformed scheme.

Assume that the estimated IPD is 180 percent of GDP and is currently financed by a contribution rate of 32 percent, whereas the long-term sustainable rate is 24 percent. Hence, inherited legacy costs are 180 (32 - 24)/24, or 60 percent of GDP. If the reform sets the new contribution rate at 20 percent, this change creates a reform-induced legacy

cost that is derived from the new sustainable IPD of $120 - (24 - 20)/24$, or 20 percent of GDP. Hence, the total legacy costs—inherited and reform induced—amount to 80 percent of GDP.

If the reform does not honor all of the acquired rights but changes, for example, the indexation from wage to price indexation, this decision reduces the inherited pension debt (the value of K_t and P_t are reduced because they were previously calculated at full wage indexation). It may or may not also increase the PAYG asset, depending on whether in the new scheme lower indexation is compensated for by a higher initial pension. The magnitudes of a change in indexation are important. For example, for an assumed real wage growth of 2 percent, a change to pure priced indexation amounts to about one-sixth of IPD (Holzmann 1998). If applied to current and future retirees, this is some 30 percent of GDP (for an IPD of 180 percent).

If there are no estimates for the accrued-to-date liability, a stock-flow relationship can be used to establish a broad estimate. Empirical estimates put the ratio of accrued-to-date liability to current (annual) pension expenditure in the range of 20 to 30 (see Holzmann 1998, table 2). This range reflects differences in the applied discount rates typically assumed to be above the annual GDP or wage growth. Assuming no difference between the discount rate and GDP growth puts the ratio at or above the upper range and makes it equivalent to the turnover duration. Mere demographically based estimates for the turnover duration put it in the range of 30 to 35 years (Settergren and Mikula 2006, annex 7D). A reasonable value is 30. Of course, such an approach is valid only if the system is broadly mature. In an immature system, the ratio starts at infinity and approaches the steady-state value only gradually (Holzmann, Palacios, and Zviniene 2004, table 7). In an unreformed system, the ratio is typically underestimated because the liabilities are not yet fully reflected in the flows that react more slowly; the reverse applies for a reformed system, where the effect on stock is immediate but the flows change little in the short run.

CASH PROFILE OF THE LEGACY COSTS AND SPEED OF TRANSITION

The estimated stock of legacy costs says little about the timing of the flows and, hence, the financing needs of governments. The considerations so far have assumed an immediate transfer of all current workers (and retirees) to the new system. Thus, everybody—from the new system entrant to the person one day before retirement—would have his or her acquired rights transformed into a notional (initial) capital and continue the next day with the recording of contributions (with reduced contribution rates) to his or her individual account. Such a full immediate transition puts the highest cash flow needs up front and concentrated on the next 40 years or so (unless coverage expansion takes place). It starts out with the difference between the broadly unchanged pension expenditure minus the revenues under the new and fixed contribution rate, with the reduction happening in an S-shaped curve for many years.

The cash flow needs for a more gradual transition for current workers would kick in more gradually, but the overall legacy cost would not necessarily be smaller. It depends on the starting conditions and how the transition is staged.

If the conversion to the new scheme concerns only younger workers—say, below age 40—whereas the older workers will continue under the old system, the immediate cash flow is smaller but increases until all workers are in the new scheme (say, in 20 years,

if the retirement age is 60). The overall legacy costs would remain unchanged if the reform only means a move from an actuarially sound system with a high contribution rate to one with a lower rate. If the system was financially unsound to start with, the older workers under the old system would continue to acquire benefits beyond their contribution efforts, and the overall legacy costs would increase.

If the conversion to the new scheme concerns only the new entrants, and everybody already in the old system stays there, the cash flow needs would increase for the next 40 or so years and gradually be reduced thereafter for another 40 years. Again, the overall legacy costs would remain unchanged if the reform only means a move from an actuarially sound system with a high contribution rate to one with a lower rate. If the system was financially unsound to start with, because all the older workers under the old system would continue to acquire benefits beyond their contribution efforts, the overall legacy costs would increase and have their highest value. They would be composed of the transition costs of moving from a high to a lower contribution rate equivalent to the move from an unfunded to a funded system plus the accrued costs of unsustainability for the longest time.

Because most NDC reforms are likely to include both moving toward a lower contribution rate and rendering a financially unsound system sustainable, the message is clear: institute a reform as quickly as possible and move everybody at once to the new system.

Financing of Legacy Costs

Legacy costs of an (NDC) pension reform can be financed in essentially three ways:

- Reducing the size of the costs by renegeing on some of the existing commitments (i.e., burdening the generations of current retirees and those soon to retire)
- Reducing the size of the costs by increasing the value of the PAYG asset by coverage expansion (for a given new contribution rate)
- Using general government revenues to finance the legacy costs with the understanding that these resources need to be levied in a less distortionary manner than contribution financing

In addition to these considerations about the type of financing and their magnitudes, real-life reforms must take into account the timing, sequence, and disbursement of the needed general government revenues. These aspects are highlighted by issues emerging under the ongoing Chinese pension reform discussion.

RENEGING ON EXISTING COMMITMENTS

The options for renegeing on legacy costs are, perhaps, more limited under an NDC reform than under a parametric reform, but they are not zero. In both cases, the renegeing options for pensions under payment are largely limited to changing the benefit indexation, and for both current and future retirees, the move toward a more consistent tax treatment can raise additional revenues. For current workers under an NDC reform, the partial renegeing seems to be limited to various technical assumptions during the calculation of the initial capital, as well as parametric increases in the retirement age.

Moving from wage or mixed wage-price indexation to mere price indexation is a powerful way to reduce legacy costs. As previously outlined, a move from wage to price indexation under an assumed real wage growth of 2 percent annually shaves off about one-sixth of an accrued-to-date liability and, hence, is a sizable contribution to financing the legacy costs. Furthermore, such a change in indexation is essentially a reduction of existing commitments and may have no material effect on the retirees under the new system. In an NDC system that lives fully within its means, the choice of indexation (price, mixed, or wages) is always done in trading off with adjustments in the initially accorded pension. In the case of planned full wage indexation instead of only price indexation, the notional interest rate and, consequently, the account values are adjusted downward to accommodate the back-loading of benefit expenditure.

Many countries across the world provide tax advantages for their pension system beyond consumption-type taxation. In numerous countries, individuals escape taxation at every stage (contribution, accumulation, and disbursement); therefore, introducing consistent taxation (in the form of exempt-exempt-taxed or taxed-exempt-exempt regimes) alone would create sizable revenues to cofinance any legacy costs of reform.

A potentially powerful approach to reducing much of the legacy costs of an NDC reform would involve first undertaking a parametric reform that increases retirement age and reduces (defined) benefits (through lower annual accrual rates, lengthening of assessment periods, etc.) before converting the reduced acquired rights into initial capital under an NDC reform. Although such an approach is conceptually possible, the political economy may speak against it. Parametric reforms have proven difficult to undertake, among other reasons, because they lack credibility. The attraction of an NDC reform is the promise to honor acquired rights while putting the scheme on a financially sustainable basis. Yet this very promise leads to higher legacy costs that need to be addressed.

In an NDC system, the retirement age should become an endogenous variable because individuals are assumed to react to initial reduction in benefits (as a result of the NDC system introduction and the move toward lower contribution rates) and future benefit reductions (as a result of increases in life expectancy) with delays in retirement under the quasi-actuarial benefit structure. However, fiscal as well as meritocratic considerations speak in favor of a more proactive approach in increasing the retirement age. For fiscal reasons, an increase in the standard retirement age, for example, to 65 (and above) should be announced and scheduled before the NDC reform. The acquired benefit rights would be calculated against this new benchmark, leading to a fall in their present values. For the NDC system itself, many experts argue for a minimum retirement age that is indexed to changes in life expectancy and request a minimum balance able to finance a benefit well in excess of a guaranteed minimum retirement income.

Last, the calculation of the initial capital that converts acquired rights into notional amounts recorded in the individual accounts can be used tacitly to reduce the legacy costs. The two key instruments are the choice of the discount rate in the case of projected future benefits under the old system converted into notional capital and the selection of the lower costs between such a discounting (top-down) approach and a revaluation (bottom-up) approach in which past contributions are revalued with historic and sustainable notional interest rates (Palmer 2006). The data and calculation demands for the latter approach are challenging but worthwhile to consider.

INCREASING THE VALUE OF THE CONTRIBUTION ASSET BY COVERAGE INCREASE

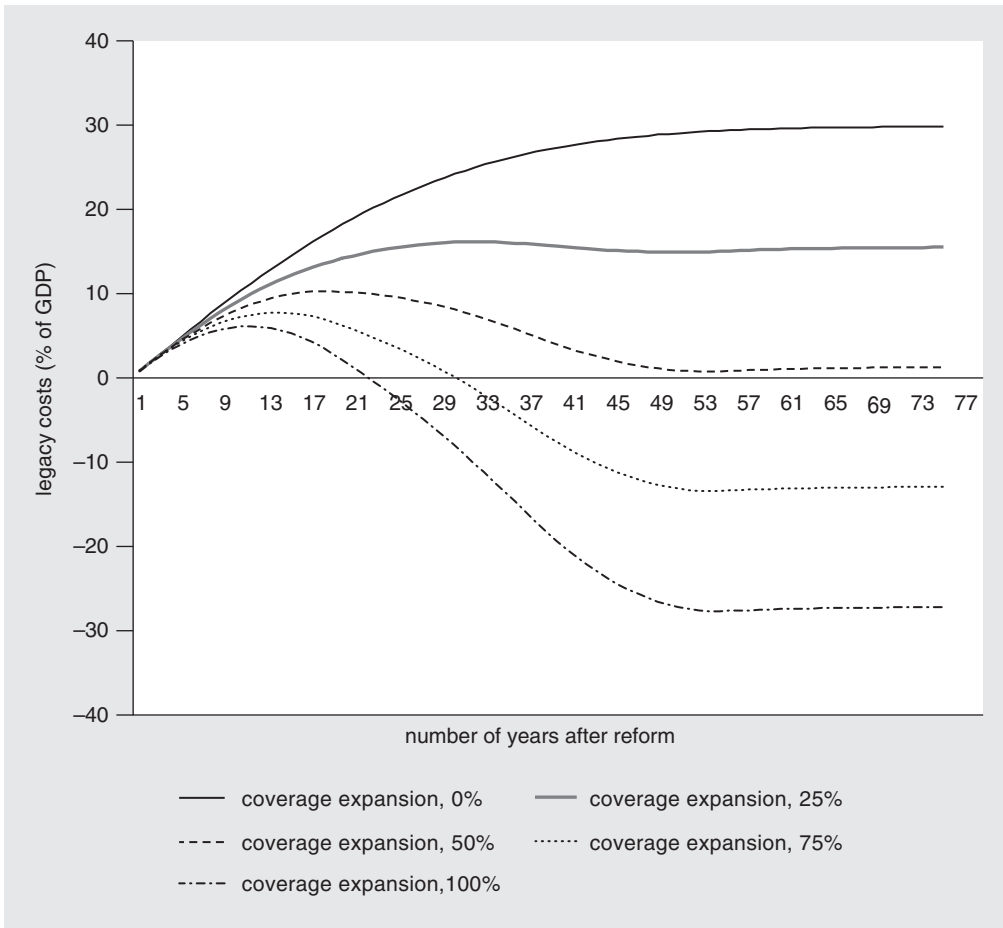
A critical contribution to the financing of the legacy costs (and the building of the reserve fund) can be expected from an increase in coverage—particularly in (developing) countries that start out with a low share of the labor force that are in the formal sector and, hence, are contributing to the (unreformed) scheme. Freeing the contribution rate in the reformed scheme from the legacy costs should create a first incentive for fostered formal labor force participation. Having a very close contribution-benefit link should create a second incentive for system participation. Having a scheme that promises financial sustainability and the creation of a reserve fund that promises solvency should muster credibility that, in turn, should create another incentive for system participation.

The size and timing of a coverage-determined increase in the contribution asset for the financing of the legacy costs will depend not only on improved incentives for system participation but perhaps equally (or more importantly) on other reform-related improvements, such as in communication, administration, and contribution collection. Although empirically system coverage of countries remains closely linked to economic development (measured by country GDP per capita), the link is far from perfect, and differences across countries for a given per capita income signal a strong influence of the latter. But they also signal that coverage expansion will be the strongest where pension reform, strong economic development, and administrative efforts coincide.

A simple modeling exercise indicates that coverage increase may, indeed, contribute to the financing of legacy costs in a major way. Assume that the unreformed system has an accrued-to-date liability of 120 percent of GDP and related expenditures of 4 percent of GDP; the reformed NDC scheme has steady-state expenditure of 3 percent (prior to coverage expansion) as the contribution rate is reduced from, say, 20 to 15 percent, hence implying reform-induced legacy costs of 30 percent of GDP; and the original coverage rate of labor force was 25 percent. In a first-scenario exercise, assume no inherited legacy costs, only reform-induced legacy costs caused by reduction of the contribution rate. Various degrees of coverage expansion are investigated between 0 (baseline) and 100 percent in steps of 25 percent. To this end, assume that the increase takes place over 40 years, and the first benefit payouts for new participants start after 20 years.

Figure 18.5 suggests that modest increases in coverage are already able to reduce the deficits and, hence, significantly reduce the legacy costs. A 25 percent coverage increase over 40 years (hence, from 25.00 to 31.25 percent of labor force coverage) would eliminate the transition deficit after year 34 of the reform and stabilize the overall legacy costs at slightly above half the baseline value; a 50 percent coverage increase would eliminate the deficit after 20 years, and the surpluses thereafter would reduce the legacy costs to almost nil after another 30 years. Higher increases in coverage (75 and 100 percent, respectively) would create even stronger surpluses that could give rise to sizable reserve funds after about 50 years. A doubling of the coverage within 40 years from 25 to 50 percent of the labor force seems possible if integrated into a broader and successful reform agenda.

A second-scenario exercise adds inherited legacy costs (from prior reforms) of 40 percent of GDP that are assumed to become expenditure over a period of 50 years in a decreasing (death-related) scale, starting with 1.5 percent of GDP in year 1 of the reform. Figure 18.6 suggests that with such high inherited legacy costs, the doubling of coverage will not be sufficient to pay for the legacy cost. However, assuming an increase by 150

FIGURE 18.5 **Legacy costs: Reform created by contribution rate reduction**

SOURCE: Authors' calculations.

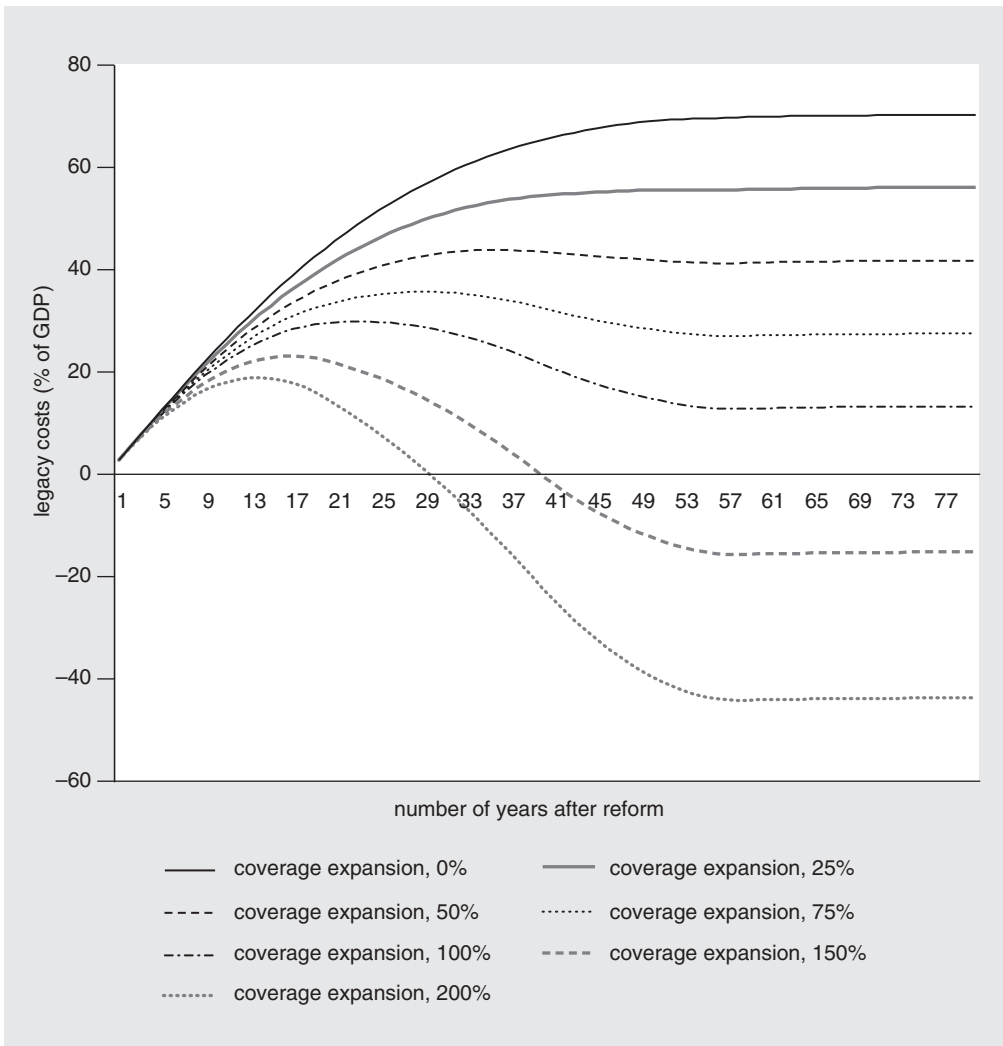
percent (to 67.5 percent of the labor force) would move the aggregated legacy costs well into surplus. Tripling coverage to 75 percent would create sizable reserves—a quite ambitious scenario, but not a totally impossible one.

These perhaps optimistic results will need to be substantiated and verified in a real-country setting using a fully fledged and actuarially based projection model. However, this chapter conjectures that such results will not differ too much from the modeling exercise.

TAX REVENUE FINANCING

General tax revenue financing has attracted increasing attention in the debate about pension reform as well as social insurance reform more broadly. On net, any such shift makes economic sense only insofar as the marginal cost of raising additional public funds is lower when using other general tax instruments rather than the more conventional tool of social insurance contributions. Expressed differently, general tax revenue financing is useful only insofar as the other tax instruments have lower financial and opportunity costs associated with them.

FIGURE 18.6 **Legacy costs: Inherited and reform created**



SOURCE: Authors' calculations.

NOTE: LC = legacy cost; CE = coverage expansion.

Beyond pure collection costs, one key decision parameter is the economic distortion generated by the various tax instruments at the level of economic decision makers. An important theoretical, empirical, and simulation-based literature has developed on this topic. Basic results of optimal tax theory—such as Atkinson and Stiglitz (1976)—point to the negative consequences of capital income taxation. The key logic is simple: by taxing capital income—be it in the form of corporate income taxes or (final) withholding taxes on dividends—the government unfavorably influences the allocation of resources and thus the growth and size of the economy in the future.

Over recent years, the International Monetary Fund (IMF) has contributed to the literature on financing the transition costs linked to population aging. It developed the

IMF Global Fiscal Model—a dynamic macrosimulation model that allows for international interdependencies, notably at the level of the capital markets.⁶ Generally, the results give simple lessons that are *de facto* the direct results of the neoclassical growth model underlying these dynamic systems. They underline the special role of capital taxation in the growth process. Indirect taxation is the most preferable tax instrument to use in the face of aging pressures, whereas wage taxation (i.e., social insurance contributions) is better than general income taxes or capital income taxes. On net, these—as well as other similar growth models—document that a shift toward consumption-based taxation away from income taxation reduces distortions of savings and labor supply decisions, and, hence, contributes to a larger “size of the pie” in the future.⁷

One real-world implication is the increasing role of VAT as a financing tool for public expenditures of all kinds, notably complementary social insurance financing. The evidence from macrosimulation models is actually further reinforced by observations on the ground showing that VAT has a moderate economic cost relative to the revenues generated—either because it does not affect savings or because VAT systems generally have a simpler structure than most income tax systems.⁸ But these empirical observations also point to another important factor: the relative cost of raising public resources with different tax instruments depends heavily on country specifics.

Although these theoretical and simulation-based results are striking, the empirical literature on the effects of taxation on labor supply and savings has been much less unanimous. Well-known individual-level studies from the United States as well as from other Organisation for Economic Co-operation and Development countries show a few key empirical regularities of the labor market: labor income taxation has little effect on the labor supply of the primary income earner in a household, whereas the effect on secondary earners is mostly one of participation rather than of modified hours of work. Similarly, more recent evidence shows that this effect is much stronger for indigenous workers in their prime years than for people just out of school, close to retirement, or from migration backgrounds.⁹ As for capital income taxation, the empirical evidence remains highly inconclusive—the main reason being the difficulty of appropriately measuring the relevant individual-level interest-rate and savings parameters (see, e.g., Attanasio and Weber 1995).

Regarding developing countries, the empirical evidence is equally mixed. For example, Keen and Mansour (2009) highlight the increasing role of VAT as a revenue source for Sub-Saharan African countries in recent decades. This increase in use of VAT has, however, not necessarily generated new budgetary margins, because most countries have faced a sustained and structural fall in customs revenues as well as strong and increasing competition at the level of the corporate income tax. Going forward, the picture looks more challenging. In a number of developing countries, simple hikes of VAT rates are an increasingly unlikely policy tool, given the standard rates currently applied in the developing world, the high degree of informality, the scarce administrative capacity, and design flaws that limit effective operations and enforcement.

Policywise, these empirical aspects have several implications. First, in the context of developed countries with quasi-universal pension systems and sophisticated VAT systems, a general shift of the tax burden away from labor to consumption is likely to have smaller-than-expected efficiency gains, hence reducing the attractiveness of such a policy.¹⁰ For developing countries, an additional aspect is that financing the transition of a pension system covering a moderate fraction of the population by a generally applicable (potentially

dysfunctional) VAT could involve major inefficiency and undesired redistribution among households in the country. Furthermore, it might necessitate profound reforms of the VAT system itself to restore its primary aim as a simple tool for nondistortive revenue generation.

SEQUENCING AND DISBURSING NEEDED GENERAL REVENUES

The burden-sharing arrangement over the different generations plays an important role in the design of the transition. Whenever legacy costs are explicitly recognized in the context of a reform, they appear as one-off amounts at the time of the reform even as they are disbursed over time. Benefits of the transition toward a reformed system, however, do accrue progressively over time to all the generations going forward.

This situation leads to a number of intertemporal considerations. Holzmann (1998) already recognized several concerns that would justify the temporary buildup of an explicit debt. These issues included intergenerational equity as well as efficiency arguments based on intertemporal tax smoothing and incremental deadweight loss attributable to the inefficiency of existing tax-benefit systems. In contrast, the absence of perfect equivalence between explicit and implicit debt, as well as negative externalities on the development of private (financial) markets and government financing costs, would plead against debt financing of legacy costs with costs spread over different generations.

Another approach explored by Feldstein, Ranguelova, and Samwick (2001) is to identify and isolate the legacy costs of the old system, but to keep the legacy costs implicit rather than convert them to an explicit amount. To study the consequences of their setting, they used a formal model of the U.S. economy to simulate the partial shift toward a fully funded individual accounts system. By positioning their model in the context of uncertain returns and by imposing a constraint that any generation gets benefits that are at least as large as the baseline represented by current legislation, they showed how a social welfare-enhancing transition can be orchestrated by a rather modest complementary individual savings component—with the existing PAYG system used as a top-up scheme for the new individual accounts system. De facto, their model is a progressive social contribution-financed transition with the costs of the transition spread over a number of future generations.

Giving Meat to the Bones: The Concepts Applied to a Hypothetical Chinese NDC Pension Reform

Despite major and minor reforms of the Chinese pension system over recent decades, it remains fragmented within and between the urban and rural areas, does not provide comprehensive basic means-tested benefits for poor, elderly people, and has no credible occupational or personal voluntary retirement saving scheme. The reformed urban system collects a high contribution rate (between 28 and 31 percent) to cover legacy costs, with the cost-covering contribution rate estimated at 35 percent and the steady state of the reformed scheme estimated at 27 percent (Sin 2005). Separate schemes exist for public service units (PSUs) and state organs (i.e., civil servants), and migrants are only very partially covered by separate schemes. For the rural area, voluntary saving schemes with government-subsidized contributions existed for some time, and a new pilot of such a

(voluntary) matching defined contribution scheme covering 10 percent of the counties started in 2009.

The Chinese government is very much aware of the key shortcomings of the system. In preparation for the next five-year plan (2012–17), the government has asked an (undisclosed) set of international institutions and academics to prepare their vision piece for a Chinese pension reform to fertilize the domestic Chinese reform discussion. A number of commentators have proposed making an NDC system the core of the future pension scheme (e.g., Barr and Diamond 2010; Oksanen 2010, 2012; Zheng 2012; Dorfman et al., forthcoming). A key element to make such a proposal credible is, of course, to have broad estimates of the legacy costs and a game plan for their financing.

This section presents the broad estimates that were undertaken by the World Bank (Dorfman et al., forthcoming) using the rule-of-thumb methodology outlined previously. It uses expenditures and a range of multipliers to estimate the implicit pension debt for the three schemes to be harmonized (urban scheme, public organ scheme, and PSU scheme). A range of multipliers is needed because the Chinese pension scheme is not yet mature and well above the steady-state multiplier of 30; the multiplier range has drawn on historical national and provincial estimates. For scenario calculations of the new and common contribution rate, 15, 20, and 25 percent are selected. These rates compare with cost-covering contribution rates of the three unreformed schemes of 35, 36, and 34 percent, respectively. Applying the estimator for the legacy costs in equation 18.8a provides the range of legacy cost estimates in the shaded area of table 18.4. The lower is the selected new contribution rate; the higher is the legacy cost for a given estimated IPD.

Given the scenario approach, the resulting legacy costs differ widely, depending on the IPD estimated and selected new steady-state contribution rate. The highest estimates for total legacy costs (correlating to the lowest new contribution rate of 15 percent) range between 89 and 133 percent of GDP and are distributed between the urban and the government sector schemes in the ratio of 3:1. Of these total legacy costs, a large share is inherited and needs to be financed, and much or all of the legacy costs for the newly integrated government sector schemes are already tax financed because contributions are not levied from state organs and are levied for only a small share of the PSU employees. Altogether (and using an average of the calculated IPD of 150 percent), this situation leaves some 75 percent of GDP to be financed from additional general government or other means—most important, coverage expansion in the private sector.

During the period from 1998 to 2008, coverage increased from 39.2 to 54.9 percent (i.e., 15.7 percentage points) in the urban scheme. This increase has helped augment the reserves of the urban scheme from 0.7 to 3.3 percent of GDP (i.e., 2.6 percentage points). Achieving a coverage rate of 90 percent by 2050 seems possible and in line with international trends in the relationship between per capita income and coverage (see World Bank 2006); it is also a goal of the Chinese government. Furthermore, during the period from 1998 to 2008, the labor force increased by almost 40 percent. Over the next 40 years, the labor force could easily double as the result of rural-urban migration (plus an increase in labor force participation). As a result of both effects, the overall number of contributors could increase greatly and create cash flows to help finance the legacy costs.

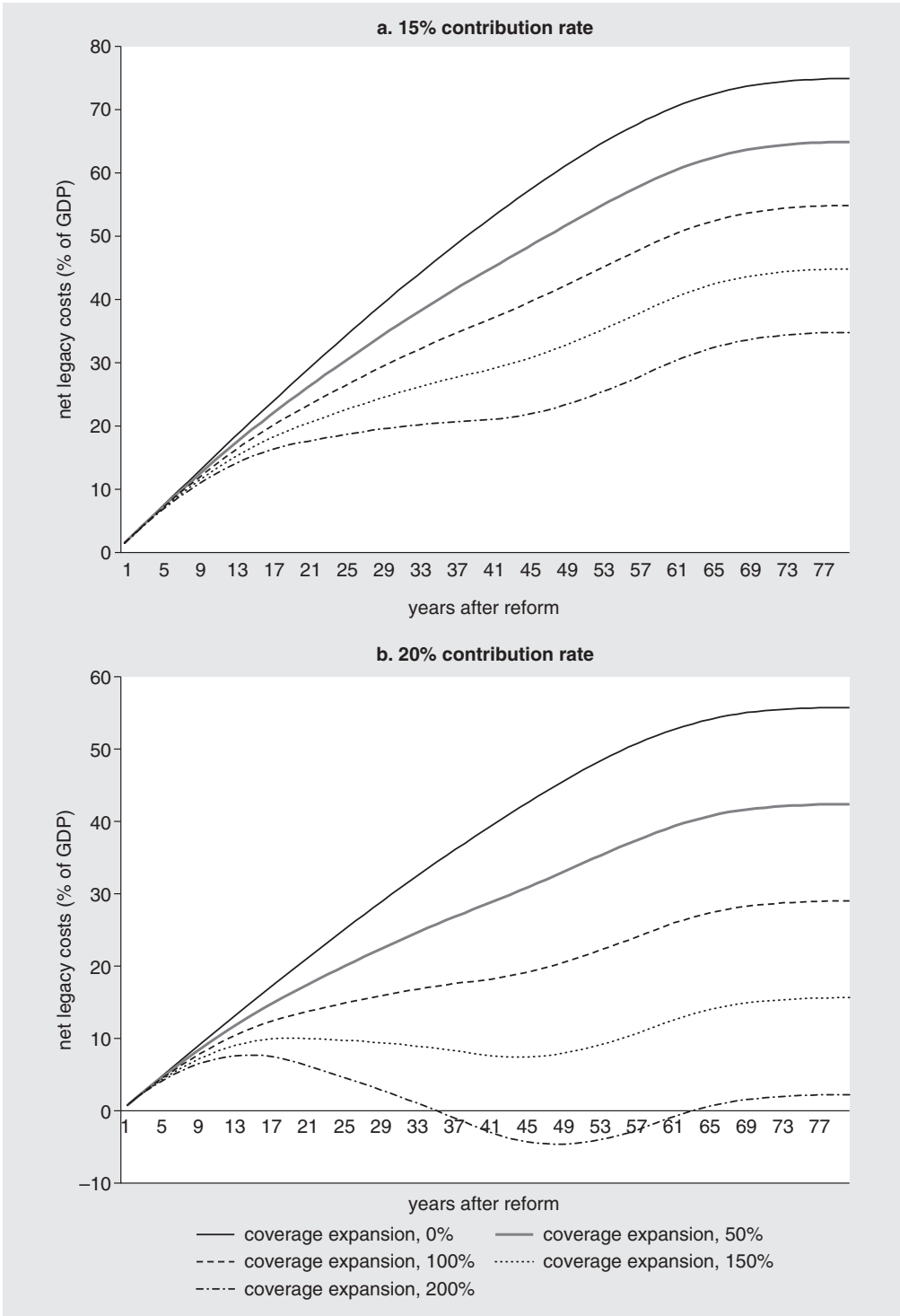
Figure 18.7 provides stylized estimates for China of the net legacy costs (i.e., without government sector schemes) for different coverage expansion scenarios and two selected new contribution rates (15 percent and 20 percent). They are derived from a model that

TABLE 18.4 **China: Broad estimates of the legacy costs under an NDC reform and alternative contribution rates for the new scheme, 2008**

	Pension expenditure (% of GDP)	Implicit pension debt (% of GDP)		Cost-covering contribution rate (% of GDP)	Legacy costs: low IPD estimate (% of GDP)			Legacy costs: high IPD estimate (% of GDP)		
		Low estimate	High estimate		New contribution rate			New contribution rate		
					15%	20%	25%	15%	20%	25%
Urban system	2.46	118	147	35	67	50	34	84	63	42
State organs	0.34	12	16	36	7	5	4	9	7	5
Public service unit	0.75	26	36	34	15	11	7	20	15	9
Total	3.54	155	199		89	66	44	113	85	56

SOURCE: Dorfman et al. forthcoming.

FIGURE 18.7 China: Phasing of net legacy costs under different degrees of coverage expansion and contribution rates



SOURCE: Dorfman et al. forthcoming

replicates the initial deficit and the estimates for the inherited legacy costs (30 percent of GDP) and reform-created legacy costs (45 percent of GDP under an assumed new contribution rate of 15 percent). It ignores demographic changes by assuming they are neutralized by higher retirement age or lower benefits. The figure indicates that coverage expansion could, indeed, significantly contribute to the financing of the legacy costs by some 10 to 13 percent of GDP for an expansion of the covered labor force of 50 percent over 40 years.

Concluding Remarks

Summing up, several key elements stand out. First, for an NDC reform to be credible and fully effective in its desired results, determining the legacy costs of the reformed system is absolutely necessary—no matter how these costs will be financed. Second, for the reform from an NDB scheme to an NDC scheme with a fixed and long-term sustainable contribution rate, the definition of legacy costs simply amounts to the actuarial deficit at the time of reform and is finite. Third, various sources of the legacy deficit may be differentiated, in particular (a) any inherited old legacy costs attributable to prior reforms of the scheme, (b) any accrued-to-date liability attributable to the inclusion of other schemes with cost-covering contribution rates above the sustainable new one, and (c) any new reform-induced legacy costs caused by the shift toward a lower sustainable contribution rate. Fourth, distributive effects come into play at both the intergenerational and the intragenerational levels, because benefits and costs of the reform are borne unequally by different subgroups of the current and future populations. Fifth, to improve equity and efficiency aspects of an NDC reform, policy makers are strongly advised to address legacy costs in an explicit manner and explore alternative financing mechanisms, such as coverage expansion and well-selected general government revenue. Sixth, in the developing world, one promising way to finance the legacy costs is to use increased coverage to strengthen the contribution asset. Avoiding the financing of the legacy costs with earmarked contributions may be an important feature of such coverage expansion. Last but not least, for developed countries, theoretical models show that tax financing, in particular through indirect taxes such as VAT, is an interesting and promising tool, but empirical limitations tend to dampen the real-world usefulness.

Notes

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1. The chapter introduces the model in rather general notation but will at times simplify without loss of generality.
2. For more generation presentations of the IRR and further references, see Settergren and Mikula (2006) and Robalino and Bodor (2009).
3. The *implicit debt* of the system is a concept that expresses the liabilities toward current and future beneficiaries related to past and, at times, future contributions. The most restrictive

definition of implicit debt is based on acquired rights to date (accrued-to-date liability—see Holzmann 1998, 1999; Holzmann, Palacios, and Zviniene 2004); this definition is used in this chapter. The notion of legacy costs relates to the accrued-to-date liabilities beyond the sustainable level under the reformed system.

4. The actuarial balance (deficit or surplus) is the present value of future period balances that can be measured for a finite period (e.g., 50 or 75 years) or for all future periods.
5. The lower future benefits of these new groups of participants may come at a certain cost. If participants are fully or partially compensated by supplementary occupational schemes, additional future outlays will emerge for the plan sponsors and need to be taken into account.
6. Botman and Kumar (2007) and Botman and Tuladhar (2008) are just two examples of this approach.
7. Diamond (2009) emphasizes the strong theoretical requirements for obtaining such clear preference relations over tax instruments. He notably emphasizes the role of heterogeneity between individuals, as well as the complicated interactions between year-based tax systems and lifetime redistribution in the context of social security programs. His results further emphasize the point previously mentioned that intragenerational considerations play a crucial role in evaluating the desirability and the incidence of any pension system transition.
8. It is generally recognized that a VAT system, to achieve its objectives of raising substantial revenues at moderate administrative and compliance cost, should have a simple design—with possibly only one positive rate combined with a very limited number of exemptions. Such a system would be accompanied by adequate public expenditure programs to address distributional issues whenever they arise.
9. For example, Kramarz and Philippon (2001) as well as Chéron, Hairault, and Langot (2008) study tax and contribution policy in the face of labor market segmentation.
10. See the discussions on the desirability of a “social” VAT in France, as detailed in Besson (2007).

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CHAPTER 18

COMMENT

Florence Legros

This chapter addresses the difficult question of the transition between a defined benefit (DB) pension scheme and a nonfinancial (notional) defined contribution (NDC) scheme. Transitional problems occur when a pension scheme switches to a different rule, because a generation has acquired rights (under the old scheme) that imply a greater contribution from the younger-generation workers if the government does not want to renege on such acquired rights.

This transitional problem is rather well known; it has been widely explored by the literature dealing with the transition from a pay-as-you-go (PAYG) pension scheme to a funded defined contribution scheme. Of course, in the case of a transition from a DB to a defined contribution (DC) scheme, the costs are much smaller because the choice of PAYG financing is maintained.

It is important, at this stage, to insist on the difference between *legacy costs* and *transition costs*. This difference is rather simple to understand: the issue is not to make the transition toward NDC responsible for an infinite deficit caused by a mix of demographic deficit, bad design of an old scheme, and so on, but rather to identify the difference between promises made to retirees or near retirees and actuarially fair contributions paid by the young.

A simple preliminary question arises from this observation. If legacy costs attributable to the transition from a DB to an NDC scheme are comparable to those that result from the transition from a PAYG scheme to a fully funded scheme, why conduct a new study on these costs? The reason provided by Robert Holzmann and Alain Jousten in chapter 18 is that these costs are specific in the sense that they are related to a transition that makes the scheme financially sustainable in the long run. For that reason, Holzmann and Jousten think such costs must be paid out of general revenue, because they profit the whole population and future generations.

Roughly speaking, the chapter addresses two questions:

- How to pay legacy costs?
- How to measure them?

How to Pay the Legacy Costs?

About “how to pay,” the recipes remain classical:

- Public transfers (i.e., taxation) can pay these transition costs. The authors particularly recommend using a value added tax (VAT).
- A buffer fund can be used to pay for the vested rights, but whether this buffer fund is created with public assets, by privatization of public holdings, or by public borrowings, each way requires future taxation.

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- A whole generation's tax burden can be increased (e.g., that of the older generation). However, this solution seems politically difficult because it cancels out the rights of the considered generation.
- Holzmann and Jousten promote another solution, which seems less costly; it relies on increasing the number of contributors by increasing the coverage rate of the population. Of course, this solution seems painless and even desirable if one refers (as Holzmann and Jousten do) to middle-income countries. Even if a costly reform is less costly than no reform, increasing the coverage by a PAYG system remains a future taxation device if the pension scheme yield is lower than the discount rate, which is usually rather high in a low-income population.
- Another solution is to compensate a given generation for the change. For example, a wage increase could be given to workers from the "old" generation who switch to the new, less generous scheme. Alternatively, the increase could be given to members of the "young" generation who must pay for the older generation's more generous DC pension scheme. The main problem is that this partial solution would apply mainly in the public sector or in an economic sector where wages are fully administrated. The induced problem is a double-cost one: taxation has to pay first for the additional wages and in a second period for additional linked pensions. In France, some *regimes spéciaux* (that is, schemes that have been specially designed for public companies) have been recently reformed (around the 2003 reform), and the current workers have been given additional bonuses to compensate them for additional contributions. A reform that appeared as rather unfair to the rest of the population is, in the end, costly for those who consume public goods or goods that are produced by national companies.

Because they think that legacy costs should be paid out of the general revenue, Jousten and Holzmann prefer imposing a VAT in developed countries and using an increase in coverage in developing countries. Because NDC remains based on the PAYG mechanism (a kind of Ponzi scheme), any increase in pension scheme coverage—however desirable to improve intragenerational equity—will increase the future generation's debt and increase taxes in the future as well.

Finally, the answer to the question "how to pay," is often "taxation"—now or later. An important aspect to consider when taxing the economy is how to introduce or increase a tax that will not introduce a distortion. In many countries—especially European countries—we are used to favoring VAT because it concerns consumption, which is not (often) subject to relocation; because it does not distort the labor market or the savings behavior; and because it can be administered very easily. These attributes do not hide VAT's main fault: its antidistributiveness.

How to Measure the Legacy Costs?

The proposition drawn from Holzmann and Jousten's chapter is first to differentiate the deficits:

- On the one hand, the deficit that results from the imbalance of the “old” pension scheme
- On the other hand, the deficit that results temporarily from the move from the old scheme to the NDC scheme during the transition period (i.e., the sum of future benefits out of the past excess contributions)

If we focus on the legacy costs, the main problem is to measure them in the long run and to take into account all the economic impacts. When the economic rules are changed, even marginally, the economic growth (by means of labor market, of capital accumulation, etc.) is changed because behaviors will adjust to the new rules.

A very first conclusion is that a macroeconomic model is undoubtedly better than an actuarial one at measuring the economic consequences and changes attributable to a change in the retirement pension rules, even if actuaries are able to give more precise results assuming everything is well known and ignoring economic behavioral aspects. (Holzmann and Jousten state, “An actuary can calculate everything, given a price and quantity structure.”)

A well-designed macroeconomic model—especially an overlapping generations general equilibrium model—is undoubtedly the favored solution. A general equilibrium model will help determine the legacy costs, assuming they are fully specified; that is, all the direct and indirect costs or advantages must be shown by the model. For example, the form of the production function can be discussed; obviously an endogenous growth one is worth considering, assuming that positive externalities are supposed to be drawn from the reform.

Another example can be provided that favors general equilibrium models: after the production function, wages and then employment are given; once given the labor market, the virtual capital of the sum of contributions flows is provided according to the rules of the NDC scheme.

Labor market representation—especially the behavior of older workers and their trade-off between leisure and labor—constitutes important data. Taxation attributable to legacy costs can discourage capital accumulation, and then a raise in interest rates while the coverage rate or retirement age is increased can decrease wages and especially net wages (then lower labor supply, according to the held labor market representation). An excess buffer fund relative to the needed capital accumulation in the economy can decrease interest rates, which can depress savings.

The problem is then obvious; the extreme sensitivity of the results to the variables is doubled by the definition of the model itself. If the model or the assumptions do not stick to reality, the measurement of the legacy costs will be wrong. It will, indeed, be highly difficult to raise a tax to balance the legacy costs. Holzmann and Jousten provide highly interesting simulations of legacy costs according to various assumptions in coverage expansion. If these simulations are to suggest that even a modest gain in coverage is able to balance legacy costs, they also indicate that the sustainability of such a device is extremely sensitive to the labor market and enterprises’ behavior.

In sum, because it is well known that a closed economy is a better approximation of reality than a small open economy (with exogenous interest rates), a poorly designed macroeconomic model will not improve the quality of the results if compared with a good actuarial computation.

In contrast, when all the costs are explicit, one risks reaching an enormous amount, quite difficult for anyone but specialists to understand. The risk is that politicians will refrain from switching to different pension schemes if costs are too big—that is, if young workers feel their interests are being sacrificed to the older generation. Finally, it can be more politically attractive to mix legacy costs with structural costs; they will appear as a by-product of past wealth and innocence instead of a costly economic policy.

Generic NDC: Equilibrium, Valuation, and Risk Sharing with and without NDC Bonds

Edward Palmer

James Buchanan (1968) sketched what in retrospect can be seen as the first thoughts in the academic literature around the topic of what has come to be called nonfinancial (notional) defined contribution (NDC) pension schemes. However, until the first NDC schemes began to take form in the early 1990s, a defined contribution pay-as-you-go (PAYG) pension scheme was generally thought to be an impossible construction. About a decade later, NDC pension schemes had been introduced in a number of countries,¹ and in the view of the World Bank (Holzmann and Hinz 2005), NDC had become one of the alternatives countries should consider in reforming mandatory public pension systems.

Despite its increasing popularity, no coherent exposition of the conceptual framework for NDC answers this question: What are the design properties of “generic NDC”? Nor is there an answer for the logical follow-up question: How does NDC deal with the demographic and economic risks inherent in PAYG pension schemes, and what are its inherent distributional properties? Answering those questions is the first goal of this chapter.² The second is to introduce and define an NDC bond and discuss its role in distributing uncovered risk, random or systematic, that can arise because of practical limitations in designing the internal rate of return or in making the statistical projections of cohort life expectancy needed to compute NDC annuities.

Briefly, what is NDC? NDC is a PAYG pension scheme in which a fixed contribution rate is the essential element. This feature distinguishes NDC from all other PAYG pension schemes and, more specifically, defined benefit (DB) schemes. Every monetary unit of contributions paid by or on behalf of the individual gives an equivalent pension right and every pension right is backed by a contribution. These rights are then valued with the system’s internal rate of return, which covers the economic and demographic risks, thereby maintaining intergenerational financial balance at a fixed rate of contribution from individual earnings.

Technically, contributions for the individual are noted on the individual’s personal account. All individual workers over all generations pay the same fixed percentage of earnings into an NDC scheme. This is its claim to intergenerational fairness. The NDC scheme has no pretention to redistribute pension rights among participants, other than those arising naturally through variation in the internal rate of return. This is its claim to intragenerational fairness. And in this sense, an NDC scheme has no built-in tax wedge,

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as opposed to customary DB PAYG pension schemes, and can be viewed as neutral with regard to individual labor market decisions in the same sense that a mandatory financial individual account scheme can make this claim. Nevertheless, as long as one expects the rate of return on financial assets to surpass the rate of growth of the economy, any PAYG scheme, including an NDC one, will be second best to a fully prefunded scheme (Lindbeck and Persson 2003).

Because NDC is an individual account scheme, it is easy for the policy maker to pursue distributional objectives by creating “noncontributory rights,” in the form of explicit transfers—or contributions—from the general budget to individual accounts. This framework brings transparency and financial discipline to societal distributional goals of importance for people’s future pensions. This general feature of defined contribution (DC) individual account schemes distinguishes them from the diffuse and sometimes perverse distributional results of DB schemes. Already one can say that one of the arguments for introducing the NDC bond, as presented in this chapter, is to give these rights a status that is on the same footing as more traditional forms of government debt financing.

NDC is thus an individual account scheme that transfers individual income from years of work to years of retirement, in a manner similar to that of the illiquid financial accounts of a prefunded financial defined contribution scheme. The system can be closed with the help of an NDC bond, which, by definition, has the same formal status as any other government debt instrument. So, in this way, NDC accounts are “invested” in government debt instruments. The government emits NDC bonds to NDC participants, with shares equal to individual account values, with the proceeds of the emission going to cover the system outlays for current pensions. That is, the government can be viewed as borrowing this money from the NDC participants to pay its current pension commitments. In principle, this is really no different from a financial pension scheme that invests individual accounts in marketed government bonds.

NDC thus mimics a personal saving scheme, and from the point of view of the participant, the contributions made are similar to premium payments made into a private insurance scheme. Accounts are credited with a rate of return driven by the factors that create growth in the NDC scheme’s contribution base (i.e., productivity and labor force growth). Just as accounts in a financial defined contribution scheme adjust automatically to changes in the financial rate of return, NDC accounts adjust with fluctuations in the economic rate of return. In this way, system liabilities adjust dynamically to changing economic and demographic conditions. In other words, liabilities are kept in line with future contribution capacity. This chapter presents and discusses mechanisms for achieving this result in practice and identifies and discusses the risks and distributional consequences for individuals.

The NDC requirement that accounts continuously adjust to changes in the internal rate of return is necessary for financial equilibrium, but it is not sufficient. Considerable uncertainty is also involved in the life expectancy projection that must underlie the calculation of individuals’ annuities. In its simplest form, the NDC annuity is created by dividing the individual’s capital balance by the individual’s cohort’s life expectancy at retirement. This calculation covers the cohort idiosyncratic risk—that is, the individual risk of living a long, rather than a short, life—but not a systematic risk, for example, associated with nonrandom over- or underestimation of longevity in constructing the annuity. Some group must bear this risk.

Generally, the risks in a pension scheme are borne by the participants or the insurer. If one views NDC as being a self-financed (“mutual”) pension scheme, the participants alone would bear the risk. In fact, if one keeps with the self-financing principle of generic NDC, one could say that the risk should be borne by the individual or, more specifically, as it could be in practice in a standard insurance model, by the group of individuals in the individual’s birth cohort. This would mean that the scheme is set up so that each cohort pays for itself during the payout phase, which creates a risk distribution that under certain annuity designs will be borne disproportionately by the oldest members of the cohort (see chapter 22 of this volume).

The principle that the participant should bear the risk would be indisputable in the NDC context if the risk were known in advance and workers could adjust their supply of labor and personal saving decisions accordingly. This philosophy can, however, be considered to conflict with the social goals of a mandatory public pension scheme. Instead, the annuity divisor, which can arguably vary up to a moderate age (and, hence, be used to adjust accounts) such as 70 (or 75), could then be fixed for the remaining life of pensioners as an NDC bond, while retaining NDC indexation. This, in fact, creates a defined benefit from the point at which the annuity is fixed.

The NDC bond developed in this chapter covers the remaining systematic risk, the scale of which depends on the annuity rules. The bond performs the same function that a longevity bond would in the financial market. The NDC bond proposed in this chapter is a nontradable instrument, in the spirit proposed in the recent literature on financial pension systems (Blake and Burrows 2001; Blake, Cairns, and Dowd 2006; Brown and Orszag 2006), but it is not issued for sale on the financial market. The NDC bond is a contract between the government and the NDC scheme participants that emulates the market contract underlying bond financing of government debt. The rate of return of the NDC bond is the NDC internal rate of return.

Traditional pension insurance works around the mechanism of a solvency ratio. If the present value of liabilities exceeds the present value of the flow of contributions available to finance these liabilities, balance is achieved by deflating liabilities. If balancing is performed proportionately within the mutual insurance collective, both workers and pensioners sacrifice rights in accordance with their individual shares in total liabilities. This approach has been integrated into the Swedish NDC scheme. In contrast, the NDC bond transfers the *residual* risk (the risk of under- or overestimating cohort longevity) to the insurer—that is, the government. Different NDC designs will de facto lead to different uncovered risks. The uncovered residual risk in the NDC scheme thus becomes an explicit government expense, backed by a government debt instrument, to be financed like any other government debt instrument (i.e., through general fiscal revenues). The government’s budget will also retain any surplus that might arise, and in this way, the general budget becomes a buffer fund.³

NDC delivers fiscal balance, and the creation of an NDC bond—potentially up until the time the annuity is fixed, followed by an explicit longevity bond for the amount of the fixed annuity (which can still be indexed with the internal rate of return)—offer a means of providing an annuity with what many may consider to be a more attractive profile to the government’s commitment to the very old. By transferring the residual longevity risk to the government through an NDC bond, the government is forced to “regulate” the distribution of income between pensioners and workers through the income tax. And it is always free to supplement the benefit outcomes of NDC with separate tax-financed benefits with specified

distribution goals. Generally speaking, DC pension schemes—specifically NDC pension schemes—have advantages over DB pension schemes, where distributional elements are built into the scheme (often without transparency). First, the account system makes it easy for the policy maker to create social transfers to accounts and earmark explicit financial sources. Second, the government is compelled to create targeted distributional measures to supplement the (N)DC scheme. Third, the income tax is based on the individual's *overall* income, a broader base than the contribution base, and in addition, *all* sources of government revenues are included in government revenues, such as profit and commodity taxes. People with higher income, regardless of source, would pay more with either a flat or a progressive tax than those with lower incomes. In addition, a tax policy that applies the same tax rate to individual earnings and pension income means the tax rate itself would be neutral in terms of its potential effect on the decision to work or exit the labor force with a pension.

The rest of this chapter is organized as follows. The next section sets up the NDC accounts. The section that follows then derives the NDC equilibrium condition, discussing equilibrium characteristics and valuation of rights. The chapter then introduces the NDC bond. Finally, it discusses the different approaches to dealing with the risk inherent in the current procedure of computing fixed-life annuities at the time of retirement.

Basic Framework of NDC

During the accumulation period in an NDC scheme, worker i with individual earnings w_i pays contributions, cw_i , in accordance with a contribution rate, which are noted on his or her personal NDC account. The money itself is used to pay the NDC benefits of current pensioners.

The capital on an individual's account at time T is,

$$K_{i,T} = \sum_{t=1}^T cw_{i,t} I_t \quad (19.1)$$

where I is an index based on the internal rate of return π :

$$I_t = \prod_{s=1}^{t-1} (1 + \pi_s) \quad (19.2)$$

$$I_T = 1.$$

Worker i becomes pensioner j in period τ . In the calculation of the annuity, $P_{j,\tau}$, total capital in the individual's account, K^* , which also includes the capital of those in the cohort who have died before reaching the pension age (so-called mortality credits or inheritance gains), is divided by life expectancy for the individual's birth cohort at the age he or she claims a benefit:

$$P_{j,\tau} = \frac{K_j^*}{\sum_{t=0}^{\omega-\tau-1} (1 + \pi)^{-t} \cdot {}_t p_x} \quad (19.3)$$

The denominator can include the internal rate of return π (front-loading); alternatively, it can be indexed annually with actual outcomes. Denoting mortality of a birth

cohort age x at time t as $\mu_x(t)$, the survival probability is $p_x = f\{t, \mu(x, t)\} = \exp\left\{\int_t^0 \mu(x + \Delta t, \Delta t) d\Delta t\right\}$. In principle, life expectancy can be single sex or unisex.⁴ Let LE_κ denote the ex ante estimate of life expectancy used in computing the NDC annuity and LE_κ^* denote ex post life expectancy, based on the outcome of all individuals in cohort κ . The condition for system equilibrium is thus

$$E(LE_\kappa - LE_\kappa^*) = 0. \quad (19.4)$$

Financial balance in an NDC scheme requires that the future flow of contributions—that is, the contribution assets—cover liabilities. The liability to worker i is the individual's personal account balance at time t , $K_{i,t}$. The liability to pensioner j is the stream of future pension income to pensioner j , $\sum P_{j,t}$, discounted at the internal rate of return over the individual's expected life. Summing over all workers and pensioners, the present value of liabilities at time t is

$$PV(A_t) = \sum K_{i,t} + \sum P_{j,t}. \quad (19.5)$$

If funded assets exist from previous contributions, there is a fund F , also valued at time t :

$$PV(A_t) = A_t(C_t) + Ft. \quad (19.6)$$

Financial balance requires

$$PV(A_t) = PV(A_t). \quad (19.7)$$

Expressions 19.5 to 19.7 apply to any PAYG system. Three features are unique to NDC, however. First, a one-to-one relationship exists between individual contributions and pension rights. This relationship is generally not found in PAYG DB schemes. Second, because of the first feature, in NDC, the liabilities accounts of workers and pensioners (future pension entitlements) are always *uniquely* defined. Third, with the internal rate of return as the NDC gyro mechanism (see the next section), the contribution rate is held constant over all time:

$$c_t = \text{constant for all } t. \quad (19.8)$$

As has already been mentioned, NDC has no within-scheme distribution of contributions between participants other than (a) the pure insurance distribution of the account balances of the deceased (i.e., mortality credits) to the survivors within the insurance pool or, possibly, to external, family-related survivors; (b) (if used) a redistribution through the use of unisex life expectancy; and (c) (if used) a redistribution through front-loading of the annuity with an assumed growth rate, if the counterfactual is taken to be lifetime yearly indexation with the internal rate of return.

Finally, NDC has no formal need for “the” pension age, as does a typical PAYG DB pension scheme. A minimum age at which an NDC benefit can be claimed is necessary, however, because allowing people to claim a benefit at an age that yields a life benefit that does not keep the individual out of poverty in old age is not reasonable from the individual or the societal point of view. The age should be set at an age appropriate to deliver an

acceptable benefit level for the average worker. This age will differ depending on country-specific demographic profiles and would ideally be adjusted with life expectancy.

The Rate of Return, Valuation of NDC Rights, and Properties of Equilibrium

The concept of the net pension liability (Iyer 1999)—the difference between assets and liabilities—is used here as a point of departure to derive the internal rate of return and equilibrium conditions for NDC. The net pension liability is in a continuous process of change, driven by the flow of new contributions and the payment of benefits:

$$dV(t) = V(t)\pi(t)dt + c\bar{W}(a,t)g(t)L(a,t)\lambda(t)dt - \bar{P}(a,t)R(a,t)\pi(t)dt, \quad (19.9)$$

where a = age, from the minimum age for coverage in the pension scheme to the age of the oldest person; π = internal real rate of return; $\bar{W}(a)$ = average real wage, cohort a ; $\bar{P}(a)$ = average pension, cohort a ; $L(a)$ = number of covered workers in age a ; $P(a)$ = number of pensioners in age a ; g = rate of growth of real wages; λ = rate of growth of the labor force; V = the net pension liability; c = contribution rate; and t = discrete period in time.

Expression 19.9 includes all present and future cohorts of workers and pensioners. Also, for any cross-section in time, equivalence exists between “age” and “cohort,” in the sense that persons who are at a specific age at calendar time t will also belong to a specific birth cohort.

In a fully prefunded pension scheme, the first term on the right-hand side of expression 19.9 is the fund, which is invested in financial assets. In fact, an NDC scheme starting from scratch, with no benefit payments, is a financial defined contribution scheme. However, if it is formally an NDC scheme, then some or all funds can be distributed as NDC-financed PAYG benefits, according to some DB rule. If an NDC scheme replaces a nonfinancial DB scheme, the money would go instead toward honoring the old scheme’s commitments until all pensioners are receiving their benefits according to the new NDC rules.

Integration of expression 19.9 over time, $t = \mu, \dots, \tau$, for individuals age $a = \alpha \dots \kappa$, gives

$$V(t)e^{-\pi t} = \int_{\mu}^{\theta} \int_{\alpha}^{\kappa} \left\{ V(t)e^{-\pi t} + c\bar{W}(a)L(a)e^{-(g+\lambda)t} - \bar{P}(a)R(a)e^{-(g+\lambda)t} \right\} dt da. \quad (19.10)$$

This expression can be used to examine the characteristics of valuation of rights and properties of equilibrium for an NDC pension scheme. In the infinite time horizon, the expected value of contributions exactly matches the stream of benefit payments, from $t = \mu \dots \theta$ and for ages $a = \alpha \dots \kappa$. Hence,

$$c = E \left\{ \frac{\int_{\mu}^{\theta} \int_{\alpha}^{\kappa} \bar{P}(a)R(a)e^{-(g+\lambda)t} dt da}{\int_{\mu}^{\theta} \int_{\alpha}^{\kappa} \bar{W}(a)L(a)e^{-(g+\lambda)t} dt da} \right\}. \quad (19.11)$$

Equation 19.11 expresses all rights, present and future, as converted into pensions. The expression is general, but what is important for NDC is that individual benefits adhere to equations 19.1 to 19.3. Thus, the average benefit in equation 19.11 also does so. From equation 19.11, it is clear that these pensions are to be indexed with the rate of return $\pi = g + \lambda$, the exogenously determined rates of growth of productivity and the labor force, which will maintain a fixed contribution rate. This rate is the NDC internal rate of return. This constant contribution rate can easily be shown to be the same rate that applies for all individuals (see annex 19A). Note also that if the NDC scheme has a reserve fund, the internal rate of return is a weighted average of the financial rate of return on the fund and the economic rate of return. In terms of expression 19.9, where β_r is the percentage of financial assets in total assets, A , in period t $\pi = \beta_r(t)r(t) + (1 - \beta_r(t))g(t)\lambda(t)$.

Through indexation that follows g and λ , NDC adjusts benefits to what is affordable at a constant contribution rate. This dynamic process covers the demographic risks, apart from that deriving from the estimate of life expectancy in the computation of the annuity. Through λ , NDC covers, first, the effect of changing fertility rates on the working-age population and potential supply of labor; second, the effect on the covered labor force of population migration; and, third, the effect of net changes in time spent in the labor force with labor market remuneration. The growth factor g in the internal rate of return covers the risk associated with productivity (wage) growth. Although productivity, which the per capita wage follows in the long run, is expected to have a long-term positive value, the risk of negative g is also covered. Of course, it is the covered wage that is important in the context of pension scheme financing.

In a demographic environment where $\lambda > 0$ over generations, successive cohorts of pensioners will benefit from Samuelson's (1958) biological rate of return. Such a scenario could also happen in a country that experiences continuous net immigration, as has the United States during much of its history. Moreover, in any economy experiencing a transition from the informal to the formal labor force, such a scenario could occur. Generally, for $(g + \lambda) > 0$, indexation with less than $g + \lambda$ (e.g., only per capita "wage indexation," which is sometimes used in PAYG pension schemes) creates an undistributed surplus. One can argue for indexation only with g , which maintains a constant ratio of an average benefit to an average wage. This policy choice leads to an undistributed biological rate of return and thus a surplus in an economic environment where $E(\lambda) > 0$. In a closed, self-contained pension scheme where this money ends up in a fund (i.e., as in equation 19.9), this situation would result in a welfare loss because it unnecessarily reduces the consumption possibilities of the society.

With chronic decline in the working-age population (i.e., $\lambda < 0$), the scheme will be in constant deficit. Most of the world seems to be headed in this direction (UN 2010), with fertility rates well below the 2.1 needed to reproduce the population, which is a strong argument for indexation with $g + \lambda$ (i.e., the growth rate of the covered wage sum). Such indexation distributes the negative drag of a declining labor force between the accounts of pensioners and workers—with distribution proportions reflecting the distribution of account capital between workers and pensioners. In a developed country, the proportion is likely to be in the general vicinity of two to one in the coming half decade, with considerable variation between countries. The policy maker can, and should, discuss the distribution of the effect of long periods with negative λ . In fact, this distributional issue should be discussed in an even broader context. A long-term strategy

to maintain at least a constant labor force would be to shift resources to policy directed toward maintaining a demographic fertility rate of around 2.1—that is, a rate that at least reproduces the working-age population—by, for example, providing substantial parental benefits during the first period after childbirth, publicly subsidized day care for younger children, and so on.

The fact that generic NDC adjusts for changes in λ has other distributional consequences that are important to acknowledge. Consider a long-run demographic steady state in which the population is simply reproducing itself in all ages. The steady state is suddenly “shocked” by a one-time-only baby boom. This shock leads to extra positive indexation of worker accounts and benefits of pensioners when the baby-boom generation enters the workforce. As the baby boomers exit at retirement, λ will turn negative for a period. Accounts of workers and benefits of pensioners who are currently in the insurance pool will be reduced as the baby-boom exit continues to produce negative values of λ . The normal situation in an economy is, however, that both g and λ are constantly changing because of many overlapping economic and demographic events. The outcome of all these events is the exogenous economic rate of return.

Equation 19.11 does not include explicitly a term for inflation. NDC is inflation neutral, however. In nominal values, the exponential expression in the denominator of equation 19.11 is $e^{(g+\lambda+\zeta)t}$, where ζ is the rate of inflation. Because the numerator is indexed with the same factor, NDC is inflation neutral by definition. Also, it follows that if all *covered* income from work gives rise to contributions at the given contribution rate, then the pension system grows at the same rate as the economy’s wage base, and $g + \lambda$ in equation 19.11 is the real rate of growth of a Golden Rule economy, where the share of profits in gross national income (as well as balance in international transfer payments) is constant. Of course, the Golden Rule conditions are not likely to hold in practice because the profit rate may increase or decrease over long periods of time. The internationalization of capital flows breaks the band between the rate of return on domestic capital investment and the domestic rate of growth. Hence, there is no reason to believe that NDC equilibrium would be maintained with indexation based on growth of national income instead of the growth of the covered wage base.

In equilibrium, the system dependency ratio in equation 19.11 has a counterpart in the average number of years of work and years in retirement, evaluated with a de facto macro average ratio of an average benefit to an average pension (derived in annex 19B). In addition, it is shown that given the contribution rate and average wage, the average pension is determined by the average individual’s lifetime years of work and years of retirement. This information can (and should) be used to set the contribution rate in designing a country’s NDC scheme.

By way of conclusion, transition issues must be considered in implementing an NDC scheme. A country making a conversion from an existing PAYG DB scheme to an NDC scheme must consider two important issues: first, how to transform rights of workers in the old system into rights in the newly introduced NDC system and, second, how to quantify the unfinanced legacy from the old system, which should be financed by general revenues. These issues have been discussed elsewhere (e.g., Palmer 2006a). If the initial social security setting prior to introduction of a mandatory, universal old-age pension scheme is primarily traditional intergenerational families, introduction of NDC is tantamount to introduction of a financial individual account scheme. The important

difference is the possibility afforded to distribute part or all of contributions contemporaneously (i.e., as PAYG social security to the older generation), already alluded to.

The Systematic Longevity Risk and the NDC Annuity

The life expectancy factor used to compute the NDC annuity is a key component of financial equilibrium in NDC schemes. By their very nature, longevity (mortality) projections are uncertain. As a result, the insurer incurs a risk, which may be substantial. In private insurance, the insurer passes this risk off to the annuitant. This practice is also possible within an NDC scheme, leading one to ask, is it a desirable practice for a public pension scheme? If not, the question becomes, how should this risk be distributed given the principle of intergenerational equity underlying generic NDC. Of course, if the risk is truly random, which is the ideal situation, the expected difference between the estimate used in creating the annuity and the actual outcome is zero. The concern here is that there will be a systematic risk component arising because of underestimation of longevity that is possible to discern exactly only when most of the cohort has expired.

The obvious first step is to produce longevity forecasts that vary only randomly between cohorts. This is easier said than done, however, as “best practice” longevity seems to be forever rising (Oeppen and Vaupel 2002). And even if the general trend is toward increased survival at all ages, the specific circumstances of countries vary greatly. If they did not, one would observe much better longevity forecasts in practice. Statisticians and actuaries have turned more and more to the use of time series models to project life expectancy in the handful of countries where data are sufficient. In most countries, however, data are insufficient or of poor quality, which means time series analysis of existing data may not be at all meaningful. In more developed countries, where historical data are available, time series analysis of historical data has become a major, if not the sole, tool used. Lee and Carter (1992) have presented a time series model that has become a standard tool in longevity forecasting where reliable historical time series data are available. It projects mortality with two components: one that captures the overall trend in population mortality and another that distributes this trend by age. A whole genre of models has emerged developing this general idea even further (e.g., Lee and Miller 2001; Booth et al. 2006; Cairns, Blake, and Dowd 2008). Nevertheless, even after application of this state-of-the-art technology, considerable systematic error remains (e.g., Booth 2006).

A recent study of some variants of the Lee-Carter model (see chapter 22 of this volume) shows that for a group of eight developed countries this sort of modeling is likely to give a systematic cohort error of around 5 percent, with considerable variation in accuracy and timing of occurrence among countries, even when life expectancy is estimated for persons age 65 (instead of from birth). The source of the systematic error for the countries examined is accelerating improvements in mortality in older ages, a process that extends over decades, creating a long series of deficit-creating projection errors.

Surprisingly, recognition and discussion of the systematic error in projecting life expectancy is not a well-developed topic in the economic pension literature. Given that eliminating the systematic error is technically difficult, if not impossible, the question becomes, what can be done when its existence is acknowledged? A simple approach would be to adjust annuities continuously as new estimates of life expectancy become available. This approach puts all the risk entirely on the pensioners—and potentially relatively more

risk on the older pensioners. Each cohort ends up paying for itself, thus freeing the insurer (in the NDC context the government) from the systematic risk. Piggott, Valdez, and Detzel (2005) and Valdez, Piggott, and Wang (2006) have suggested procedures of this type for private financial insurance schemes.

In chapter 22 of this volume, Alho, Bravo, and Palmer use over a century of time series data for the four Scandinavian countries (Denmark, Finland, Norway, and Finland), beginning in 1903, and the standard Lee-Carter model to project life expectancy for cohorts who turned age 65 in 1943 to 1973. They then calculate age-based longevity and adjust annuities accordingly as the pensioners age, which eliminates the risk for the insurer (the government in an NDC scheme) if the strategy is pursued through the life of the last cohort member. This is so by definition. More interesting is that this procedure almost eliminates the risk to the insurer if the cutoff age for revision is set at a high age (for example, in Alho, Bravo, and Palmer's study, age 85). This is far from the end of the story, however. The net outcome of this adjustment, in a regime with indexation, depends on (a) the form of indexation, including the option between front-loading of the annuity or yearly indexation without frontloading (or some combination of these) and (b) whether the effect of indexation counterbalances or reinforces the effect of longevity adjustment. The study shows that the combination of the risk-spreading rule and the indexation choice must be taken into account in any analysis of the distributional effects of a particular set of design decisions.

The question of who should bear the remaining systematic longevity risk in NDC goes beyond being a technical issue. In the opinion of the author of this chapter, the elderly survivors in a cohort of pensioners should not have to bear this risk. Instead, it should be shifted into the overall tax transfer context, as it would be with the NDC bonds. What this scenario would look like technically is discussed in the next section.

The NDC Bond: The Putty That Seals the NDC Scheme?

Because in the everyday operating sense NDC is in near equilibrium with the appropriate internal rate of return,⁵ the creation of an NDC bond "closes" NDC financially through a government commitment to assume remaining risk, notably the systematic longevity risk arising due to the underestimation or (more unlikely) the overestimation of the life expectancy factor used in the computation of annuities. In the generic NDC model presented in this chapter, the NDC bond is a longevity bond. The implications of this approach to closing the NDC scheme are discussed here.

With an NDC bond, the NDC accounting system ascribes to every unit of liability to an individual participant a corresponding share in an NDC bond. The individual shares in the NDC bond are similar to those created by issuance of marketed bonds to finance government borrowing for various purposes. The NDC bond can be viewed as a loan from workers to the government, with the rate of interest being the NDC internal rate of return. The money is used to pay the benefits of current pensioners. Workers convert their bond shares into pensions from retirement, albeit only in yearly increments corresponding to the amount of their yearly annuities payments.

The NDC bond can be seen as two bonds, the first of which is simply an accounting concept until the time of the issuance of a fixed annuity, and the second of which is a bond that covers a fixed annuity for all pensioners in a cohort, from a specified age throughout the entire life of the cohort. The NDC bond can, thus, be viewed as a longevity bond, tantamount to the sort of bond that some authors believe should exist for covering the longevity

risk in private financial pension schemes (Blake and Burrows 2001; Blake, Cairns, and Dowd 2006; Brown and Orszag 2006). The government covers the NDC scheme longevity risk in the same sense that these authors have promoted for financial pension schemes, *but without marketing the bond*. In this case, marketing the bond would simply create deadweight loss to be paid by the taxpayers. Because there is no deadweight loss, the unissued NDC bond can be claimed to be the perfect financial longevity instrument and the embodiment of the risk-free asset, barring the ultimate risk of total government collapse and bankruptcy.

With NDC bonds, the government, as the insurer, provides per definition the buffer “fund” for the uncovered (due to systematic under- or overestimation of life expectancy) longevity risk discussed in the preceding section. The government, as insurer, absorbs cohortwise deficits and surpluses, with the goal of almost breaking even in the long run. Systematic life expectancy projection errors, to the extent that they occur, first, would be financed by a broader tax base than contribution-based earnings and, second, would reflect more strongly the taxation principle of ability to pay.

On top of the other advantages of NDC, the issuance of NDC bond shares reinforces the transparent accounting of NDC—that is, it provides an even stronger barrier to the political risk. Individual shares in the NDC bond make clear the cost of government default. That said, clearly the creation of the NDC bond does not mean that the government cannot default, because, of course, it always can. What it means is that the cards are on the table for everyone to see. In case of default, it makes clear who is sacrificing what. The bottom line, which should not be disregarded, is (a) that the NDC scheme is financially stable, which itself contributes to maintaining stable government finances, and (b) that the extent of the commitment is fully transparent for the financial market in judging the creditworthiness of sovereign debt.

The rate of return on this longevity bond is the NDC internal rate of return, $(1 + g)(1 + \lambda)(1 + \xi)$, the same rate that determines account values and maintains financial λ equilibrium in the absence of an explicit bond. If the policy maker chooses to eliminate from the equation, then this choice explicitly delivers demographic dividends to the government coffer, while at the same time making the deficit that may arise from a declining labor force a policy issue. It is highly questionable whether this scenario is preferable to the rule-based generic NDC design. Furthermore, if a solvency approach is chosen, as discussed in the next section, the NDC bond mechanism could be used to transfer the liquidity “problems” arising because of temporary economic recessions, at least within certain bounds, to the government budget, in which case the government budget becomes the buffer fund.

Using the Fisher equation, the return on a marketed government bond can be expressed as $(1 + r) = (1 + i)\{1 + E(\xi)\}$, where here r is the nominal rate of return and ξ is the relevant price index, here the consumer price index. Then the NDC bond, with return $1 + r = (1 + g)(1 + \lambda)(1 + \xi)$, is the perfect inflation hedge for a pension provider, in this case the government.

Reflect for a moment on how bond shares could be created in practice. Workers are granted shares in the NDC bond that exactly match their account values, and pensioners are granted shares that exactly match their contracted annuity payments (also implicitly the present value of their accounts). The government creates bond shares to be held by the insurer (the NDC insurance administration) on behalf of the participants that exactly cover these liabilities. All workers and pensioners hold unit bond shares equivalent to their earned rights. The outcome for any individual pensioner will depend, however, on his or her actual life. So in the absence of systematic longevity error, cohorts pay for themselves,

with random discrepancies between actual and expected outcomes on a cohort basis. The insurer's (government's) liability is thus backed by NDC bond shares. This arrangement is tantamount to an insurance company holding marketed government bonds. It can be formalized using the apparatus developed previously for the account balances of workers and pensioners, KL and KR . These are exactly matched by NDC bond equivalents, which can be designated BL for workers and BP for pensioners:

$$PV(A_t) = K_L + K_R = B_L + B_R = B_t, \quad (19.12)$$

where K_L and K_R are the stocks of notional capital of workers and pensioners in expression 19.7 and B_t is the total stock of NDC bonds. Two expressions are specified for these two groups.

The capital of workers and the equivalent bond holdings is specified as

$$\begin{aligned} K_{L,t} &= \sum \left\{ \left[K_{L,a,t-1} + T_{a,t-1} \right] (1 + g_t)(1 + \lambda_t) + \Omega_{LD,a,t} \right\} + \sum \left\{ cW_{a,t} L_{a,t} + T_{a,t} \right\} \\ &\quad - \omega_{a,t} K_{L,t-1} (1 + g_t)(1 + \lambda_t) - \Omega_{LD,a,t} \\ &= \sum K_{L,a,t-1} (1 + g_t)(1 + \lambda_t) + \sum \left\{ cW_{a,t} L_{a,t} + T_{a,t} \right\} = B_{L,t}, \end{aligned} \quad (19.13)$$

where $\omega_{a,t}$ is the unretired share of a cohort.

The first term within curly brackets on the right-hand side of equation 19.13 is the previous period's capital indexed to current values at the end of the preceding period, plus a capital transfer from the accounts of workers who die during the period, $\Omega_{LD,a,t}$. The second set of curly brackets encompasses new contributions on earnings, cWL . In addition to earnings-based notional capital, the government may pay money into the system from general revenues to finance noncontributory rights,⁶ denoted by $T_{a,t}$. The third term denotes capital of workers who exit into retirement. The final term is attrition attributable to deaths in all cohorts of workers, that is, $\Omega_{LD,a,t}$, which represents the redistribution of capital from the accounts of the deceased (i.e., mortality credits) to the survivors in cohort a in the first set of curly brackets. Overall liabilities are unaffected by these internal transfers.

Expression 19.13 says that bond shares in any period t for workers equal bond shares at the start of the period, indexed with the rate of return $(1 + g)(1 + \lambda)$, plus bond shares for new contributions in period t , minus bond shares for retiring workers. The share of workers from cohorts exiting for retirement is included in expression 19.14 for retirees:

$$\begin{aligned} K_{R,t} &= \sum \left\{ \rho_{R,a,t} \bar{P}_{R,a,t-1} R_{a,t} (1 + g_t)(1 + \lambda_t) + \sum \Omega_{RD,a,t} \right\} \\ &\quad + \sum K_{RN,t-1} (1 + g_t)(1 + \lambda_t) - \sum \Omega_{RD,a,t} \\ &= \sum \rho_{R,a,t} \bar{P}_{R,a,t-1} R_{a,t} (1 + g_t)(1 + \lambda_t) = B_{R,t} \end{aligned} \quad (19.14)$$

where $\rho_{R,a,t}$ is life expectancy from age a at time t .

Expression 19.14 says that bonds for retired members of cohort a in period t equal the cohort's average pension in the preceding period, indexed with the rate of return $(1 + g)(1 + \lambda)$ to get the present value, multiplied by the number of pensioners and number of years benefits are expected to be paid, that is, $\rho_{R,a,t}$, which is an estimate that can be revised on a yearly basis until the birth cohort has expired completely. The second set of new terms is the capital of new retirees in year t . The capital (present value of expected

pension payments) of those who die in period t , Ω_{RD} , is redistributed to surviving retirees and does not affect overall liabilities.

Summing over financial commitments to workers and retirees, one finds that the stock of NDC bonds in period t is

$$B_t = \sum K_{L,a,t-1}(1+g_t)(1+\lambda_t) + \sum \{cW_{a,t}L_{a,t} + T_{a,T}\} \\ + \sum p_{R,a,t} \bar{P}_{R,a,t-1} R_{a,t} (1+g_t)(1+\lambda_t) \quad (19.15)$$

Indexation with $(1+g)(1+\lambda)(1+\zeta)$ harmonizes the nominal rate of return on the stock of NDC bonds with the rate of return on the stock of NDC liabilities.

With this formulation of the NDC asset, the NDC assets are the individual NDC bond shares. All bond shares are valued with the nominal rate of return $(1+g_t)(1+\lambda_t)(1+\zeta)$. The “fund” earns exactly the rate of return on the bond shares needed to fulfill the NDC commitment, which is the rate of return required to maintain financial equilibrium. In principle, the creation of the NDC bond—and bond shares—renders an explicit financial reserve fund unnecessary; with the creation of the NDC bond, the government has already committed itself to covering the entire commitment (i.e., the scheme’s buffer fund becomes embedded in the government budget). Alternatively, the pension administration could maintain an explicit fund, the net balance of which would be the government’s payments into accounts for noncontributory rights.

Along the same lines, a demographic (or economic) buffer fund could, and many would argue should, be established to avoid having to decrease pensions temporarily following downturns in the economy.⁷ The money in the buffer fund could, in fact, be invested in tradable financial market instruments, with an expected rate of return at least as high as the internal rate. However, it is more in keeping with the closed NDC system to issue these NDC bond shares comparable to the government commitment, with the rate of return $(1+g_t)(1+\lambda_t)(1+\zeta)$. In other words, the government has no reason to attach a risk premium to this debt component, and if it does not do so, the cost to the taxpayers is exactly on par with the value of the commitment behind the bond.

In sum, compared with just going through the accounting exercise of NDC, issuing and assigning NDC bond shares to the individual rights of participants adds to the transparency of the scheme and creates an even stronger barrier against ad hoc political intervention (i.e., protecting individual rights). For the government’s financial market lenders, the main message is still that the pension scheme is in fiscal balance, maintained by the NDC internal rate of return and use of longevity in creating annuities. The government’s only additional commitment is to cover the residual longevity risk if and when it leads to a deficit. And because the bond is not marketed, deadweight costs in the form of transaction costs and a risk premium are avoided and, hence, not shouldered by the insurance collective. Marketing the NDC bond creates no welfare gain for the participants, whereas it creates an extra cost for the taxpayers. Finally, this method of financing the residual longevity risk is tantamount to creating a government buffer fund financed through general taxes and other sources of government revenues. This situation gives the outcome a more preferable distributional character, compared with the alternative of pensioners shouldering this risk through the creation of variable annuities or through use of the solvency ratio for this purpose. Finally, the NDC bond approach described here can be combined with the solvency ratio *cum* balancing approach presented in the next section, thereby transferring the residual longevity risk to the taxpayers.

Using a Solvency Ratio to Maintain Financial Balance

The *solvency ratio*—the ratio of assets to liabilities—is a standard measure of financial balance used in insurance. A ratio greater than unity indicates assets are in excess of what is needed to cover current liabilities. A ratio less than unity indicates that assets are not sufficient to cover liabilities. A solvency ratio can be integrated into an NDC scheme to create a procedure to maintain financial balance, *regardless* of the indexation rule chosen. The procedure would be rule driven, with a legislated rule empowering the insurance provider to adjust liabilities—that is, accounts of workers and pensioners' annuities—to maintain a solvency ratio near unity. This requires a definition of assets necessarily based on an estimate of future contributions, as well as a readily available definition of liabilities.

The main idea behind the solvency ratio is that the NDC insurance scheme should be self-contained. If assets, which in the case of an NDC scheme consist primarily of future contributions, are less than liabilities, then equilibrium requires scaling down liabilities to create balance. If the policy maker has chosen to set up the NDC using $(1 + g)(1 + \lambda)$ $(1 + \xi)$ as the internal rate of return, as defined and discussed previously, then the remaining risk to be managed is the longevity risk. The policy maker may opt for indexation with $(1 + g)(1 + \xi)$ with the aim of maintaining a long-run neutral rate of growth in the average pension relative to the average wage, perhaps with the expectation that the country will have positive labor force growth, driven by some combination of a high fertility rate or continuous net immigration. Or there may be an expected extended increase in coverage associated with a growing formal sector in a developing country.

If the balancing mechanism accompanying the solvency ratio is symmetric, any surplus that might arise because of the choice not to index with the growth in the covered labor force would be automatically distributed with symmetric balancing when positive labor force growth drives the solvency ratio to values above unity. In the absence of an explicit reserve fund, so that an undistributed surplus is maintained, the balancing rule can be triggered only when the estimate of contribution assets falls below liabilities.

NDC liabilities are easily defined at time t because they are the present account values of workers and the present expected value (given the life expectancy estimate used in computing of both workers and pensioners); NDC assets are not. The central issue in working with a solvency ratio is the question of how to define the NDC scheme's assets, where clearly the definition must be based on an estimate of the future flow of contributions—that is, the *contribution asset*.

The flow of assets and liabilities is, of course, intimately related in an NDC world, because every future contribution creates a simultaneous liability. In a steady state with no systematic error in the estimate of longevity and no other problems arising because of the technical practicalities of measuring the internal rate of return exactly, the population would simply repeat itself over the long run. Assets would always be sufficient to cover liabilities.

The real world is not a steady state, however. The rate of growth of the per capita wage and the labor force can vary considerably over long periods of time. Many, many scenarios are possible, suggesting stochastic modeling of the future as the tool. A tolerance level would be established for the acceptable variation around a solvency ratio of

unity, and when the estimate of assets was outside the permissible boundary, the insurer would be required to adjust (index) liabilities to bring them back within the permissible bounds. Adjustments would be both downward and upward. This idea can also be combined with a reserve fund, such as a demographic fund, where the demographic reserves would be built up by large cohorts and would be available for distribution when members of the cohort became pensioners. An alternative model has been developed for and used in the Swedish NDC scheme. This method defines the contribution asset as the product of the time a liability is in the system until it is paid out, which is the turnover duration (TD) of liabilities, and the most recent outcome for contributions paid. TD is measured (a) using *known outcomes* of the determinants of the flow of contributions and payments (i.e., historical data) and (b) as it is used in Sweden, on the basis a moving average of the very recent past. These data are used to construct a snapshot in time. In other words, the definition is a static definition. The dynamics of adjustment result from the periodic (yearly) snapshots of each period's value of liabilities and assets.

One begins by constructing the definition of contribution assets used for this model, which has not previously been done in the literature with the technical detail needed to make clear how it works.⁸ The point of departure is the definition of NDC liabilities—that is, the balances on the individual accounts of workers and pensioners in expression 19.5, which are always completely known at any point in time, clearly one of the advantages of the NDC framework. One can start with the fact that personal account values are based on contributions and are a product of a fixed contribution rate and individual earnings. Also, looking back from any present time T , one sees that the historical rate of growth of wages (W) for a given discrete time period is known. The sum of wages earned by an individual (or the average for a cohort of individuals) can be expressed as $\sum_{\gamma}^T W_t (1+g)^{T-\gamma} = (T-\gamma)W_T$, where g is the average rate of growth of wages. Hence, an average the cohort rate of wage growth, $\bar{g}(a)_T$, can be calculated at time T , which yields the average cohort wage, $\bar{W}(a)_T$, for an average number of years of work $(\bar{T}-\bar{\gamma})(a)$ for the average cohort member up to time T . It follows then that the liability to workers—that is, the value of accounts summed over all workers at time T —can be expressed as

$$\sum_a^m c(\bar{T}-\bar{\gamma})(a)_T \bar{W}(a)_T L_T. \quad (19.16)$$

The insurance system's liability to pensioner cohort a is the average pension, $\bar{P}(a)$, times the number of years (denoted by the life expectancy at time T for persons in birth cohort a , $\bar{T}(a)$) that the pension is expected to be paid out from time T ,

$$\sum_a^m \bar{\rho}_T(a)_T \bar{P}(a)_T R_T. \quad (19.17)$$

System liabilities to workers and pensioners are

$$PV(\Lambda_T) = \sum_a^m c(\bar{T}-\bar{\gamma})(a)_T \bar{W}(a)_T L_T + \sum_a^m \bar{\rho}_T(a)_T \bar{P}(a)_T R_T. \quad (19.18)$$

Denoting the share of workers and pensioners in the population as L_T and R_T , one can rewrite equation 19.18 as

$$PV(\Lambda_T) = \sum_a^m c \overline{(T - \gamma)}(a)_T \overline{W}(a)_T L_T + \sum_a^m \overline{\rho}_T(a)_T \overline{P}(a)_T R_T. \quad (19.19)$$

Multiply the first expression on the right-hand side of equation 20 by $\overline{W}_T / \overline{W}_T$ and the second expression by $\overline{P}_T / \overline{P}_T$, and note that in equilibrium, contributions equal pension payments; that is,

$$\overline{P}_T R_T = c \overline{W}_T L_T. \quad (19.20)$$

To complete the derivation, substitute contributions (the right-hand side of equation 19.20) into the second expression on the right-hand side of equation 19.19 to get

$$PV(\Lambda_T) = \sum_a^m \overline{(T - \gamma)}(a)_T \frac{\overline{W}(a)_T}{\overline{W}_T} c \overline{W}_T L_T + \sum_a^m \overline{\rho}_T(a)_T \frac{\overline{P}(a)_T}{\overline{P}_T} c \overline{W}_T L_T. \quad (19.21)$$

Rearranging terms gives

$$PV(\Lambda_T) = \left\{ \sum_a^m \overline{(T - \gamma)}(a)_T \frac{\overline{W}(a)_T}{\overline{W}_T} + \sum_a^m \overline{\rho}_T(a)_T \frac{\overline{P}(a)_T}{\overline{P}_T} \right\} \cdot c \overline{W}_T L_T. \quad (19.22)$$

The expression on the right-hand side of equation 19.22 is a description of liabilities. In equilibrium, assets equal liabilities, implying that the right-hand side of equation 19.22 is a possible definition of assets. The term within curly brackets is the sum of the wage weighted average number of years of labor force participation of current cohorts and the pension weighted average of the length of payments to currently living cohorts of pensioners. It is a measure of the time a unit of money will remain in the system from the average time the contribution is paid until it is paid out as a benefit.⁹ This is the turnover duration, denoted TD .

Assume this definition of assets is adopted. If a possible reserve fund (F) is brought back into the picture using expression 19.22, the present value of assets equals the right-hand side of equation 19.22, with the addition of a possible fund—that is, $PV(A_T) = TD(C_T) + Ft$. Given this definition of assets, the solvency ratio implicit in equation 19.22 is

$$\psi = \frac{PV(A_T)}{PV(L_T)}. \quad (19.23)$$

This definition has been used to maintain financial balance in the Swedish NDC scheme since 2001, albeit asymmetrically because adjustments are made only for values less than unity.

The philosophy behind the Swedish NDC design is to index accounts with $1 + g$ and to accumulate a reserve in times when $\psi > 1$, to provide a reserve that can cover, if only partially, times when $\psi < 1$. Auerbach and Lee (2009) have tested this definition

using U.S. data projections. They demonstrate that the Swedish asymmetric balancing rule creates a welfare loss under circumstances where surpluses arise, because reserves created with $\psi > 1$ constitute forgone consumption opportunities, potentially for decades of workers and pensioners. Although extremely large reserves are not desirable, the Swedish method of indexing with $1 + g$ and building reserves when $\lambda > 0$ provides a possible buffer fund transferring revenues from times with good labor force growth to cover declining revenues in mild recessions, despite their origin.

Note that expression 19.21 is not as definition of an asset in conventional terms. Instead it measures whether a flow of contributions based on present (recent history) economic outcomes will be sufficient to cover liabilities at their present level. It has been labeled the *contribution asset* in the Swedish context.

What is also important to note (expression 19.22) is that the value of the contribution asset is determined by the liquidity of liabilities. Accordingly, the shorter the time a unit of money is estimated to remain in the pension scheme from the time it is paid in until it must be paid out, the less “asset” value it has—and vice versa. Thus, if two states are compared, all other things being equal—including the amount of total contributions, benefits, age earnings, and payment profiles—the state with a younger age distribution of labor force participation has a higher contribution asset value even though the *ceteris paribus* assumption means that a younger and older labor force will produce exactly the same wage sum and contributions from it, which is what is important for the NDC scheme, prior to “the” pension age. Likewise, all other things being equal, the value of the contribution asset is higher, including the total amount of payments to be made, in a state where longevity of annuitants is higher. In other words, for a given constellation of liabilities, there may be many definitions of the assets, depending on the age composition and relative age-related wages of the work force.

The effect of an aging labor force is clearly a liquidity effect, which would have relevance in determining the desirable time-to-duration content of a financial pension scheme investment portfolio, but in the NDC PAYG context, a liquidity effect of the type described here is of no consequence for the long-term outcome if the age of retirement is constant and the *amount* of contributions paid is the same in all states.

In contrast, other liquidity effects matter. For example, if the age of retirement from the workforce increases, all other things also being equal, this situation creates liquidity for the system, where this form of *liquidity* could be interpreted as synonymous with a higher asset value, *ceteris paribus*. Taking yet another example from the component $\sum_a^m \bar{p}_T(a)_T \frac{\bar{P}(a)_T}{\bar{P}_T}$ in expression 19.22, one sees that for any total amount of pension payments, more liquidity will be needed to make payments if younger pensioners have relatively higher pensions. All other things equal, this situation would create a liquidity problem for the NDC pension scheme. This would lead to a *ceteris paribus* need for balancing using the Swedish mechanism, a decrease in all pensions, whereas with the bond it would be covered by general tax revenue. Of course, in practice there will be offsetting positive effects and liquidity occurring at the same time.

In practice, the balancing mechanism works because it is constantly adjusting for new (yearly) snapshots of the most recent outcomes. That is, the expected stream of contribution assets is revised continuously. But this method can trigger adjustments that are not needed, because of its “naive” snapshot perspective. For example, recession is a temporary

event for an economy, normally followed by a strong recovery falling back in the third phase on a normal growth trajectory. The model is ignorant of the fact that a downturn is followed by a compensating upturn, and if a moving average is used (as in Sweden), there will be a several period lag in covering the entire phenomenon. Hence, adjustments of pensions will normally be out of phase with what is happening with wages. Of course, a buffer fund could be used to cushion or eliminate “unnecessary” negative balancing of pensions, but to date, in the only country using the balancing mechanism—Sweden—there is no rule creating a well-defined buffer fund for this purpose.

Finally, the solvency ratio approach, which distributes the adjustments proportionately among workers and pensioners regardless of their overall economic situations, can be compared with the NDC bond approach, which passes on effects of temporary downturns to the government budget and general income taxation, which can be based on individuals’ entire economic situation. Compared with a solvency ratio, the attraction of the NDC bond approach is that benefits of pensioners are not automatically reduced if solvency is temporarily less than unity because of liquidity reasons (e.g., economic recession). However, the NDC bond approach also suggests that the government must view part of its budget as the buffer fund for the pension scheme, which implies lowering the overall debt in good times to provide a buffer for harder times.

Should NDC Liabilities Be Valued in the Financial Market?

This chapter has already presented the view that there is no welfare gain associated with valuing the NDC bond on the market, if one views it as a longevity bond. One can ask the broader question, is there an advantage in valuing the debt on the market, given both the longevity and economic risk as well? The recent literature on PAYG pensions contains several proposals to set market values on overall PAYG liabilities, including NDC liabilities. One proposal is to sell a portion (not necessarily all) of the NDC debt on the market to establish a market value (Valdès-Prieto 2006; Robalino and Bodor 2009). Once the market value has been established, the argument goes, all liabilities can be valued based on the market resultant evaluation.

Another possibility is to set a price on liabilities using asset pricing methods (Blocker, Kotlikoff, and Ross 2008; Geanakoplos and Zeldes 2008, 2009) or to market the entire NDC debt. In NDC, liabilities are always known, as opposed to what is often the case in nonfinancial DB pension schemes, so the risk sold to the market would be the cost to the provider (the government) of covering uncertain outcomes, such as the combined longevity and economic risk. The market would value this risk and set a price on the government commitment. The risk premium that emerges would reflect the government’s ability to pay and would become a cost to be deducted from the internal rate of return. In essence, participant workers and pensioners would pay the cost for covering the risk of government default on their future benefits.

The government can afford to pay the internal rate of return, which in a Golden Rule economy would be the same rate at which tax revenues increase, with a tax rate that is proportional to income, less the cost of selling and servicing the debt (i.e., the deadweight transaction cost and the cost of the risk) to the market. In this perspective, there seems to be no value added by giving NDC liabilities a market value. Going back to the fundamentals, one finds that what is required to keep an equilibrium intergenerational contribution rate is that (a) the systematic longevity risk be covered and (b) liabilities (pension rights of

workers and pensions) grow with the economic internal rate of return. The remaining risk is the political risk, which, in fact, is likely to be reduced by the introduction of NDC and is nevertheless also associated with the entire budget—and with general political cultural fundamentals, not just the pension system.

Final Remarks

The NDC PAYG pension scheme is a recent innovation, and its generic dimensions have not previously been explored in a coherent context. This chapter has done so. The demographic, economic, and distributional properties of NDC have been identified and analyzed. A conclusion is that NDC brings to the pension stage a number of desirable features. Among the most desirable are benefits linked directly to contributions, thereby removing the tax wedge characteristic of PAYG DB schemes, resulting in intragenerational fairness; rule-determined financial balance with a fixed contribution rate, which ensures intergenerational fairness; an individual account scheme that can be used to create explicit, policy goal-oriented noncontributory rights with transparent financing; system transparency through overt liability accounting; and explicit mechanisms for dealing with the economic, demographic, and political risks.

Pension systems are confronted with two significant demographic risks in the coming century: the risk of a declining labor force, which most of the world will have to confront, and the longevity risk associated with the acceleration in the aging of the older population. NDC provides a format for dealing with both of these risks, including some options to the generic model. This chapter has argued for factoring changes in the labor force into the internal rate of return, following the format of the basic generic NDC model. Since the rate of growth of productivity—or more specifically covered per capita wages—should generally be considerably greater than the rate of decline in the labor force, there will thus be a considerable long-run positive rate of return on accounts and pensions, even with a declining labor force.

In contrast, developing countries, where the introduction of a universal pension scheme, such as NDC, largely replaces traditional multigenerational household security in old age, can use NDC to introduce a flat-rate demogrant (or guarantee level) for the elderly, where the NDC scheme eventually dominates. The asymptotic result could then be NDC with a guarantee. Creation of a financial fund with market investments is also possible under these circumstances.

The residual (systematic) longevity risk creates a special problem, which is resolved with an NDC bond, the asset that seals the system financially. The NDC bond functions like a longevity bond, but there is no advantage in putting it into the market. Marketing the bond would create costs that constitute an unnecessary transfer from present and future pensioners to financial market institutions, without creating any value.

However, the NDC bond is tantamount to any marketed government debt instrument. And one can view it as a loan from workers to the government to finance current pensions. The bond shares are held by the NDC participants. Finally, by covering the residual longevity risk, the mechanism of the NDC bond moves the distributional burden of the risk to the general arena of the income tax. This can be considered to be an advantage in itself, because the general income tax reflects overall ability to pay. The alternative, internalizing the risk within the pension collective with the additional risk that those who live the longest bear a greater share, through the solvency-ratio, does not take into consideration

the individuals' ability to pay the "tax." In addition, general government budget finances include revenues from profit taxes, other taxes, and other sources of income.

The complementary policy in an NDC regime consists of two additional components: (a) a minimum guarantee benefit—or set of benefits and taxes—to set the minimum standard guaranteed the elderly population and (b) the definition of desirable social activities to reward within the accounting framework provided by NDC, an important example being noncontributory rights in conjunction with the birth and care of children in the early years and, possibly, other care situations. Furthermore, NDC accounts can easily be shared between spouses, and joint annuities can be contracted at retirement, either by individual choice or through a mandate. This important characteristic of NDC is examined in chapter 11 of this volume by Klerby, Larsson, and Palmer, who discuss the structural difficulties confronting women and the accompanying effects on women's pensions, which provide a main motivation for sharing accounts between partners. However, even in the absence of structural characteristics of society that lead to low pensions for women, the fact that women outlive their partners by a considerable number of years provides an argument in itself for joint annuities for retiring partners. NDC opens the way for these political options.

What has not been discussed here is that the NDC scheme could be augmented with a reserve fund to buffer small "normal" cyclical economic changes, to avoid negative liquidity and the need to adjust pensions downwards in cyclical recessions (with a negative change in the wage sum). It is possible that the policy maker would want to transfer even more risk to the government budget using the NDC bond—namely, the risk of a chronically declining labor force—by leaving λ out of the indexation formula. Namely, one could argue that this risk is similar to the longevity risk and that the same arguments could be made for using the government's general revenues to finance this risk. The argument against this, however, is that it adds government discretion, which goes against the grain of the rule-based NDC principle. Finally, in developmental situations where the degree of formality will increase over an extended period, thereby creating a long run of demographic dividends, one might argue in favor of transferring these dividends into the government coffer. Various uses could be weighed against each other, and creating a demogrant is only one of many options.

A final point to be made is that NDC is a benchmark for other possible pension scheme alternatives. It covers, explicitly, all the important aspects of a PAYG pension scheme. By starting with the generic NDC scheme as the benchmark, the pension policy maker is able to weigh the pros and cons of diverging from or approaching the generic NDC structure.

Annex 19A: Demonstration of the Equivalence of the Macro Contribution Rate with the Individual Contribution Rate

In this annex, the equivalence between the macro contribution rate in expression 19.11 in the text and expression 19.1 is demonstrated. \bar{P} in expression 19.11 is the average of individual pensions, determined by individual capital balances and cohort life expectancy at retirement (expression 19.3). Indexing accounts with $(1 + g)(1 + \lambda)$, one finds that the average individual in pensioner cohort a has an annuity, \bar{P}_a , which can be expressed in terms of the current average wage, \bar{W}_a , where $\bar{\rho}(a)$ is the value of life expectancy used to calculate the benefit of pensioners in cohort a :

$$\bar{P}_a = \frac{\bar{K}_a}{\bar{\rho}_a} = c\bar{W}_{a,t} + \bar{K}_{a,t-1}(1 + g)(1 + \lambda) \left(\frac{1}{\bar{\rho}_a} \right). \quad (19A.1)$$

If one assumes that the average individual in the cohort works T years until retirement, equation 19A.1 becomes

$$\begin{aligned} \bar{P}_a = \{ & c\bar{W}_{a,t} + c\bar{W}_{r-1}(1+g)(1+\lambda) + c\bar{W}_{r-2}[(1+g)(1+\lambda)]^2 + \dots \\ & + c\bar{W}_{a,T}[(1+g)(1+\lambda)]^{T-1} \} \left[\frac{1}{\bar{\rho}_a} \right] \end{aligned} \quad (19A.2)$$

Similar reasoning can be applied to all cohorts of pensioners at any time t , the difference between cohorts being the life expectancy factor used in computing their annuities. The average pension for all pensioners together is the sum of pensions of all cohorts, a , weighted by the cohort's relative share in the entire population of pensioners, which is \bar{P} and can thus be expressed in terms of the current average wage of all wage earners in t . \bar{W} is derived in a similar fashion. Expression 19A.2, for *all* pensioners at a specific time is, thus

$$\bar{P} = c \frac{\bar{T}}{\bar{\rho}} \bar{W}_t (1+\lambda)^{\bar{T}-1}. \quad (19A.3)$$

Without labor force growth (or with labor force growth, but with solely wage indexation), equation 19A.2 simplifies further to

$$\bar{P} = c \frac{\bar{T}}{\bar{\rho}} \bar{W}_t. \quad (19A.4)$$

Where L_t denotes all workers and R_t denotes retirees at any time, t , the discrete-time version of expression 19.11, the financial identity for the entire pension scheme, is

$$c = \frac{\bar{P}_t}{\bar{W}_t} \frac{R_t}{L_t}. \quad (19A.5)$$

R_t/L_t is simply the system dependency ratio. Without labor force growth, substituting equation 19A.4 into equation 19A.5 and making use of the fact that ex post, $W_t = (1+g)W_{t-1}$, gives

$$c = \frac{c \frac{\bar{T}}{\bar{\rho}} \bar{W}_{t-1} (1+g) R_t}{\bar{W}_{t-1} (1+g) L_t}, \quad (19A.6)$$

and with labor force growth $L_t = L_{-T} (1+\lambda)^{\bar{T}-1}$ and indexation with both g and λ , seen ex post over T periods, is

$$c = \frac{c \frac{\bar{T}}{\bar{\rho}} \bar{W}_{t-1} (1+g) (1-\lambda)^{\bar{T}-1} R_t}{\bar{W}_{t-1} (1+g) (1+\lambda)^{\bar{T}-1} L_{-T}}. \quad (19A.7)$$

Ex post, one can always calculate values for g and λ that have generated the development of average earnings and the labor force during the period in which rights have been acquired.

One can rewrite the expression for individual benefits, 19A.4, as

$$\frac{\bar{P}_t}{\bar{W}_t} = c \frac{\bar{T}}{\bar{\rho}} \quad (19A.8)$$

and the macrofinancing condition for a PAYG scheme (19A.5) as

$$\frac{\bar{P}_t}{\bar{W}_t} = c \frac{L_t}{R_t}, \quad (19A.9)$$

which together give

$$\frac{\bar{T}}{\bar{\rho}} \frac{R_t}{L_t} = 1. \quad (19A.10)$$

Substitution of this expression into expressions 19A.6 and 19A.7 shows that exact equivalence exists in equilibrium between the macro contribution rate on the left-hand side, which reflects the ratio of total system expenditures to total system revenues, and the contribution rate used in computing individual pension accounts on the right-hand side. Clearly, with nonzero labor force changes, maintenance of equilibrium requires indexation with both g and λ , as is shown by equation 19A.7. In equation 19A.7, both the labor force and the average pension are $(1 + \lambda)^{\bar{T}-1}$ greater if $\lambda > 0$ and $(1 + \lambda)^{\bar{T}-1}$ smaller if $\lambda < 0$ than in equation 19A.6.

Annex 19B: Equilibrium Relationship between the Ratio of the Average Number of Years of Work and Retirement and the System Dependency Ratio

A less obvious steady-state equilibrium result is inherent in equation 19.11, as is demonstrated in this annex. The system dependency ratio in equation 19.11 has a counterpart expressed in years of work and years of retirement. In terms of expression 19A.3, $\bar{T}(a)_t/\bar{\rho}(a)_t$ is the ratio of the average number of years of work to the average number of years of retirement for cohort a . $\bar{W}(a)_t$ is the cohort's average wage, and c is the fixed contribution rate. The average pension for all pensioners in period t is a weighted sum of the pensions of all cohorts in t , where the weights are the number of pensioners in the cohort relative to the total pensioner population, and the average wage is the weighted sum of the wages of all cohorts in period t , where the weights are the number of workers in a cohort relative to the total number of workers. Thus, the macro replacement rate is \bar{P}_t/\bar{W}_t . Likewise, $\bar{T}_t/\bar{\rho}_t$ is the weighted macro ratio of years of work to years in retirement.

It follows, then, that in a steady state the ratio of years of work to years of retirement for the whole (covered) population under consideration is the system replacement rate.

Hence, in any period t , with macro replacement rate \bar{P}_t/\bar{W}_t , equation 19.11 reduces to the equality

$$L_t/R_t = \bar{T}_t/\bar{\rho}_t, \quad (19B.1)$$

which is an equilibrium characteristic of NDC. If one were to simply “drop” an NDC pension scheme onto a steady-state population, one would observe that equation 19.A.1 holds.

A second characteristic of equilibrium is that for a given contribution rate c and wage \bar{W} , the country’s average pension is determined by aggregate outcomes for years of work T (i.e., the average of all individuals’ actual lifetime work careers and years of average retirement, ρ).

Given expression 19.12, in contemplating a suitable magnitude in establishing the fixed contribution rate for an NDC scheme, the policy maker would consider the average benefit that an actual or targeted number of years of work and retirement for the mean (or median) worker would yield.¹⁰ Note that the dependency of an NDC benefit on lifelong earnings (expression 19.1) and the life expectancy at retirement (expression 19.3) are key characteristics of an NDC scheme that distinguish it from DB schemes.¹¹ In comparison, in a DB scheme, individual benefits are determined by a separate benefit rule, which does not necessarily fulfill either of these properties.

Notes

1. By 2010, countries as diverse as Italy, the Kyrgyz Republic, Latvia, Norway, Poland, the Russian Federation, and Sweden had adopted versions of NDC, albeit with varying degrees of adherence to the generic model to be presented here.
2. The chapter builds on a previous paper, “What Is NDC?” (Palmer 2006b).
3. It would not, however, function as a reserve fund in the sense that a reserve fund would buffer against temporary cyclical economic effects on indexation. Such buffering would require earmarking and creating a rule for how to use such funds (see chapter 20 of this volume).
4. Court decisions in Europe and the United States regarding the choice of life expectancy in mandatory public schemes require unisex life expectancy, which entails an overt redistribution from men to women, given the historical and present considerable difference in gender life expectancy.
5. In practice, the index constructed to measure the internal rate of return will be based on information that is less than perfect and becomes available with a lag, whereas the theoretical model presupposes instantaneous information. In addition, any attempt to smooth the fluctuations in the internal rate of return in the index formula applied will, in practice, create additional distortions.
6. Examples are money transferred into the system to cover some specified time in conjunction with childbirth, money to cover pension rights of people with disabilities, people receiving unemployment benefits, and so on.
7. See chapter 20 by Holzmann, Palmer, and Robalino of this volume for a framework for discussion of reserve funds in NDC.
8. Settergren and Mikula (2005) provide a macro picture of the model but no details of the rationale underlying the definition.

9. It is easily computed from the pension scheme's statistics on the age distribution of workers and pensioners and the age-specific (specific cohort in time t) average wage and average benefit at time t .
10. For example, a replacement rate of 50 percent with an actual or targeted relation between the average number of years of retirement to years of work of 18 years to 45 years is consistent with a contribution rate of 20 percent.
11. Note that a polar opposite scheme to an NDC scheme would be a DB scheme that provides a demogrant, based neither on years of work or years of residence, but simply on the fact that one is alive at a given age from which the benefit is granted.

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CHAPTER 19

COMMENT

Lans Bovenberg

This chapter provides a useful overview of the basic principles underlying nonfinancial (notional) defined contribution (NDC) pension systems. The most innovative part of the chapter is the proposal for NDC bonds. My comment focuses on these NDC bonds and the potential consequences of Edward Palmer's proposals for intergenerational risk sharing.

Reducing Political Risks through Financial Instruments

Palmer argues in favor of backing the assets of the NDC system with government-issued NDC bonds. The dividends on these bonds are determined by the growth rate of the contribution base and unexpected longevity shocks of the retired population. With these NDC bonds, the NDC system resembles a financial scheme in which the scheme is buying government debt instruments to back its liabilities. In this specific case, government debt instruments in effect provide the pension system with a share in the contributions levied on labor income and insure the pension system against unexpected developments in the longevity of its retirees. Through this latter longevity insurance, the government in effect allows the pension system to take on the character of a defined benefit (DB) system in the sense that higher pension costs caused by unexpectedly high longevity of retirees do not lead to lower pensions—as would be the case in a pure defined contribution (DC) system—but result in a higher tax burden. Indeed, the resulting pension system can be viewed as a hybrid DC-DB system: shocks in the contribution base (resulting from, for example, lower fertility) are absorbed by participants of the pension system, but unanticipated longevity shocks of retired cohorts are borne by taxpayers who act as insurers of the pension system.

STRONGER GOVERNMENT COMMITMENT TO PENSIONS THAT SHIFTS RISKS TO OTHER AREAS

Palmer maintains that making the government liability to the NDC system explicit through NDC bonds reduces political risks. Indeed, issuing these bonds raises the government commitment to the pension contract and makes it more difficult for the government to renege on its commitment to earmark part of future payroll taxes to NDC pensions. The property rights of the participants of the pension scheme on the future payroll would become considerably stronger if the government would decide to issue these bonds.

Raising the government commitment to the pension scheme is not costless, however. First, the quality of other government commitments would decline if the government made

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a stronger commitment to the pension system. Indeed, the share of payroll revenues that is earmarked for pensions can no longer be used to finance other government programs. It can also not be used to service other government debt if the government faces difficulties in financing these debts. The reduced flexibility of the government to default on its promises to the NDC system thus reduces the quality of other debt instruments issued by the government: commitment problems in the pension system are shifted toward more credit risk on other government commitments. Financial markets will therefore demand a higher risk premium on tradable government bonds to reflect the additional credit risk. Indeed, if the Swedish government would recognize its debt to the NDC system by issuing explicit NDC bonds, official public debt would more than quadruple. The transformation of soft implicit debt to the pension systems into hard legal claims would send a shock to financial markets. In the context of the European Union (EU), it would have major implications for the Stability and Growth Pact.

RULES VERSUS DISCRETION: THE ROLE OF POLITICAL DISCRETION AS AN INSURANCE DEVICE

A related issue is that making the pension contract more explicit by issuing government bonds reduces the flexibility of the system to respond to unforeseen circumstances (the so-called unknown unknowns). In fact, the decision of the government whether or not to issue explicit legal instruments to back its commitments to the NDC system is closely related to the debate between rules and discretion. Explicit rules involving complete contracts demand that the government can ex ante foresee the most relevant contingencies. Government discretion, however, has the advantage that it can respond ex post to contingencies that were not anticipated ex ante.

Governments thus face a fundamental trade-off between commitment and flexibility. On the one hand, issuing government bonds raises the commitment of the government to the participants in the NDC system and thus reduces political risks for the pension system. On the other hand, issuing these bonds reduces the flexibility of the government to redirect the revenues of payroll taxes if unforeseen circumstances were to call for such an action. Palmer maintains that the government should not reduce pensions in such a case but rather should use tax instruments. However, taxes feature rather different distributional impacts and tend to distort labor effort more than pension cuts do. Indeed, a stronger public commitment not to cut pensions in case public finances are in trouble does limit the flexibility of governments.

Which position one selects on this trade-off depends, among other things, on whether one views political decision making as an additional insurance device or as an additional risk factor. An important determining factor in this respect is the quality of political governance in a country. In this respect, it is telling that even Palmer, who lives in a country with some of the finest public institutions in the world, argues in favor of reducing political discretion by making explicit the commitments of the government to the pension system.

Another relevant factor is whether one trusts the designers of the system to come up with a system that works well in all future circumstances and whether one thinks the most important future contingencies can be anticipated ex ante. As an illustration, the

Swedish government recently decided to adjust the way the automatic balancing mechanism operates in view of the unforeseen volatility of the system in the wake of the recent worldwide financial crisis. This discretionary decision can be viewed as fixing a problem that the designers of the system did not foresee. Political discretion thus acts as an insurance mechanism against these unanticipated shocks. Discretion thus becomes more valuable in a fundamentally risky world—a world that even smart bureaucrats who designed the system do not understand well.

NDC Bonds and Intergenerational Risk Sharing

Despite these reservations about NDC bonds, I do like the idea of making the government commitments to the pension system more explicit.¹ In this way, the risk features of the pension claims become clearer. Thinking in terms of NDC bonds can help identify and address some of the major design flaws in the current NDC system in Sweden. These flaws involve inefficient intergenerational risk sharing, insufficient intertemporal consumption smoothing, and excessive choice in the financial defined contribution (FDC) system.

INEFFICIENT INTERGENERATIONAL RISK SHARING

The current pension system in Sweden allocates risk inefficiently across generations. In particular, according to the rules of the system, pensions paid out to retirees should have been cut substantially in nominal terms after the financial crisis in 2008 and 2009 because the value of equities in the reserve fund had fallen substantially in the wake of the financial crisis. Indeed, in the Swedish NDC pension system, all participants hold the same portfolio of implicit claims on the equities in the reserve fund and implicit claims on human capital of future generations in the form of a share of the contribution asset. Efficient intergenerational risk sharing, however, would dictate that equities in the reserve fund be held more by younger generations, whereas human capital claims would be held mainly by the older, retired generations. Indeed, the young would like to get rid of human capital risk by shifting it to the older generations. The older generations, in contrast, would like to hedge their standard-of-living risk by buying wage-linked bonds. Moreover, they would prefer to reduce their exposure to financial market risk. Indeed, claims on long-lived assets, such as real estate and equity, should be held by long-lived agents to reduce the maturity mismatch and the associated valuation risk.

THE FINANCIAL CRISIS AND INEFFICIENT RISK SHARING

The credit crisis originated in short-term investors (such as banks), rather than long-term investors (such as pension savers who are in the accumulation stage of their pensions), being exposed to the macroeconomic valuation risks of these long-lived assets.² These long-term investors are better able to deal with these valuation risks because they can spread out the macroeconomic risks over a longer period of time. Moreover, they have more time to adjust their habits to adverse shocks. Finally, younger agents face less maturity mismatch, because their consumption patterns more closely match the dividend patterns of these long-lived assets. Indeed, over their longer investor horizons, they can

benefit from mean reversion in returns as result of cyclical variations in discount rates and long-run co-integration between wages and equity prices.

By giving the retired generations an excessive stake in risky equity capital of the reserve fund, the Swedish pension system harms macroeconomic stability. In the depth of a recession, pensions are reduced, thereby reducing aggregate demand further. If more of the equity risk would have been transferred to the active, younger generations, these generations would have been able to smooth out the negative shocks over a longer time horizon, thereby alleviating the decline in aggregate demand. Indeed, the reserve fund could have operated like a buffer fund that absorbs adverse macroeconomic shocks.

INADEQUATE INTERTEMPORAL CONSUMPTION SMOOTHING

In addition to inefficient risk sharing, the NDC system in Sweden involves inefficient intertemporal consumption smoothing. In particular, the Swedish automatic balancing mechanism prescribes that imbalances between assets and liabilities need to be corrected immediately. This situation leads to rather volatile pensions and is suboptimal from the point of view of consumption smoothing, especially if participants exhibit habit formation. Indeed, the combination of inefficient risk sharing and suboptimal consumption smoothing yields excessively volatile pensions and leads to inefficient life-cycle financial planning.

A related issue is the DC nature of the pension system. By fixing contribution levels, the pension system gives up an important way to absorb shocks. Indeed, after an adverse shock in pension rights (e.g., pension rights decline by 4 percent because of the automatic balancing mechanism), workers should ideally spread the shock over not only the decumulation but also the accumulation phases of their life cycle by raising contributions. In effect, the possibility of saving part of their human capital and changing premium levels is an important reason workers can absorb more risk in their financial portfolio than retired agents can. The default premium rate should thus depend on the pension rights that have been accumulated thus far at any age.

FUTURE DESIGN OF PENSION SYSTEMS: INTEGRATION OF NDC AND FDC

If the government makes its commitments to the pension system explicit, it offers the possibility to integrate NDC and FDC systems. In particular, young agents who have still substantial human capital can take on most of the financial market risks, while older, retired agents can take on most of the human capital risk implicit in the NDC bonds.³ Moreover, protecting retirees against systematic longevity risk through NDC bonds makes sense. The NDC system, which distributes human capital risk uniformly over the pension claims of various age categories, can thus be seen as a transitional arrangement on the way to pension arrangements that optimally distribute financial market and human capital risks across generations. In particular, older generations hold most of the NDC bonds while younger generations hold more equity claims. This model in effect integrates pay-as-you-go (PAYG) financing and funding through financial markets. It also involves both government bonds and financial instruments issued by private parties.

By issuing wage-linked bonds backed by payroll taxation, the government, in fact, makes human capital tradable. Accordingly, human capital risks can be shared with the retired generations who have depreciated their human capital. The younger agents can absorb financial market risk through their own retirement accounts. Moreover, the government can take on financial market risks on behalf of younger generations. In particular, if the government taxes pensions on a cash flow basis, it participates in the financial market risks taken on by the pension system.

Tradability of NDC Bonds

Palmer argues that nothing is gained by making NDC bonds tradable. I am also rather skeptical about the trading of financial instruments by individuals. In fact, in this regard, the Swedish FDC system provides too much choice, thereby leading to excessive transaction costs. However, tradability can be important in countries with decentralized private pension funds or insurance companies. By making NDC bonds and longevity bonds tradable, the government allows these institutions to limit the mismatch risks if they offer wage-linked annuities. This approach contains the required solvency buffers while reducing credit risks facing those who have claims on these institutions. Moreover, tradability allows institutions to optimally combine FDC and NDC along the lines previously sketched. In particular, by trading these securities, institutions can, in effect, implement the required trade of financial risk and human capital risk between different cohorts.

SELECTION OF SOCIALLY OPTIMAL LEVEL OF INSURANCE

Another benefit of tradable instruments is that an endogenously determined risk premium induces pension insurers and governments to select the optimal level of insurance. Without a risk premium, the NDC system may impose excessive costs on taxpayers as they receive government insurance below the social cost of this insurance.

CHECK ON THE AUTOMATIC BALANCING MECHANISM

Another major advantage of making a limited number of NDC bonds tradable is that market valuation provides a check on the automatic balancing mechanism and the actuarial valuations of assets and liabilities used by it. Indeed, the automatic balancing mechanism suffers from a number of weaknesses. First, it abstracts from risk. Second, it is based on steady-state analysis and, thus, does not properly account for transitional issues. For example, it does not distinguish between temporary and permanent effects on the contribution assets. Third, the balancing mechanism is based on historical data rather than forward-looking projections.

Financial markets, in contrast, allow for risk,⁴ look forward, and take account of temporary effects as a result of transitions to a new long-run equilibrium. Financial markets also impose strong discipline on the political system and reduce the risk of political and bureaucratic interference. In particular, politicians cannot affect the value of government liabilities by changing certain actuarial parameters in the balancing mechanism. Most important, the discount rate used to compute the value of the liabilities of the pension system is not determined by a single agency but by traders who compete to make

proper projections of the cash flows of the NDC securities in various contingencies and to price these various contingencies.

TRANSPARENCY ABOUT IMPLICIT TAXES IN A PAYG SYSTEM

Valuation of NDC bonds by financial markets will reveal that the steady-state returns and values of these bonds are lower than the returns and values imposed by the actuarial balancing mechanism. Whereas the actuaries assume that the returns of these obligations are equal to the dividends paid out by these bonds, financial markets will price these bonds by using discount rates that take into account the correlation between dividends and returns, on the one hand, and fundamental macroeconomic risk factors, on the other hand. Because the dividends are typically lower than the applied discount rates (see Valdés-Prieto 2006), the NDC bonds trade with a discount, reflecting the PAYG nature of the NDC system. Indeed, for each euro of contributions, the contributor receives pension rights that are worth less than one euro—because part of the contribution is a tax for servicing the implicit debt in the PAYG system. As a percentage of the discounted value, the returns on NDC bonds thus exceed the steady-state dividends. In the case of bonds with finite maturity, the returns also include a capital gains term because the discount becomes smaller as the NDC bond gets closer to its maturity date. Furthermore, the market value of these bonds is much more volatile than the accounting value of these liabilities.

TRANSPARENCY ABOUT PROJECTED RISKS

Wage-indexed bonds with a very long maturity are quite risky and thus attract high discount rates. The reason is that the correlation between wages and stocks is quite large in the long run. Indeed, long-run productivity risk affecting the long-run value of human capital is substantial. Moreover, pro-cyclical variations in the discount rate may give rise to substantial pro-cyclical valuation risk. Wage-indexed bonds with shorter maturity are less risky. In fact, they may provide older agents with a hedge against standard-of-living risk. These observations confirm that NDC bonds are attractive for older agents, whereas equities are more attractive for younger agents. Accordingly, the government should issue NDC bonds of relatively short maturities. Moreover, the retirement accounts of younger, long-lived agents should contain more equity claims on long-lived securities exposed to financial market risk.

TRANSPARENCY ABOUT INTERGENERATIONAL REDISTRIBUTION

Financial market valuation of NDC bonds also provides transparency about the solidarity and the taxes implicit in an NDC system. For example, if NDC bonds are valued by the market, one can see clearly that compared to old agents, young agents pay a larger implicit tax on their NDC contribution because they get NDC bonds with a longer duration. These bonds are worth less than NDC bonds with a short duration for two reasons. First, the implicit tax on account of the positive difference between the financial market return and the growth rate of the economy rises with the duration of the acquired wage-linked asset. Second, the discount rate that younger agents use to value the acquired wage-linked claims exceeds that of older agents because the wage-linked securities pay off in good states for younger agents but in bad states for older agents (because of standard-of-living risk).

MORE FISCAL DISCIPLINE

One can view current earnings-related PAYG schemes as governments forcing their citizens to buy bonds from their own national governments. This view distorts a free European capital market. Replacing PAYG systems by tradable wage-indexed debt imposes more fiscal discipline on governments because capital markets must willingly absorb these securities. Indeed, risk premiums on NDC bonds reflect credit risks and thus signal government promises that are not credible. This approach imposes strong market discipline on governments not to promise more than they can deliver. This additional market discipline contributes to long-run financial and fiscal stability in Europe.

BETTER DIVERSIFICATION IN OPEN ECONOMIES

Making NDC bonds tradable also allows better diversification of pension portfolios across the European Union. By buying bonds from different EU countries, insurers can better diversify credit risks (of government defaults), thereby enhancing financial stability in the EU. Hence, the EU should deepen the European capital market by encouraging governments to make their PAYG promises tradable. Thus creating a deeper European capital market enhances a more efficient allocation of capital within Europe. Moreover, it facilitates intra-European risk sharing in which Europeans rely on each other for their retirement security. Such reliance is an important step toward greater economic and political unity and stability within Europe.

Conclusions

Palmer's chapter is a potentially very important contribution. By thinking in terms of NDC bonds, Palmer gives Sweden a novel way to approach its NDC system in terms of optimal life-cycle financial planning. Most important, it opens the way for improving how the current Swedish pension system allocates systematic risks across generations, thereby enhancing macroeconomic stability. This step is important not only for Sweden but also for other countries in view of the major influence the Swedish NDC system has on the way policy makers all around the globe think about pensions.

Notes

1. A pragmatic solution may be to give the government commitments the status of defaults. The government can deviate from these defaults only in exceptional circumstances.
2. The idiosyncratic risks, in contrast, should be borne by the banks that finance these assets to combat moral hazard and selection. Indeed, the recent financial crisis originated in banks being able to shift too much idiosyncratic credit risk of the loans they extended, while at the same time absorbing too much macroeconomic valuation risk on their balance sheets.
3. In addition to defaults for exposure to major risks (financial market, longevity, and wage risks), defaults for contribution rates (saving) and payouts (dissaving) should be set.
4. In technical terms, financial markets do not value securities under P (the actual probability distribution), but under Q (the probability distribution adjusted for risk). Under Q , bad states are overweighted and good states are underweighted. Hence, securities that are risky because they pay out a lot in good states attract a low value.

Reference

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The Economics of Reserve Funds in NDC Schemes: Role, Means, and Size to Manage Shocks

Robert Holzmann, Edward Palmer, and David A. Robalino

Introduction: Motivation and Structure

Anonfinancial (notional) defined contribution (NDC) scheme holds many high promises, including solvency of the scheme, even under adverse economic and demographic prospects. It links benefits to contributions through an individual account system that pays out what an individual paid in, indexed with the internal rate of return, but not more. To that end, it links the benefit level at retirement with the accumulated account value and remaining life expectancy, and it offers to remunerate the accounts while workers are active and index the pensions while they are retired with a (notional) interest rate that is in line with what an unfunded system can pay to remain solvent. But real-life proxies for a sustainable notional interest rate are just that—a proxy such as the rate of growth of gross domestic product (GDP) or covered wage bill—and accurate projection of life expectancy remains technically a challenge. Therefore, the toolbox of an NDC scheme should also include an additional safeguard feature to ensure sustainability—a balancing mechanism. This mechanism should trigger interventions at the level of the notional interest rate or benefit indexation when the liabilities fall short of assets, thus establishing long-term financial sustainability.

However, because an NDC scheme is not prefunded and uses current contribution revenues to finance current pension expenditure, it cannot promise the necessary liquidity at all times unless special arrangements are established. Hence, to ensure that pensions are paid at a sustainable level even if *temporary* macroeconomic or demographic shocks hit, or to avoid stark fluctuations of pension benefits that can only move in line with contribution revenues, special arrangements need to exist. The most promising proposal is the establishment of a reserve fund that holds sufficient cash or short-term government debt instruments so as to be able to address negative shocks within an established level of risk tolerance. But how large would such a reserve fund need to be? Should it deal with macroeconomic shocks “only”—that is, be able to address a multitude of temporary shocks that

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affect wages and employment and, hence, pension expenditure and revenue? And which types of shocks should it address and with what objectives and what risk tolerance? Or should such a fund also handle temporary demographic shocks, such as the retirement of the baby-boom generation?

To address these and other reserve fund–related issues, this chapter is structured as follows. The next section discusses in more technical terms the liquidity problems that an NDC scheme can face and reviews the main options to address them: access to borrowing from the financial market, NDC bonds, and a reserve fund. The following section then proposes a methodology to estimate the size of the fund in the steady state on the basis of a given objective function, the type and characteristics of shocks to be considered, and the level of risk tolerance. To keep things simple, these sections focus on macroeconomic shocks only. The chapter then investigates why and which kind of demographic shocks may be covered under a reserve fund and explores what size the fund would need to be. The steady-state conditions used in the earlier analysis are then relaxed, and the chapter analyzes how the size of the design of the fund would be affected to take into account an increase in coverage, legacy costs, and the buildup of a reserve fund. Finally, the main conclusions of the chapter are presented.

Liquidity Issues of Sustainable NDC Schemes and Key Options

The starting position selected for this exploration of liquidity issues is a sustainable NDC scheme—that is, a scheme that guarantees solvency now and in the future. This assumption will be relaxed later in the chapter. Such a solvent scheme can be characterized by the micro- and macroeconomic conditions presented next.

The *individual equilibrium* is achieved if accumulation of the individual accounts and decumulation (disbursement) follow the design in equations 20.1 and 20.2:

$$K_{i,T} = \sum_{t=1}^T cW_{i,t}I_t \quad (20.1)$$

$$I_t = \prod_{i+1}^{T-1} (1 + \alpha_t) \quad (20.2a)$$

$$I_t = I. \quad (20.2b)$$

In these equations, K is the capital for individual i at period T ; c and W are the contribution rate and wage in period t , respectively; and I is the periodic indexation of the capital with the notional interest rate α .

The individual capital at any moment is the accumulated contributions over the activity span (equation 20.1) that are remunerated (indexed) with the notional interest rate α (equation 20.2). At retirement, the individual capital is translated into an annuity that is determined by the expected remaining cohort life expectancy at retirement and expected notional interest rate during retirement (equation 20.3). Under this quasi-actuarial setting, the individual gets out (in expectation value) what he or she paid in.

$$P_{i,\tau} = \frac{K_{i,\tau-1}}{G(L E_k, \text{Exp}[\alpha])}. \quad (20.3)$$

In equation 20.3, $P_{i,\tau}$ is the initial pension of individual i at period τ (retirement), G is the conversion factor as a function of cohort life expectancy of individual i at age κ and $\text{Exp}[\alpha]$ is the expected notional interest rate over the remaining lifetime.

The *macroeconomic equilibrium condition* can be presented by the static balancing condition that needs to hold at any moment (equation 20.4) and simply says that for sustainability, the liabilities cannot be greater than the assets:

$$K_t + P_t = L_t \leq A_t = FA_t + PA_t. \quad (20.4)$$

In equation 20.4, K_t is the notional capital of all active workers, P_t is the present value of all benefits in disbursement, L_t is total liabilities, A_t is total assets, FA_t is financial assets, and PA_t is the pay-as-you-go asset.

The dynamic equilibrium conditions link the growth of assets and liabilities (equation 20.5) that allows one to determine the permissible growth rate of the liabilities (indexation of notional capital and benefits). Complying with this condition ensures sustainability of the NDC scheme ad infinitum.

$$L_t(1 + \alpha^*) = FA_t(1 + r) + PA_t(1 + w) \quad (20.5)$$

$$\alpha^* = \frac{FA_t}{L_t} r + \frac{PA_t}{L_t} w + \frac{FA_t + PA_t - L_t}{L_t}. \quad (20.6)$$

In these equations, α^* is the notional interest rate that ensures sustainability, r is the rate of return on the financial assets, and w is the growth rate of the pay-as-you-go (PAYG) asset.

The long-term solvency of such an NDC scheme would not be affected if the growth rate of financial assets (if there is a fund) and the PAYG asset follow a random process around the (expected) equilibrium values of r and w (or even some moving averages). In such a case, the liabilities can be indexed with the expected notional interest rate. Under such conditions, the alternative would be to index all liabilities with the realized notional interest rate based on the realized rates of return on financial as well as PAYG assets, respectively. Such an approach would also achieve the long-term financial solvency of the scheme, but with stochastic variations in annual indexation of individual accounts' capital and pensions. This approach already includes some smoothing, because it is necessarily based on alternative models of projecting and assessing the level of financial and PAYG assets, which themselves can entail smoothing and may differ substantially from the cash flow position of the pension scheme (i.e., the actual contributions received and pensions paid). An example of a group of simple projection models includes models based on a moving average of the most recent outcomes of variables, which change periodically (e.g., annually). This principle underlies the Swedish model, which is based on an estimate of the time a unit of money remains in the scheme, called *duration time*. The Swedish model

measures the assets (i.e., contribution assets) needed to cover the current valuation of liabilities. A solvency ratio is then created as the ratio of liabilities to this estimate of necessary contributions.

Without any access to liquidity, individual benefits of pensioners must vary with the cash flows of contribution revenues. Such variations create negative welfare effects for retirees and active workers, in particular. Retirees may be subject to reductions in nominal benefits that could accumulate to 10 or more percent during periods of “drought,” with reduced capacity to compensate through labor supply and private asset decumulation. Active workers would have more years to recover, except those workers facing retirement, when future higher increases of pensions would not be sufficient to compensate for the lower account indexation that occurred when they were active.

What, then, are the main options to avoid temporary variations in benefit and individual account indexation that are merely the result of liquidity and not long-term solvency issues? There are essentially three: access to market borrowing, NDC bonds, and a reserve fund.

ACCESS TO MARKET BORROWING

In a world of full access to information, when liquidity problems occur, a credible NDC scheme would be able to borrow freely from the banking system or financial market at market rates (and deposit and invest surpluses as they emerge). The net cash position should balance not only over a normal business cycle but also over major macroeconomic shocks and over the long term, as these events would have been anticipated in the estimation of the sustainable notional interest rate sketched above.

Clearly the underlying assumptions are too optimistic, because information issues are bound to arise, particularly in two areas: (a) the technical quality of the sustainable NDC scheme, including projections of the sustainable notional interest rate, and (b) the political quality of the governance structure that allows corrective actions to be imposed if and when unprojected deviations emerge. Perhaps for NDC systems to be able to borrow in the market, credit will need to have government guarantees. Otherwise, untested NDC schemes will need to have recourse to other approaches.

NDC BONDS

An NDC bond can be seen as an instrument that closes the link between the liability of an NDC scheme and its assets. The rate of return of an NDC bond should shadow the sustainable equilibrium rate of the return of the NDC system. The individual contracts between the government and the NDC participants are similar to those created by issuance of *marketed* bonds to back other forms of government debt. As a result, the NDC bond is, in principle, able to address the key risks of an NDC scheme, including the longevity and political risk (Robalino and Bodor 2009; see also chapter 19 of this volume).

Robalino and Bodor (2009) propose indexing accounts of workers with a formula reflecting the rate of return of the “contribution asset”—estimated with projections of cohort labor market participation, cohort wage growth, and cohort survival probabilities—and the rate of return on government-issued NDC bonds.¹ The government issues NDC bonds with a rate of return equaling the rate of growth of GDP; they are nontradable

bonds purchased with the cash surplus of the NDC pension fund. Benefits of pensioners are indexed using the rate of return of the GDP bonds. This method of indexation does not necessarily guarantee financial balance, and if, for some reason, reserves turn negative, most likely owing to the demographic labor force or mortality projections, the government covers the financial gap with general revenues.

In Palmer's model for generic NDC bonds (see chapter 19 in this volume), every monetary unit of NDC liabilities owed to workers (NDC accounts) and pensioners (NDC annuities) is matched by an NDC bond share. The rate of return on the NDC bond is the rate of growth of the covered wage sum, which is the internal rate of return; that is, through this procedure, account values and pensions are indexed with this rate of return. The NDC bond is like any other bond issued by the government, but it is not marketed. If the annuity in the NDC scheme is a fixed annuity from the time the worker exits the labor force and claims it, then the NDC bond shares issued prior to the age at which annuities are issued are converted into a specific cohort-based longevity bond that picks up the remaining longevity risk. What might still remain is the need to create a reserve fund to counterbalance cyclical economic risks, according to a defined norm. Alternatively, this norm-defined economic reserve could be a component of the government budget. If the NDC actuary makes only random mistakes in estimating cohort life expectancy, there is no cost to the government (taxpayers).

RESERVE FUND

The reserve fund, held by the pension administration, would guarantee the liquidity of the NDC scheme; that is, it would allow the scheme to honor the promised commitments toward the beneficiaries within reestablished margins of error (discussed next). As a result, beneficiaries would be spared from transitory benefit adjustments that react to liquidity gaps in circumstances where the long-term solvency of the system is judged not to be jeopardized by short-term macroeconomic fluctuations. Benefit adjustments may still happen, but they would be either (a) a reaction to shocks beyond the assumed size and scope or (b) adjustments required to ensure the long-term sustainability of the NDC scheme given a change in the long-term outlook. Hence, a reserve fund, even if well designed, can never be a 100 percent guarantee. The state of the world can change.

A key drawback of the reserve fund solution compared to the other two alternatives is the need for partial prefunding, unless sufficient prefunding is inherited from a predecessor scheme (as in Sweden) or natural resource revenues (such as the oil reserve fund in Norway). In addition, setting aside and keeping resources for such a reserve fund creates economic, social, and political opportunity costs that may be substantial. Moreover, the creation of such a fund may prove technically complex and politically difficult if and when it is intermingled with reform issues when moving from a notional defined benefit (NDB) to an NDC scheme (discussed later in the chapter).

Estimation of the Liquidity Needs against Macroeconomic Shocks

The size of a reserve fund to address the liquidity needs of an NDC scheme in case of a macroeconomic shock depends primarily on three assumptions: (a) the level of commitment (guarantee) toward the beneficiaries, (b) the assumed type and severity of shocks

against which the reserve fund plans to ensure, and (c) the level of risk tolerance with respect to missing the target that the government is willing to accept. This section deals with each of these issues in turn before providing broad estimations of the level of reserve funds. One can easily understand that the higher the level of commitment and assumed shocks and the lower the risk tolerance, the larger the reserve fund needs to be (in percentage of annual expenditure, pension liability, or overall liability).

The first assumption is that the level of commitment (guarantee) is an eminently political decision because it concerns the level of benefit guarantees that the government wants the scheme to provide. The government may want to avoid any real reduction in benefits, allowing only nominal reductions because real reductions are politically extremely difficult, or it may limit nominal or real cuts to an accumulation of x percent over y years. Other types of adjustments could be envisaged and linked with the pension level; such adjustments have happened in the past (e.g., no real cuts might be made for the lowest pensions, and benefit adjustment could gradually be reduced to no price indexation for the highest pensions).

The second assumption concerns the assumed type and severity of shocks. Until the 2008–09 financial, fiscal, and economic crisis, a reasonable assumption about the severity and duration of shocks would have been limited to business-cycle variations, with country-specific considerations. In the crisis language that emerged since the financial crisis of 2001, the assumption of a V-curved recession—that is, a fall and quick recovery in GDP—might have been considered sufficient. Yet the depth of the recession that began in late 2008 suggests that a U-curved rather than a V-curved recession is a more appropriate assumption, and caution suggests that the possibility of a double-dip W-type recession or even an L-type recession, which demands a much broader set of assumptions, should be considered. Although making an assumption with regard to GDP development is relatively simple, the implications—and how to deal with them—for NDC-relevant employment and wage growth, as well as the effect of a recession on the numbers of beneficiaries, are much less clear-cut. Analytical tools would have to be developed to take into account this broader set of assumptions.

The third assumption deals with the level of risk tolerance. The question here is how much risk is the reserve fund going to cover: all risks all the time, or some risks some of the time? The idea is that the level of reserves needed would increase with the magnitude of the expected shock. For instance, a shock that halves contributions and requires 50 percent of liabilities to be financed might be very unlikely (e.g., it has a 1 percent probability of happening every other year), and policy makers might decide that the NDC system should not be fully covered against this risk. Hence, they would tolerate a risk of 1 percent per year of not being able to pay half of the pensions of last year. Less dramatic shocks can happen with more frequency, and policy makers might want to ensure that the system is protected against those. The challenge is that recent events have shown that the risk tail has been systematically underestimated (the black swan analogy), yet little systematic empirical guidance exists for better modeling.

Bringing all these elements together to calculate the magnitude of a reserve fund in a realistic NDC model is well beyond the scope of this chapter and task. The existing NDC schemes are not yet modeled to perform such a stochastic simulation, even less to introduce the relevant shock assumptions. For this reason, this section also offers two more modest approaches: (a) offering indications of reserve fund size based on stochastic

fluctuations and (b) using recent crisis simulations that have been undertaken with the World Bank PROST (Pension Reform Options Simulation Toolkit) model.

SIZE OF BUSINESS-CYCLE RESERVE FUNDS

Equation 20.7 can be used to first calculate the cash reserve fund that must be held to avoid negative indexations of liabilities (i.e., individual accounts as well as benefits). If one sets the financial asset to zero and assumes a balanced starting position (i.e., liabilities equal the PAYG asset), the growth rate of the PAYG asset can be written as

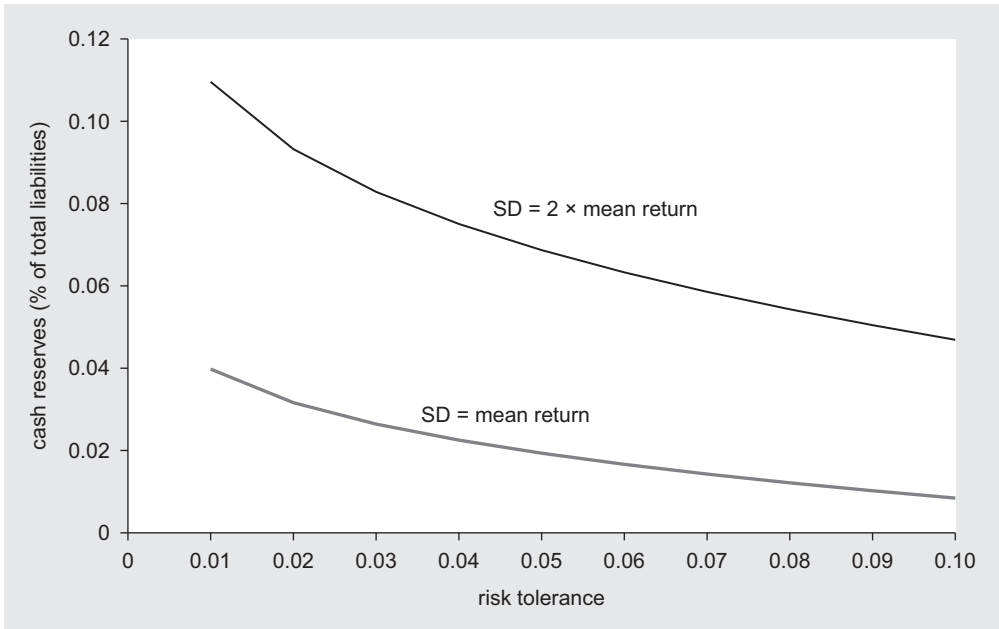
$$R_t = L_t |w + \sigma_w \Phi^{-1}(p)| \quad \text{if } w + \sigma_w \Phi^{-1}(p) \leq 0, \tag{20.7}$$

where w is the steady-state growth rate of the PAYG asset, Φ^{-1} is the inverse of the standard normal cumulative distribution function, and p is the risk tolerance. In this case, the minimum level of reserves required at time t are given by

$$\alpha_t = w + \varepsilon; \quad \varepsilon \approx N(0, \sigma_w^2), \tag{20.8}$$

where ε is white noise. Figure 20.1 puts some numbers into equation 20.8 and chooses as the steady-state growth rate, $w = 0.03$, $\sigma_w \in \{0.03, 0.06\}$ (i.e., selects the standard deviation at the level of mean wage growth and twice mean wage growth), with p ranging from 1 percent to 10 percent. Hence, with a low risk tolerance of 1 percent, the minimum reserves would have to be between 4 percent and 12 percent of liabilities, depending on

FIGURE 20.1 **Cash reserves and risk tolerance**



SOURCE: Authors' calculations.

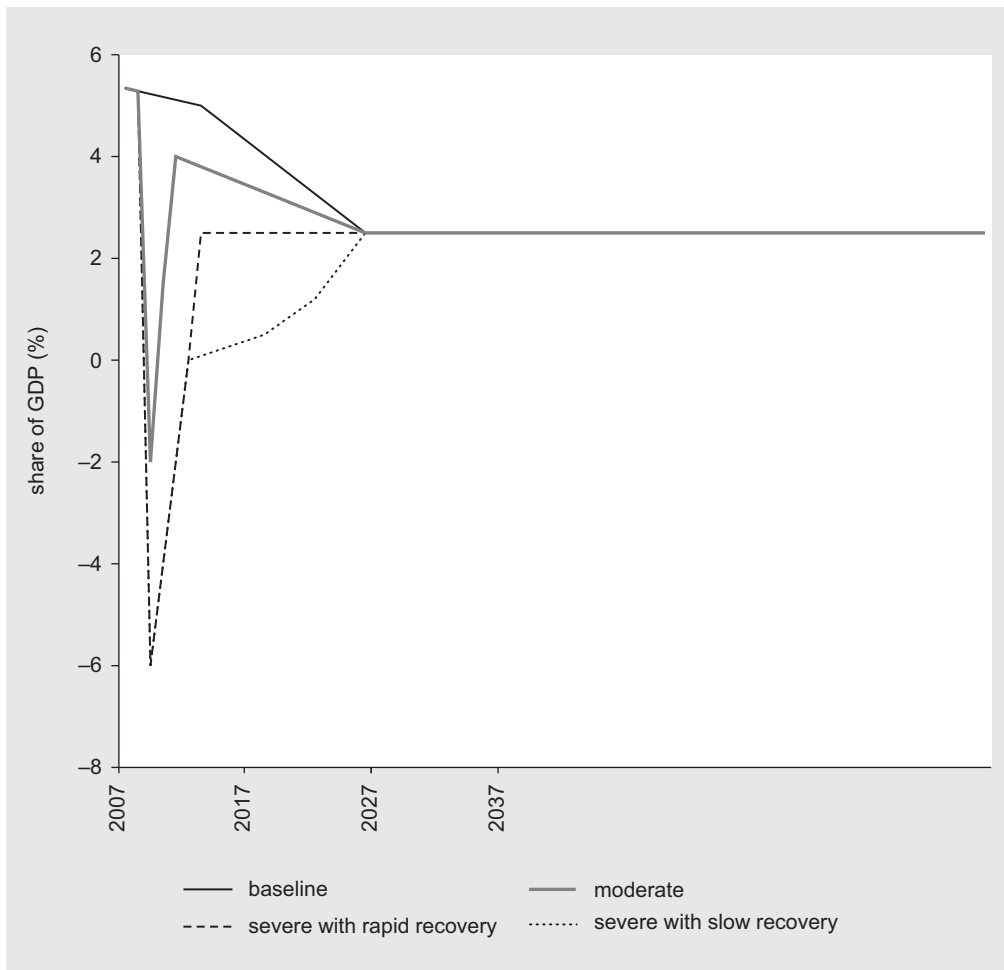
NOTE: SD = standard deviation.

the variance of the growth rate of the PAYG asset. Increasing the risk tolerance to 5 percent would reduce the range of the reserve fund to 2 to 7 percent of liabilities. With NDC liabilities of, say, 150 percent of GDP, this calculation would translate into a reserve fund in the range of 3 to 18 percent of GDP, respectively.

SIZE OF A CRISIS-RELATED RESERVE FUND

The recent worldwide financial crisis has triggered interest in the effects of events that go beyond stochastic or business-cycle-related fluctuations on the financial situation of pension schemes. To that end, simulations with synthetic pension schemes of key World Bank regions (Europe and Central Asia, Middle East and Northern Africa, and Latin America and the Caribbean) were undertaken. Three main shocks were simulated: a moderate shock, a severe shock with rapid recovery, and a severe shock with slow recovery (see figure 20.2 for the GDP path assumptions). Applied to region-specific models, this

FIGURE 20.2 Crisis scenarios and GDP, 2007–37



SOURCE: Hinz et al. 2009.

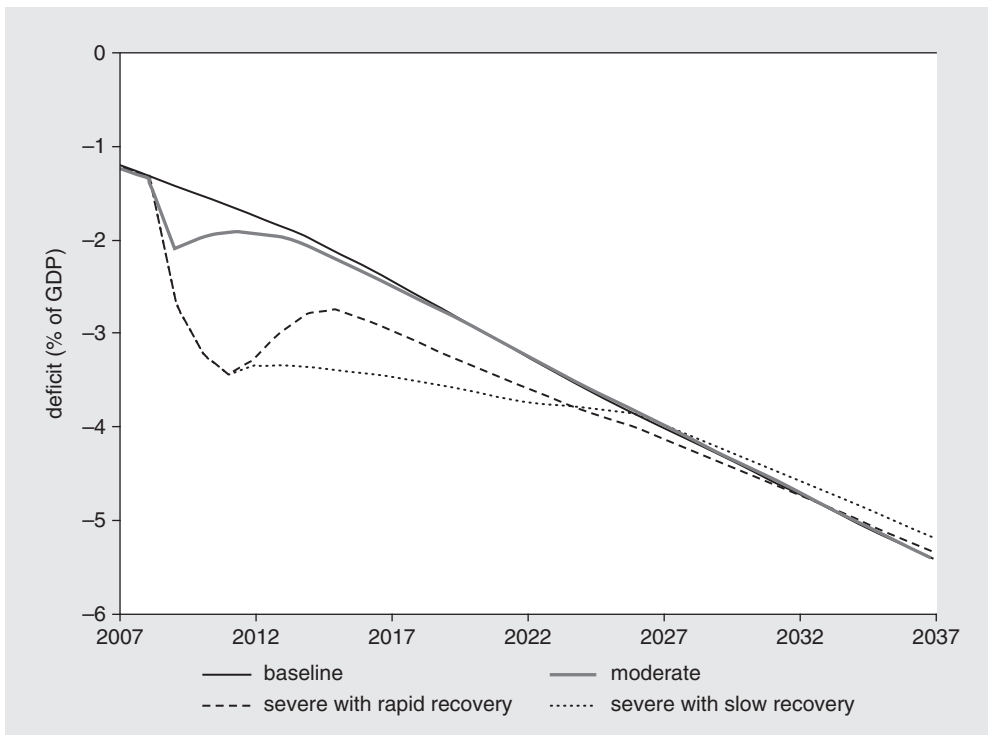
NOTE: GDP = gross domestic product.

exercise leads to deviations of the deficit (in percentage of GDP) from a baseline scenario. A good regional example is Europe and Central Asia, because it has the highest deficit deviation from the baseline (see figure 20.3). For example, the model projects for 2012 a pension system deficit of 1.8 percent of GDP that would double to 3.6 percent of GDP under the severe crisis scenario. As time passes, the temporary lower system participation and wages that are in sync with the lower GDP profile eventually translate into lower benefits and, hence, lower system deficits. As a result, by 2027 the deficit under each shock scenario goes back to baseline scenario.

The deficit difference can be used for each scenario to derive an estimate of the size of the reserve fund. That estimate is calculated by aggregating the deficit difference (in percentage of GDP) between the scenarios and baseline across the years to get an upper limit on the size of a reserve fund to cover this gap (table 20.1). Although in the model simulations the underlying steady state of return remains unchanged and, hence, is kept as a benchmark, adjustments likely would be made—in an NDC scheme, through changes in applied notional interest rate as well as in actual benefit indexation, and in an NDB scheme, through the indexation of the assessed income and benefits in disbursement. The simulations assume price indexation to safeguard the benefits in disbursement in real terms.

The simulations indicate a major accumulated impact on GDP under all crisis scenarios by the time the steady-state growth rate resumes (in 2026). Even under moderate crisis assumptions, this accumulated effect would lead to a postcrisis level of 80 percent

FIGURE 20.3 **Projected crisis-related pension deficit: Eastern Europe and Central Asia, 2007–37**



SOURCE: Hinz et al. 2009.

NOTE: GDP = gross domestic product.

TABLE 20.1 **Accumulated crisis-induced deficit as proxy for size of reserve fund, 2008–25**

Type of crisis	Moderate	Severe with rapid recovery	Severe with slow recovery
Shocked GDP by 2025 (% of baseline GDP)	80.3	59.6	47.8
Aggregated difference in system deficit (% of GDP)	1.7	13.0	16.6
Aggregate deficit difference (% of average monthly expenditure)	2.5	18.6	23.7
Aggregate deficit difference (% of initial system liability)	0.8	6.0	7.7

SOURCE: Authors' calculations, based on Hinz et al. 2009.

NOTE: GDP = gross domestic product.

of the benchmark GDP; under the worst-case assumption, the level would be less than half. These GDP developments translate into accumulated maximum differences between crisis and benchmark deficits ranging from 1.7 percent of GDP (moderate shock) to 16.6 percent of GDP (severe shock with slow recovery). If these accumulated deficit differences were to translate into a reserve fund of this size in percentage of GDP, they would equal 2.5, 18.6, and 23.7 times average monthly expenditure for the three scenarios, respectively. Expressed in the percentage of liability accrued to date (implicit pension debt) in 2007, this accumulated deficit would amount to 0.8, 6.0, and 7.7 percent, respectively.

These simulated results suggest that while smaller shocks can and should be provisioned for, doing so for larger shocks may be difficult. Moreover, it is quite likely not useful to provision against very large macroeconomic shocks: predicting such shocks is impossible, and assuming a very large shock would necessitate the creation and financing of huge reserve funds that in themselves would have welfare implications. Hence, a useful approach is to think in terms of some shock smoothing and some temporary adjustment of the notional interest rate away from steady-state values.

Demographic Shocks and Reserve Fund Issues

Do such possible reservations against excessive smoothing and reserve fund buildup also apply in the case of demographic shocks that are actually well predictable, such as the baby-boom bulge that is moving through the age structure of many richer economies? Should such demographic deviations from a long-term steady state be smoothed with a reserve fund or be subject to adjustments in the notional interest rate? What are the arguments for and against such a smoothing?

The key argument for using a reserve fund to smooth deviations from a long-term steady state or using an average of the notional interest rate is intergenerational fairness. Large fluctuations between successive cohorts may be considered unfair and should be avoided. Stabilizing, or at least smoothing, the internal rate of return through a reserve fund across generations thus has strong appeal for both NDB and NDC schemes. This idea was implicit in the buildup of generation funds in a number of countries during the

1990s and 2000s, which set aside oil and other resource revenues (Australia and Norway), privatization revenues and excess public revenues (China and France), or contribution surpluses (the United States). By the end of 2010, the size of such public pension reserve funds in the 17 Organisation for Economic Co-operation and Development economies for which data are available amounted to US\$4.848 billion (OECD 2011). How these public pension reserve funds will fare under strong fiscal stress and how many would survive a depression are the subject of current natural policy experiments. In the new Norwegian NDC-type scheme, the general government budget acts as a buffer or reserve fund for precisely the reasons discussed here and is secured, in practice, by the large Norwegian oil fund—including the prospects of future revenues (see Christensen et al. 2012).

The first argument against demographically inspired reserve funds is the opportunity cost, especially for countries not blessed with uncommitted assets that can easily be earmarked as a buffer for the pension system. In such cases, the transition generation would have to pay the cost for creation of such a fund through higher taxation or lower public expenditure. Doing so would increase the implicit rate of return for a future generation, which in an optimistic scenario might be blessed with a higher income and benefit level without such action. This situation leads to a trade-off between relative and absolute fairness that is not easily settled. A second argument against such a reserve fund concerns its potential size if full intertemporal smoothing were to be envisaged. Although no good calculations are available even for highly industrial countries to provide full demographic smoothing against the baby-boom bulge, the available fund data for Sweden provides an indication. The reserve fund of some 30 percent of GDP would not be sufficient. This conclusion is implicit in the fact that the 2008–09 recession and financial crisis has already led to balancing of liabilities in the Swedish NDC scheme (see chapter 21 of this volume).

Some additional estimates can be considered by using the results from the simulation model for Europe and Central Asia used previously in this chapter. The projections indicate a demographically induced bulge of the system deficit for the benchmark scenarios between 2030 and 2075, starting out and ending with a deficit of some 4.5 percent of GDP and increasing temporarily up to 8.0 percent of GDP. The accumulated excess deficit difference between 2030 and 2075 can serve as a proxy for demographic smoothing and amounts to 50.2 percent of GDP. Estimates for China also put the size at about 50 percent of GDP (see chapter 18 of this volume).

A final argument against such a large reserve fund concerns its governance and investment. Even before the crisis decade beginning in 2000, the performance of such pension reserve funds was very disappointing (see Iglesias and Palacios 2001). Nevertheless, more recent experiences have seemingly been more satisfactory, reflecting also a learning process within such funds about the importance of good governance and the design and implementation of investment strategies (Musalem and Palacios 2003; Rajkumar and Dorfman 2011). However, size remains an issue, both with regard to investment inside and outside the country and with respect to the difficulty of isolating such funds from populist demands. Some countries seem to be more successful than others with such isolation.²

In sum, demographically motivated reserve funds are not specific to NDC schemes; the pros and cons apply to all unfunded pension systems. In an NDC environment, such reserve funds are not needed to ensure solvency (even less, liquidity), because slow-moving demographic developments can easily be captured by appropriate proxies for internal rate

of return or an explicit balancing mechanism. Using reserve funds may still make sense to smooth (moderate) demographic deviations, but the opportunity costs for their establishment and operations need to be carefully assessed. If a fund is established, however, some good arguments support keeping such a demographically motivated fund separate (at least conceptually) from a pure liquidity-motivated fund, because they have different objectives and maturity structures and, hence, different accompanying investment opportunities and needs.

Scenarios Addressing Deviation Issues from Steady-State Conditions

So far, this chapter has considered reserve funds that emerge from deviations from a steady state within an NDC scheme that is in full operation. This simplified scenario helped to focus the analysis, but it is not realistic because few, if any, countries fall under that category. Therefore, this section explores the reserve fund issues for situations in which a steady-state condition does not apply. The following are considered in turn: (a) starting a reformed scheme, (b) financing the legacy costs, (c) increasing coverage, (d) dealing with labor force declines, and (e) starting from scratch.

STARTING A REFORMED SCHEME

NDC schemes thus far have replaced NDB schemes, with the new NDC scheme either applying only to new entrants or applying also to current participants—potentially to all existing contributors. In the latter case of an immediate and full conversion (as occurred in Latvia), a cash reserve fund is conceptually easy to apply because it would cover all participants—both contributors and beneficiaries. However, a reserve fund set up under such a full-conversion scenario also has the greatest funding need, and no solutions are readily available to achieve this level of funding. A scheme that applies only to NDC entrants would create few problems, because the reserve fund would apply to a well-defined set of future beneficiaries, and the lead time would permit good preparation and accumulation of a fund. Technically and politically more difficult would be systems that run in parallel for some time, particularly if individuals would draw both an NDC and an NDB pension under a transitional rule. A scheme that applies the benefit guarantee only to the NDC pension would be difficult to communicate; applying it to all pensions would require additional and quite likely ad hoc budgetary funding. Inability to raise the funds would have a bearing on the NDC guarantee or the funds' disbursement, with potentially negative effects on the credibility of the NDC scheme.

FINANCING THE LEGACY COSTS

The financing needs of a reformed NDC scheme are potentially compounded by the legacy costs of the old system. Such needs are accrued-to-date liabilities of the reformed system above those covered by the financial and PAYG asset. They are due to inherited legacy costs (i.e., old benefits in excess of the old NDB contribution rate needed to finance them) and reform-induced legacy costs (particularly those attributable to a reduction in the new NDC contribution rate). Such legacy costs can potentially be substantial and may amount to half or more of GDP, but they need not be disbursed all at once. However, strong

arguments can be made to finance these legacy costs through budgetary instruments and not through markups on the long-term NDC contribution rate (see chapter 18 of this volume). Even a legacy cost of 1 percent of GDP per year would compound the accumulation of funds needed for a cash reserve fund of 1 percent of GDP per year (e.g., to achieve a 20 percent fund in about 20 years).

Determining how to (temporarily) finance such a double burden is not an easy task. However, it should be financed through the budget, and some obvious channels can be outlined: additional revenues or expenditure saving. A broader discussion reveals other options as well, including the use of temporary debt financing, privatization revenues, or indirect taxation such as value added tax (Holzmann 1999; see also chapter 18 of this volume). But close inspection suggests that there are no silver bullets.

INCREASING COVERAGE

Bringing an NDC reform to an emerging economy with low or moderate coverage of the labor force promises many advantages, including (a) reducing informality by generating a closer benefit-contribution link and (b) potentially increasing the credibility of an NDC scheme, which should accelerate the increase in pension coverage. Increased coverage would also result in additional revenues and a temporary surplus that could be used to pay for legacy costs and perhaps finance a reserve fund. Model simulations for China suggest that such expectations are not just wishful thinking; the current urban coverage rate is at 50 percent (or below), and inflows from the rural to the urban sector will more than double the future urban labor force (Dorfman et al., forthcoming). If included in a reformed NDC system, the excess revenue would pay for the estimated legacy costs—broadly some 50-plus percent of GDP, depending on the choice of the new contribution rate); under optimistic coverage assumptions, there may even be enough surplus to cofinance a reserve fund (see chapter 18 in this volume).

DEALING WITH LABOR FORCE DECLINES

Countries encountering aging issues from increased life expectancy and a fertility rate below replacement level will have a special challenge under all pension schemes, but the implications are likely to be more visible under an NDC scheme. Unless compensated by later retirement, immigration, and resurgence of the fertility rate, the labor force in these countries will stagnate and soon shrink. In some former transition economies, the labor force is projected to decline by 1 percent per year or more for the next few decades (see Holzmann 2006).³ If this development is not compensated by a substantial increase in labor productivity, a permanently lower or, even at times, negative internal rate of return may emerge. Further catch-up growth for another one or two decades, as experienced in the transition economies, may somewhat camouflage such a development, but it is unlikely to last in the medium and long term. This situation speaks in favor of establishing and financing a cash reserve fund while the catch-up growth is still effective.

STARTING FROM SCRATCH

Some countries may adopt the NDC design with hardly any prior obligations. Although this scenario may create special challenges at the level of implementation and administration, building an NDC from scratch without legacy costs allows those countries to fully

plan for solvency and liquidity conditions. In the extreme case, and if no benefits are disbursed that are not anchored in prior contributions, the NDC scheme would become a provident fund–type financial defined contribution scheme. Otherwise, the government could decide to transfer some of the revenues to the older generation while at the same time accumulating sufficient reserves to address macroeconomic as well as demographic shocks, as considered useful. Of course, this scenario assumes farsighted politicians and an enabling environment that protects and productively invests such funds that may not be at hand.

Conclusions

This chapter explores the role, means, and size of a reserve fund to address macroeconomic and demographic shocks in an NDC scheme. The main conclusions are as follows.

First, although an NDC scheme promises to deliver solvency even under adverse circumstances, it cannot promise liquidity at all times. Hence, to avoid shock-related, revenue-dependent fluctuations of benefits (and possibly account indexation), the NDC scheme requires a predictable and transparent liquidity mechanism that guarantees a pre-announced indexation that is consistent with long-term solvency. The alternatives are ad hoc mechanisms such as government transfers or unexpected benefit adjustments that risk damaging the credibility of the NDC scheme and reform.

Second, there are three main candidates for such a liquidity mechanism: access to borrowing, NDC bonds, and a cash reserve fund. Whereas the first two candidates have conceptual and welfare advantages (no prefunding needed), their design and implementation challenges may dwarf the third option by a large margin.

Third, the size of a liquidity reserve fund depends on the size of the overall pension liability; the proposed protection (against, say, real or nominal benefit cuts); the assumed macroeconomic shock (V-, U-, W-, or L-shaped curve); and the risk tolerance to missing the target. Assuming only stochastic-type fluctuations around a mean notional rate of return, the fund could be as small as 3 percent of GDP (or below) or reach 20 percent of GDP (or more). In flow terms, the range is broadly between 6 months and 24 months of expenditure. Funds in this range should go a very long way to deliver on NDC promises, including liquidity in addition to sustainability.

Fourth, larger and protracted macroeconomic shocks of a W, or worse, an L type would require potentially much larger reserve funds that could double or triple the amounts needed for V- or U-type shocks. Such shocks are difficult to predict, however, and the size potentially required is unlikely to be prefunded in most countries for economic and political reasons. This fact suggests the need to make (temporary) downward adjustments for contributors and beneficiaries, even if the deviation from steady state (or long-term average) is only temporary. Hence, full protection against very large temporary shocks may not exist, even in NDC schemes.

Fifth, such reserve funds may be envisaged to deal not only with (unpredictable) macroeconomic shock but also with (predictable) demographic bulges, such as the baby boomers. The goal is similar—namely, to avoid too large fluctuations of the internal rate of return across generations. Given the potentially very large size of funds to address demographic shocks (and the funds' high predictability), the rationale is even stronger to ask for some adjustments in the notional interest rate. Of course, such a decision will depend on

the opportunity costs of fund raising, which puts countries with excess natural resource revenues, for example, in an advantaged position.

Finally, countries in different starting positions will have different opportunities and challenges to address shocks and to build reserve funds. Those countries that reform a comprehensive NDB scheme toward an NDC scheme may be faced with a double burden when establishing a transparent scheme: financing both the legacy costs and a reserve fund. Those countries that start essentially from scratch have many more options, including the building of major reserves; yet they may also face a more challenging enabling environment. Thus, it is important to consider the country specificities when deciding on the scope of a reserve fund, its financing, and its use.

Notes

1. The Swedish method estimates a factor called *duration time* based on basically the same variables, but the methods used to derive contributions can lead to different results because the Swedish method is based exclusively on known, ex post data.
2. See Flam's discussion of Sweden's experience in chapter 24 of this volume.
3. Palmer et al. (2006) provide simulations of this effect for Latvia.

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CHAPTER 20

COMMENT

John Piggott

This chapter, coauthored by the volume's three editors, focuses on macroeconomic uncertainties, or at least unpredictabilities, that a nonfinancial (notional) defined contribution (NDC) system may confront. As in much of the rest of the book, the chapter sees the NDC system as a kind of stand-alone accounting structure that embodies rules for contributions and entitlements under all predictable circumstances. The system's virtue is that the rules are tight, making it harder to favor a particular group for political gain or electoral advantage. If this commitment aspect of NDC did not exist, it would be much less valuable.

This chapter deals with buttressing the structure against unanticipated shocks. These shocks are seen to be derived from two main sources: the business cycle and demographic factors. The chapter argues that for business-cycle shocks, a reserve fund will do the job, but for demographic change, longer-lasting adjustments to the rules will be required.

A "pure" NDC system embodies (a) a rate of return on the notional accumulation equal to covered payroll growth and (b) benefits that are continually adjusted to evolving mortality experience. The risk in the NDC structure that corresponds to investment risk in a real defined contribution (DC) plan is the variation in the rate of return implied by variations in covered payroll growth. As with real DC plans, intercohort risk sharing is not admitted in the structure, reflecting the "tight rule" virtue.

But this pure model is almost never used. In practice, NDC plans almost always have built into them features that amount to ad hoc intergenerational risk sharing.

Given this context for NDC systems, a few initial observations are in order. The first point to make is that intergenerational risk sharing is welfare enhancing. Young and old cohorts have different needs and resources, and exchange is beneficial. That exchange includes the transfer of risk. Current concerns with intergenerational solidarity—or its opposite, intergenerational warfare—are grounded in the loss in well-being that would occur were generations to move toward autarky.

Second, when it comes to intergenerational exchange, markets do a poor job. The agents in the transaction are not really able to sign a legal contract (they are too young), they cannot at a later date renege on the contract (they have already received their education), or they are myopic and undervalue the worth of research and development for the future of the world. So the two major institutions that facilitate intergenerational risk sharing and intergenerational exchange of any kind are the family and the government.

So if intergenerational risk sharing is good, and the government is an important institution in facilitating such sharing, how can a social security paradigm, which in its pure form does not admit intergenerational risk sharing, be modified to admit such sharing?

In a sense, that question lies at the heart of the chapter. What kinds of, and how much, intercohort risk sharing should we allow? And how should it be done? If

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disadvantaged cohorts are to be helped, financing must be obtained—what the authors mean by liquidity. They consider three possible funding sources: access to borrowing in the market, NDC bonds, and reserves. The first two of these are given due attention but are eventually rejected. If the NDC fund can borrow in the market, the government can presumably borrow on its behalf more cheaply (or guarantee the loan, which amounts to the same thing). NDC bonds are really the same thing: the government budget is the reserve fund. So the third alternative is to set up reserves within the NDC structure, which, while challenging—how do you build the reserve?—is considered the best.

If the NDC structure is to do set up a reserve without outside support, its aims must be modest. And this is what the authors conclude. To preserve the tight rule virtue, only a limited amount of intergenerational risk sharing can be managed. Business-cycle risk smoothing can be managed; however, covering the global financial crisis may be a bridge too far. And demographic disequilibrium is not something a tightly run NDC plan can contemplate addressing through a reserve fund. Quantitatively, a reserve fund of 5, 6, or 7 percent of assets is judged manageable; a fund of 25 or 26 or 27 percent is not. Other shocks would require a change in regime, thereby altering contributions and benefits.

The last part of the chapter considers an NDC plan as a reform from a pension plan that already exists—or perhaps as a reform alongside a pension plan that already exists. The difficulties here (such as legacy costs) are well acknowledged.

Thus viewed, the chapter brings into sharp relief the trade-offs in the NDC strategy. Traditional pay-as-you-go plans—apart from their negative impacts on labor force participation at older ages and explicit recognition that the present value of constant benefits is sensitive to changing longevity at retirement—more easily allow intergenerational risk sharing. The NDC paradigm makes it more difficult for a structure that is complex to be exploited for political reasons. But this benefit comes at the cost of constraining a major intergenerational instrument from doing a job that government needs to do: spreading risk across generations.

A Decade of Actuarial Accounting for the NDC Scheme in Sweden: Quantifying Change in the Financial Position of a PAYG Pension Plan

Ole Settergren

The 1994 and 1998 pension reform in Sweden introduced a nonfinancial (notional) defined contribution (NDC) pension scheme to the public pension system (see box 21.1 for an overview of the system).¹ As part of the reform, new accounting rules were established. These rules developed as a spin-off from the efforts to achieve the goal of securing automatic financial balancing in the NDC scheme.²

The accounting rules that were developed closely follow standard double-entry bookkeeping, producing a full income statement and balance sheet. Because the pension scheme is financed on a pay-as-you-go (PAYG) basis, prefunded assets do not match aggregate pension liabilities. For the assets of a PAYG pension scheme ever to match the pension liability, the flow of contributions must be considered an asset. The rules of the Swedish NDC scheme made it both possible and reasonable to generate the necessary accounting figures without projections or discounting.³ Also, in the sense that the accounting uses only registered transactions or events, thus refraining from explicit discounting of assumed flows of payments, it comes close to traditional conservative accounting, with similar strengths and weaknesses. However, the method used to measure assets and liabilities can be interpreted either as assuming that relevant conditions prevailing at the time of valuation remain constant, or as meaning that any changed condition will affect assets and liabilities to the same extent. In such a case, the discounting rate used is the rate of growth in the system's contributions.

The accounting provides answers to questions such as the following with respect to the past calendar year:

- How much new pension liability was accrued?
- By how much did the pension liability increase because of indexation?
- What was the increase in the pension liability attributable to life expectancy improvements?
- What was the increase in system assets?

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BOX 21.1 Overview of the Swedish public pension system

The Swedish public pension system consists of two different earnings-related benefit schemes: an NDC pension, the *inkomstpension*, on which this chapter focuses, and a fully funded financial defined contribution pension, the *premium pension*. A tax-financed guaranteed pension provides supplementary support for retirees with a low *inkomstpension*.

The *inkomstpension* is a pay-as-you-go pension scheme with a substantial buffer fund. The size of the *inkomstpension* benefit is a function of lifetime contributions credited, which, from and including 2000, equal the contributions paid, with the addition of the notional return (or interest) on those contributions, survivor bonuses, administrative costs, and life expectancy effects. Here, the interest payments are referred to as *indexation*. A ceiling on pensionable income is equivalent to approximately 110 percent of an average wage for a full-time worker. In relation to the average wage of all wage earners, the ceiling is 160 percent. Occupational pensions typically insure incomes above the ceiling.

Both accounts and benefits are indexed by the increase or, more correctly, by the change in average income. When the initial pension is calculated—that is, when the notional account value is converted into an annuity—the pension is increased, or front-loaded, on the basis of an assumed annual real growth rate of 1.6 percent for the income index. This rate of advanced interest is then deducted every year from the increase in the income index. Thus, the *inkomstpension* is indexed annually by the change in the income index reduced by 1.6 percent.

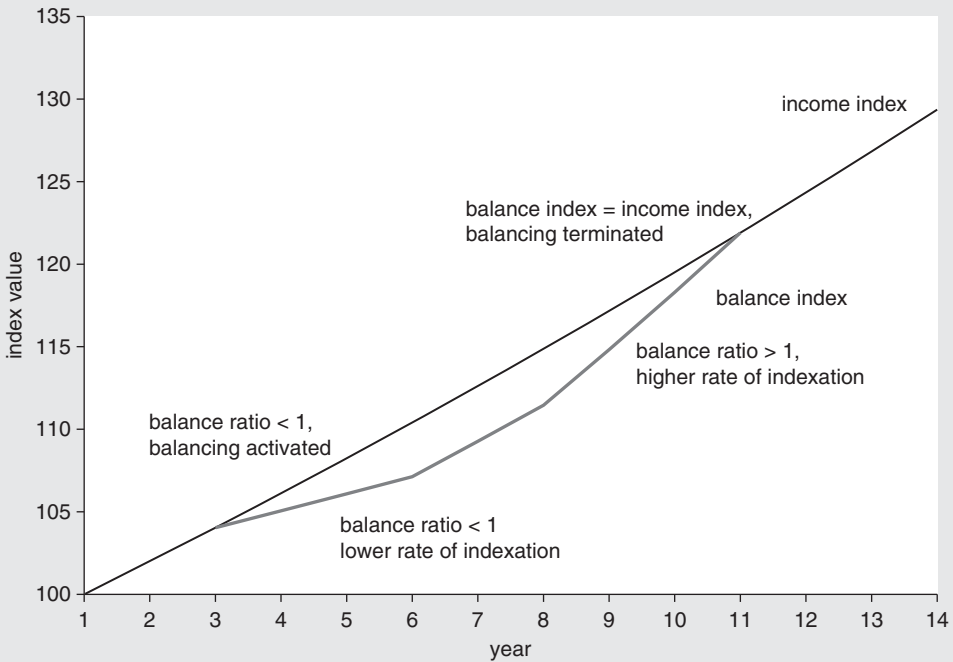
In certain situations, exceptions to the regular income indexation of accounts and benefits apply. These exceptions are governed by the ratio of assets to liabilities, as provided in the legislation on the balancing mechanism.

THE BALANCING MECHANISM

The balancing mechanism is activated if and when the accounting statement of the *inkomstpension* scheme shows that liabilities exceed assets, at which point the deficit is automatically eliminated by reducing the indexation of both benefits and pension account balances of the economically active population. Any subsequent surplus is used gradually to restore indexation to its prior unreduced level. This mechanism guarantees automatic, rule-based financial stability, thus giving a defined contribution character to what is essentially a pay-as-you-go system. See box figure 21.1A for an illustration of the balancing mechanism.

GUARANTEED PENSION AND HOUSING ALLOWANCE

For those with little or no *inkomstpension*, there is a minimum guaranteed pension. The guaranteed pension is financed by the general revenue of the national budget, not by contributions. The size of the guaranteed pension depends on marital status and years of residence in Sweden, with a reduction for fewer than 40 years of residence. The guaranteed pension is a top-up benefit that peaks at low levels of *inkomstpension* and then tapers off as the *inkomstpension* increases. It is annually adjusted according to the consumer price index. The guaranteed pension level is currently approximately 25 percent of the average wage for a full-time worker. In 2010, 42 percent of all retirees and 29 percent of 65-year-olds in the population received some guaranteed pension. The total guaranteed pension paid was 9 percent of the total *inkomstpension* paid.

BOX FIGURE B21.1 **Illustration of the balancing mechanism**

NOTE: For more detailed information, see the 2010 *Orange Report* (Swedish Social Insurance Agency 2010). The report can be downloaded from http://www.pensionsmyndigheten.se/Publications_en.html.

As long as a retiree has a low enough inkomstpension to qualify for the guaranteed top-up, an increase or decrease in the inkomstpension, whether attributable to normal indexation or to balancing, is either completely or partially offset by an increase or decrease in the guaranteed pension. In addition to the guaranteed pension, there is a general-revenue-financed and means-tested housing allowance that provides additional protection to low-income retirees.

- How great was the change in liability relative to the change in assets? That is, did the system produce a net income or a net loss?
- What is the scheme's solvency? Are assets more or less than liabilities? In other words, is the accumulated net result an accumulated surplus or deficit?

Data on stocks of assets and liabilities and on the flows that change the size of those stocks are the essence of financial information. Nevertheless, such information is scarce when it comes to public pension plans of the PAYG variety, which in most societies are the largest financial institutions. The format for financial information—a more or

less conventional income statement and balance sheet—is unique to the Swedish NDC scheme, the *inkomstpension*, when it comes to PAYG pension systems.

The most important statistic provided by the balance sheet is the ratio of assets to liabilities—the *solvency ratio*. To indicate that the solvency ratio of a PAYG scheme is different from the solvency ratio of a premium reserve pension scheme, the *inkomstpension* system calls this ratio the *balance ratio*. When the accounting data of the NDC scheme show assets to be less than liabilities, this deficit is eliminated by reducing the normal indexation of benefits and notional pension accounts. In the periods following reduced indexation, any surpluses that occur are used to increase indexation until the accumulated indexation is back at the level that would have prevailed without the reductions. The rules for such deviations from the desired indexation, which is measured as the change in average income, constitute what is called the *automatic balancing mechanism*.⁴

The aim of this chapter is to present and discuss the accounting method developed for the Swedish NDC scheme. The chapter presents the income statements and balance sheets for the nine years from 2002 to 2010.⁵ One reason this discussion might have some general interest is that although the effects on the balance sheet of changes quantified in the financial statements of the Swedish NDC scheme exist in all PAYG pension plans, these detailed “partial” effects are not normally apparent in the typical actuarial information on public PAYG pension systems. Another reason the accounting method used may be of some interest is the long-standing academic discourse on the usefulness of estimates of the pension liability in public PAYG pension schemes.⁶ The Swedish accounting adds a perspective to this discourse, essentially by supporting the view of Barr and Diamond (2009, 14), that “analysis that looks only at future liabilities (that is, future pension payments), while ignoring explicit assets and the implicit asset from the Government’s ability to levy taxes, is misleading.” The annual report of the Swedish pension system (the *Orange Report*) annually quantifies how misleading such an analysis would be (Swedish Social Insurance Agency, various years).

To provide balanced and complete financial information on a PAYG pension scheme, financial statements should, in addition to accounting for liabilities, include an asset side of the balance sheet and a full income statement. Including the “value” of future contributions as an asset in a financial statement is—and should remain—a violation of normal accounting principles. However, in the case of PAYG pension plans, the inclusion of such a value is one of arguably only two methods for arriving at a logical and informative description of the financial position and the periodic change of the financial position of such pension schemes.⁷ Inclusion of the value of future contributions in the balance sheet is not done to make the PAYG pension scheme resemble a prefunded pension plan. Rather, the PAYG pension scheme’s balance sheet clarifies one characteristic of a PAYG pension scheme: its reliance on future contributions. The balance sheet clearly shows the magnitude of the substantial obligations undertaken by the legislators that are not prefunded. Further, the presentation later in this chapter of the financial effects of increased longevity shows that very interesting differences between PAYG financing and premium reserve financing are, in fact, shown more clearly, rather than muted, when financial information on a PAYG pension scheme is presented in an income statement and a balance sheet.

Finally, the accounting developed for the Swedish NDC scheme may be of interest as an example of a legislated form of evaluation of the scheme’s capacity to finance the

accrued pension liability. This evaluation is done in terms of a measure at a given point in time of the ability of the contribution flow to finance—amortize—the pension liability. Traditional actuarial evaluations of public PAYG pension schemes do not follow this approach.⁸ They normally evaluate the scheme's capacity to finance both the current and the accrued future pension liability by projecting future flows of benefits and contributions. This aspect of the difference between the Swedish accounting method and a traditional approach, which should be evident from the presentation of the accounting items, will not be discussed in this chapter.⁹

A second aim of the chapter is to describe and discuss the policy responses to the negative effects of the financial and economic crises (beginning in 2008) on pension benefits and notional accounts, in combination with the effect of new rules for automatic balancing. Sweden is one of a few countries that have sought to maintain a fixed contribution rate by explicitly distributing all risks of adverse economic and demographic developments among all the insured, as opposed to many other pension schemes that are not explicit about when and how financial adjustments will be distributed.

The first experience of Sweden's new pension system with a serious economic recession could add to the store of knowledge on the practical functioning of such a system in times of adversity. Even here, the distribution of risk is not clear-cut. The guaranteed pension—a government-financed minimum benefit—shifts the burden of unfavorable economic developments from retirees with the lowest pensions to the government and the taxpayers.¹⁰ Also, a means-tested housing allowance financed through general revenues provides additional protection for low-income retirees.

The following two sections present the balance sheet and the income statement. The third section presents and discusses the policy responses to the negative impact of the recession on pension benefits, in combination with the accounting method and the rules for automatic balancing.

The financial accounts of the Swedish pension system are compiled in Swedish kronor. So that the reader can better understand the magnitudes involved, the data in the income statements and balance sheets are converted into percentages of gross domestic product (GDP). This transformation distorts the accounting information somewhat. For example, closing results brought forward will not equal opening results brought forward (of the following year) when expressed as a percentage of GDP, because the same amounts have been divided by the GDP for different years. Furthermore, in rounding to the closest 10th of a percentage point, some precision is lost. Annex 21A provides the income statements and balance sheets in Swedish kronor.

Development of Solvency: Balance Sheets for 2001–10

At the end of 2001,¹¹ the accrued pension liability was 212.4 percent of GDP.¹² It is calculated as a simple summation of the account values of all notional accounts as of December 31, 2001. The liability to retirees is calculated almost as simply, by multiplying the December payments by the estimated number of remaining times the amounts will be paid.¹³ To this nominal valuation of the liability is added the value of the old defined benefit system's (Allmän tilläggspension, or ATP) liability to active workers. This valuation is performed by actuarial projection. Beginning in 2018, ATP liability can no longer accrue; from that year on, all pension liability will thus be calculated without projection.

The pension liability in percentage of GDP, which over the period varies from 212 to 243 percent (table 21.1), is somewhat lower than the estimated public pension liability of many other Organisation for Economic Co-operation and Development (OECD) countries. This Swedish figure, however, cannot be directly compared to the pension liabilities of other countries that encompass more than earnings-related old-age pensions. Disability benefits, survivor benefits, and guaranteed minimum pensions are excluded in the Swedish accounting, because these benefits are not part of the inkomstpension but are financed separately, basically with general tax revenue. Another reason for the relatively low Swedish public pension liability by international standards is that the ceiling on pensionable earnings is low by comparison—only 110 percent of an average full-time worker's wage. Occupational pensions typically insure incomes above this ceiling. Finally, a contributing explanation is that the pension liability is building up in the financial defined contribution (FDC) premium pension scheme, which is not discussed in this chapter but is included in the Orange Report (Swedish Social Insurance Agency, various years).

The buffer fund holds assets equaling between 20 and 29 percent of GDP. The size of the buffer fund, as a share of the pension liability, is between 8.5 and 12.8 percent. Thus, only if contributions may be considered an asset of the system does the system have any chance to be in financial balance. Because the scheme is financed essentially on a PAYG basis, it is not subject to any legal or other requirement to hold assets to match liabilities. Therefore, it can finance pensions directly with contributions paid to the system. The distinguishing feature of a PAYG plan, relative to the premium reserve plan, is the right and ability to accumulate liabilities without holding corresponding assets. That feature implies that the flow of contributions represents an “asset” of PAYG systems. The size of this asset is defined by the amount of debt that the flow of contributions manages to finance continuously (i.e., to continuously amortize).

In the balance sheet, this asset is called the *contribution asset*. It is estimated by multiplying annual contributions by what is called *turnover duration*.¹⁴ The turnover duration is the time span, in years, between the contribution-weighted expected average age of contributors and the pension-weighted expected average age of retirees. Turnover duration thus reflects the expected period from the time when contributions are paid into the system to the time when the corresponding benefits are paid out—that is, the time span from when a liability is accrued by the pension scheme to when the same liability is amortized by that scheme. A rationale for this valuation of the contribution flow is that it shows the financially viable pension liability—the pension liability that contributions can amortize—in a steady state as determined by the accounting period. If the economic, demographic, and legal structure of the accounting period (measured by turnover duration) and volume (measured by contributions) were to persist, the contribution asset would exactly match the pension liability, with a zero buffer fund. In a PAYG scheme, the value of a contribution flow that perfectly amortizes a certain liability equals the value of that liability.

The steady state used for calculating the contribution asset will, of course, never materialize. Similarly, the asset prices as of December 31, used for valuing tangible, or at least tradable, assets of premium reserve schemes will not remain constant. Still, through continuous revaluation of assets and liabilities, both of these imperfect methods provide relevant information on solvency. The efficiency or usefulness of any accounting principle in valuing assets and liabilities depends in part on the volatility that the method will cause,

TABLE 21.1 **Balance sheets, December 31, 2001–10**

	Share of GDP (%)									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<i>Assets</i>										
Fund assets	24.1	19.9	22.7	24.3	27.8	28.7	28.7	22.1	26.8	27.1
Contribution asset	214.9	216.6	214.7	210.7	206.6	198.6	195.6	202.2	206.0	199.2
Total assets	239.0	236.5	237.4	235.0	234.4	227.2	224.4	224.2	232.7	226.3
<i>Liabilities and results brought forward</i>										
Opening results brought forward ^a	n.a.	7.3	2.0	2.2	0.3	0.9	3.2	0.6	-7.9	-9.8
Net income or loss for the year	n.a.	-5.2	0.2	-1.8	0.7	2.4	-2.6	-8.2	-2.6	12.9
Closing results brought forward ^a	7.6	2.1	2.3	0.3	1.0	3.3	0.6	-7.6	-10.4	3.1
Pension liability	231.3	234.4	235.1	234.6	233.4	223.9	223.8	231.8	243.2	223.2
Total liabilities and results brought forward	239.0	236.5	237.4	235.0	234.4	227.2	224.4	224.2	232.7	226.3

SOURCE: Swedish Social Insurance Agency.

NOTE: GDP = gross domestic product; n.a. = not applicable.

a. Closing results brought forward (end of year t) and opening results brought forward (beginning of year $t + 1$), in percentage of GDP, differ because the same amounts have been divided by different GDP values. In currency units, these accounting items are identical.

relative to the volatility caused by other accounting principles. Another important aspect is the objectivity and transparency of different methods.

Estimating the value of the contribution flow by multiplying it by the turnover duration is equivalent to discounting an assumed constant flow of contributions by the inverse of turnover duration. This discount rate has varied between 3.09 and 3.16 percent. (Discount rates for the period studied are shown later in table 21.4.) Because that rate is defined by the capacity of contribution flows to amortize pension debt, it can be regarded as the system's discount rate for contributions. The rate results from, and can be calculated objectively by, using only the interaction of pension system rules with economic and demographic conditions during the accounting period. The rate is interestingly close to 3 percent, a discount rate often used in long-term economic projections. As could be expected for this broad measure, it has had pleasantly low volatility. Indeed, without such low volatility, turnover duration would be unsuitable for use in the accounting and balancing of the inkomstpension.

At the end of 2001, the contribution asset was 214.9 percent of GDP (table 21.1). Since liabilities were 231.3 percent of GDP, the system would have been in solvency deficit had it not been for the buffer fund assets equal to 24.1 percent of GDP. With the funded assets included, total assets exceeded the pension liability by 7.6 percent of GDP—the *closing results brought forward*. The solvency ratio—that is, total assets over pension liability—was 1.0329, implying that total assets were 3.29 percent greater than liabilities. To distinguish the solvency measure for the PAYG scheme from the solvency measure for the premium reserve scheme, this ratio is termed the *balance ratio* in the legislation and accounting system. The main difference is that the solvency ratio indicates tangible assets over liabilities, whereas the balance ratio expresses the sum, in relation to liabilities, of the intangible contribution asset and tangible funded assets.

When active, the balance ratio is applied at the end of the year after the accounting period. Thus, the 2008 ratio was used in the indexation of accounts and benefits at the end of 2009, thereby affecting benefits paid in 2010.

Up to and including 2007, the pace at which assets and liabilities grew varied, with somewhat higher growth in liabilities than in assets. In 2008, the system's financial position substantially deteriorated: the net loss, equivalent to 8.6 percent of GDP, put the closing results brought forward into the red for the first time, creating a deficit corresponding to 7.6 percent of GDP. Any negative closing results brought forward cause the balance ratio to drop below unity and triggers the automatic balancing mechanism. The balance ratio of 0.9672 on December 31, 2008, was published in April 2009 (table 21.2). According to the original legislation, the balance ratio would have reduced the income indexation of notional pension accounts and pensions by 3.28 percent in 2009/10. However, parliament modified the legislation in the autumn of 2009, thereby increasing the balance ratio to 0.9826 and reducing the balancing effect to 1.74 percent. The decision is described later in this chapter.

In 2009, the system reported another loss. This loss was not as large as the one in 2008 but still equal to 2.6 percent of GDP, causing the negative closing results brought forward to deteriorate further, to 10.4 percent of GDP, and the deficit of assets over liabilities to reach 4.3 percent, for a balance ratio of 0.9570. The pension liability was 243 percent of GDP at the end of 2009, by far the highest during the period. The negative indexation of benefits and notional accounts in 2009 and 2010 forced this ratio down

TABLE 21.2 **Balance ratios, 2003–12**

	Accounting period									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Balance ratio for year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Balance ratio, original definition	1.0329	1.0090	1.0097	1.0014	1.0044	1.0149	1.0026	0.9672	(0.9570) ^a	(1.0140) ^a
Balance ratio, modified legislation	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.9826	0.9549	1.0024

SOURCE: Swedish Social Insurance Agency.

NOTE: n.a. = not applicable.

a. The balance ratio as calculated according to the original legislation for 2011 and 2012 does not reflect the different effects of the original definition on the accrued pension liability—including benefits and, thus, buffer fund assets—if the definition had remained unchanged. In the balance ratios in the table, the pension liability is assumed as given. Balance ratios would thus have been higher than indicated by the table in 2011 and 2012 had the original legislation not been modified.

significantly by the end of the period. Owing mainly to negative indexation of benefits and notional accounts in 2009 and 2010, assets exceeded liabilities once again at the end of 2010. The closing results brought forward for 2010 were a modest surplus of 3.1 percent of GDP. Relative to the pension liability, this surplus is equal to 0.24 percent, for a balance ratio of 1.0024.

When only the accrued pension liability is measured, comparing that liability with a measure of the contribution flow that will finance it at a given time is the essence of the Swedish actuarial accounting method. For better or worse, it dramatically shortens the time horizon and simplifies the task of providing information on the financial position of the PAYG pension scheme, as well as information on the reasons for changes in that position. Before this method was implemented, there was no means of estimating the sustainability of the accrued pension liability of PAYG pension schemes.

The income statements of the NDC scheme show the development of solvency between 2002 and 2010 (table 21.3).

Quantified Reasons for the Change in Financial Position: Income Statements

The reasons for the change in solvency are specified and quantified in the income statement of the NDC scheme, just as in any double-entry accounting. The income statement is divided into three sections: change in fund assets, change in contribution assets, and change in pension liability.

CHANGE IN FUND ASSETS

All pension contributions are paid and distributed monthly to the four buffer funds, known as *AP funds* (*allmänna pensionsfonder*),¹⁵ and all benefits are paid monthly from the funds. A quarter of contributions and benefits are paid to and from each fund. Contributions and benefits are 6 to 7 percent of GDP (table 21.3). That rate is somewhat low by international standards, for the same reasons that pension liabilities are relatively low.¹⁶

In the first seven years, there was a modest positive net cash flow to the AP funds (collectively referred to as the *buffer fund*). However, pension disbursements have grown faster than pension contributions and became higher in 2009. In the base scenario of the 75-year projection that the Swedish Social Insurance Agency is required by legislation to publish annually, net contributions will stay negative until about 2045.¹⁷ The development of net cash flow follows quite closely the projections made for the reformed pension in the mid-1990s. The cash flow deficit will be financed by the return on assets and capital in the buffer fund. The main reason for the decreasing net cash flow is the retirement of the baby-boom generation, which in Sweden encompasses individuals born in 1945 and some subsequent years.

In percentage of GDP, pension disbursements have been rather stable, averaging 6.3 percent of GDP, with a distinct increase to 7.0 percent in 2009. The jump is explained by the high indexation of benefits paid in 2009 and the recession that hit Sweden hard that same year. Total earnings decreased, and GDP fell by 5 percent, the sharpest decrease in a single year since the 1930s. The main reason for the high indexation of benefits at the

TABLE 21.3 **Income statements, 2002–10**

	Share of GDP (%)								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
<i>Change in fund assets</i>									
Pension contributions	6.6	6.5	6.4	6.5	6.1	6.1	6.3	6.6	6.2
Pension disbursements	-6.2	-6.1	-6.2	-6.1	-5.9	-5.9	-6.2	-7.0	-6.7
Return on funded capital	-3.5	3.2	2.4	4.1	2.8	1.2	-6.1	4.4	2.6
Administrative costs	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1
Total	-3.2	3.5	2.6	4.4	3.0	1.3	-6.0	3.9	2.1
<i>Change in contribution asset</i>									
Value of change in contribution revenue	7.1	6.3	5.3	5.9	7.9	6.2	12.3	-3.7	7.0
Value of change in turnover duration	3.0	0.5	0.0	-1.8	-0.4	-0.7	-1.0	0.0	-0.6
Total	10.1	6.8	5.3	4.1	7.5	5.5	11.3	-3.7	6.4
<i>Change in pension liability^a</i>									
New pension credits and ATP points	-6.9	-6.8	-9.2	-6.8	-6.4	-6.2	-6.8	-6.9	-6.5
Pension disbursements	6.2	6.1	6.1	6.1	5.9	5.9	6.2	7.0	6.7
Indexation or change in value	-11.3	-9.0	-6.1	-5.8	-6.5	-8.6	-12.0	-2.1	5.0
Value of change in life expectancy	-0.2	-0.4	-0.7	-1.3	-1.1	-0.6	-0.8	-0.7	-0.8
Inheritance gains arising	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3
Inheritance gains distributed	-0.3	-0.3	-0.3	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4
Deduction for administrative costs	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0
Total	-12.1	-10.0	-9.8	-7.9	-8.1	-9.4	-13.5	-2.7	4.4
Net income or loss for the year	-5.2	0.2	-1.8	0.7	2.4	-2.6	-8.2	-2.6	12.9

SOURCE: Swedish Social Insurance Agency.

NOTE: ATP = Allmän tilläggspension; GDP = gross domestic product.

a. A negative item increases the pension liability, and a positive item decreases it, by the amount shown.

end of 2008 was the high growth wages in the three-year moving average that is used for the income index.

Dividends on assets held by the fund are naturally paid to the fund and are included in the *return on funded capital*. Also included in that section are effects of changes in asset prices. Assets are valued at their quoted price on the last trading day of the year. With the volatility in asset prices, the return on funded capital has varied from -6.1 percent of

GDP in 2008 to 4.4 percent of GDP in 2009. The loss in 2008, expressed as a percentage of buffer fund capital, was 21.6 percent.

An important, but not the sole, reason for the loss incurred by the pension system in 2008, equivalent to 8.2 percent of GDP, was the sizable negative return on the buffer fund. The average annual capital-weighted return over the period up to the end of 2008 (the asset valuation date when the balancing mechanism was first triggered) was only 2.1 percent.¹⁸ This figure can be compared to the indexation of the pension liability, which grew by 3.4 percent, the average annual income increase during the same period. Because the buffer fund grew more slowly than the income index—which is used for indexing the accounts of the economically active and the pensions of retirees—solvency deteriorated, contributing to the deficit of the scheme. With the high return on the buffer fund in 2009 and 2010 (19.3 and 10.3 percent of assets, respectively), the capital-weighted annual average return for the nine-year period increased to 5 percent, higher than the indexation of the pension liability. Thus, for the full nine-year period, the buffer fund has contributed positively to the finances of the NDC scheme, but the contributions have varied significantly over the years.

The high variability in the return on the buffer fund reflects the volatility in the prices of the assets in which the four main AP funds have chosen to invest. Although the investment strategies of the funds differ somewhat, on average close to 60 percent has been invested in equities and 40 percent in bonds.

Administrative costs, including those of the buffer funds, are financed by withdrawals from the funds. These costs reduce the value of the funds by 0.1 percent of GDP, rounded to the closest decimal point. Most asset management fees are deducted from the return on capital and thus are not explicitly shown in the income statement.¹⁹

CHANGE IN CONTRIBUTION ASSET

In the income statement, the change in contribution asset is decomposed into *value of change in contribution revenue and value of change in turnover duration*.²⁰

The value of the change in contribution revenue is the monetary value, in terms of how much more (or less) liability can be financed by a higher (or lower) level of contributions relative to the preceding year. It is the monetary value of the pension scheme as expressed by per capita growth in value multiplied by the growth of the labor force.²¹ Because contributions increased every year until 2009, the value of change in contribution revenue is positive, peaking in 2008 at 12.3 percent of GDP. In 2009, contributions dropped, for a decrease of 3.7 percent of GDP. This decrease was the primary reason for the loss incurred by the pension system in 2009, a loss that worsened the solvency ratio even after the reduction of benefits and notional accounts by the balancing mechanism in 2010 and despite the high return on the buffer fund—3.9 percent of GDP—in 2009. However, the decrease in contribution revenue was only 0.2 percent in 2009; the much larger loss of 3.7 percent is explained by the annual smoothing of the contribution asset. The reason for the smoothing of the contribution asset is the smoothing of the income index, which has a significant negative impact on the volatility of the balance ratio, as will be discussed further later.

The value of the change in turnover duration has varied from 3.0 percent of GDP in 2002 to -1.8 percent in 2005. The large increase in 2002 is related to the phasing in of the legislation for the new system and, thus, is not representative. Low annual figures and

low volatility are expected for this indicator, whereas the accumulated effect of systematic trends will still be significant.

Turnover duration was 31.87 years in 2001 and 31.66 years in 2010 (see table 21.4). The marginally lower turnover duration represents a slight increase in the discount rate for the contribution flow, from 3.14 percent to 3.16 percent. The decreased turnover duration and increased discount rate have reduced the capacity of the contribution flow to finance the pension liability by less than 1 percent. This stability obscures the significant movements in the two contributor ages that define turnover duration: as both have changed in the same direction, leaving the time span between them largely unaltered. Table 21.4 illustrates that the pension-weighted expected average age of retirees has increased from 75.01 to 75.83, an increase in payout duration of 0.8 years, or 300 days, for an average increase of 33 days per year. This increase is close, but not identical, to the average yearly increase in life expectancy from age 65 on.

The contribution-weighted expected average age of contributors has increased from 43.14 years to 44.17 years, an average increase of 42 days per year over the nine years. This change represents a decrease in pay-in duration. The reasons for the negative tendency have not been fully investigated.²² The increased expected money-weighted average age of contributors has more than offset the increase in the corresponding expected average age of retirees. The net effect of the change in expected ages is a marginally reduced turnover duration.

The double-entry bookkeeping used not only provides information on the increased liability resulting from improved life expectancy, but also reveals the much less realized effect of increased life expectancy that is distinctive for PAYG pension schemes: a positive financial effect on the capacity of such schemes to finance the pension liability.²³ Increased life expectancy not only adds to the pension liability, but also changes the pension liability's structure—the time profile of payments—in a way that does not need to be fully financed in a PAYG pension system. The increased duration implies that the same flow of contributions can finance a larger pension liability.

The net effect of increases in life expectancy in a PAYG pension system is an increased pension liability minus the increased value of the contribution flow that results

TABLE 21.4 **Turnover duration or discount rate for valuing the flow of contributions, 2001–10**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Pension-weighted expected average age of retirees (A)	75.01	75.33	75.43	75.43	75.57	75.59	75.67	75.69	75.79	75.83
Contribution-weighted expected average age of contributors (B)	43.14	43.00	43.03	43.03	43.45	43.54	43.73	43.93	44.12	44.17
Turnover duration (A – B) (years)	31.87	32.33	32.4	32.4	32.12	32.05	31.94	31.76	31.67	31.66
Discount rate for contribution flow (1/turnover duration) (%)	3.14	3.09	3.09	3.09	3.11	3.12	3.13	3.15	3.16	3.16

SOURCE: Swedish Social Insurance Agency.

from higher turnover duration. Settergren and Mikula (2005, annex 7A, example 2) provide a simplified but detailed description of how cash flows, stocks of assets, and liabilities are affected by a change in mortality (see also Vidal-Meliá and Boado-Penas 2010).

Higher life expectancy has led to an average annual increase of 0.3 percent in turnover duration, assuming a fixed contribution-weighted expected average age of contributors.²⁴ That increase is the yearly average positive effect of life expectancy improvements on the contribution asset. In percentage of GDP, the contribution asset in 2010 is 5.2 percentage points higher than it would have been without the increase in life expectancy. This increase in the contribution asset has no equivalent in a premium reserve scheme. Thus, an increase in life expectancy is somewhat cheaper to finance. As a consequence, a smaller increase in contributions or in the retirement age, or a more limited reduction in pension benefits, is required in a PAYG pension system than in a fully funded system, assuming the same rate of return in both systems. The following section explains the increased liability that is also caused by the higher life expectancy and its net effect on the solvency of the scheme.

Annex 21B illustrates the different effects of life expectancy increases in premium reserve plans relative to PAYG schemes. In addition, it shows how the assessed value of the contribution flow correctly reflects the effects of increases in life expectancy on solvency. Ediev (2011) provides an economic demographer's explanation of the same fact.

CHANGE IN PENSION LIABILITY

The reasons for the change in pension liability are presented in seven items of the income statement (table 21.3).

The pension liability increases by 6 to 7 percent of GDP with the value of new pension credits and ATP points for the transition cohorts. Pension credits are accumulated in the notional accounts, whereas ATP points correspond to the estimated value of new pension credits earned in the defined benefit system that is being phased out.²⁵ As of 2018, when ATP points can no longer be earned, this accounting item will be close to identical to pension contributions. The equality between contributions paid and new pension credits is a defining characteristic of an NDC or DC scheme.

Because pension payments are an amortization of the pension liability, that liability is reduced by the amount of pension disbursements. The pension liability is increased by the value of indexation. *Indexation* refers to both the interest on the notional accounts and the indexation of benefits. When the ATP system is phased out in 2018, the value of indexation will depend solely on the change in the income index or, when balancing is in effect, the change in the balance index. During the phasing out of the ATP system, the value of indexation is also being affected by other factors and has varied greatly. In 2008, it produced an increase in pension liability equivalent to 12 percent of GDP, and in 2010, it reduced the pension liability by the equivalent of 5 percent of GDP. The reduction of the pension liability in 2010 is explained by the negative indexation in 2009 and 2010, which can be attributed to the adverse economic tendency and the balancing mechanism.

The pension liability is also increased by higher life expectancy. In the income statement, the effect of this relationship on liabilities is referred to as *value of change in life expectancy*. The NDC benefit is calculated by converting the insured individual's notional capital into an annuity. The annuity calculation uses fresh mortality data from the year before the insured turns 65 years old.²⁶ Improvements in life expectancy reduce actuarially

the future monthly benefit for those younger than age 65.²⁷ Therefore, the pension liability for active workers is unaffected by changes in mortality. Mortality changes affect the pension liability for only the pensions that have begun to be paid. However, during the phasing out of the defined benefit ATP plan, the ATP liability to active workers will increase when life expectancy increases.

Table 21.3 shows that the value of the change in life expectancy has varied annually between -0.2 percent of GDP and -1.3 percent. In 2010, the pension liability, in percentage of GDP, is 6 percentage points higher than it would have been without any increase in life expectancy. This increase in the pension liability is somewhat more than the increase in the contribution asset because of the higher life expectancy, equivalent to 5.2 percent of GDP, that was discussed in the previous section. However, if the defined benefit ATP system had been fully phased out, the increase of pension liability resulting from reduced mortality would have been less—4.5 percent of GDP—and the inkomstpension would have recorded a small net surplus from improvements in life expectancy.

The accounting clearly shows that the system design—with conversion of notional capital to a lifetime annuity based on experienced mortality and without any use of projections—almost perfectly insulates the solvency of the pension system from changes in mortality. It is perhaps surprising that such a design, in a period of increasing life expectancy, will constantly result in excessively high annuities. The explanation is that in a PAYG scheme, the full increase in the pension liability owing to greater life expectancy need not be financed. The increased turnover duration is a measure of the size of the increased pension liability that need not be financed. Annex 21B gives a simple explanation of this feature.

Owing to the rules of the inkomstpension system, the value of the increased turnover duration that results from increases in life expectancy is implicitly distributed entirely to retirees. The economically active receive none; instead, through a lower monthly annuity, they will sustain the full negative effect on their future pension benefit that results from the increase in life expectancy. Pensioners will receive the same monthly amount for a longer time than was expected when the annuity was calculated, without putting financial strain on the scheme. This reallocation of the benefits and costs of mortality improvements may be justifiable, because people of normal working age are in a better position than retirees to adapt to the effects of increased life expectancy. They can delay or save for their planned retirement or possibly lower their expectations of the monthly pension benefit that they will receive.

Here a clear policy implication emerges. From a financial stability perspective, a PAYG pension scheme can deal satisfactorily with the effects of life expectancy increases without projections of future mortality. If the policy is to stabilize or even to fix the contribution or tax rate in relation to the effect of life expectancy improvements, it needs only to adjust (reduce) the initial pension benefits or the retirement age for new cohorts reaching retirement age, according to increases in experienced mortality. An argument may be made, though less clear-cut, that such a policy is also socially appealing. The adjustment burden—accepting an increased retirement age or lower monthly benefits—is borne exclusively by the economically active, with a windfall gain to retirees.²⁸

As for the remaining accounting items in table 21.3, inheritance gains represent the notional capital of active insured individuals who died during the accounting period. Inheritance gains distributed represent the survivor bonuses distributed during the year.

The items amount to 0.3 to 0.4 percent of GDP. They do not offset each other perfectly.²⁹ Deductions for administrative costs are made from the notional accounts to finance administrative and certain buffer fund management costs. The deduction, 0.1 to 0.0 (rounded) percent of GDP, does not correspond exactly to the cash withdrawals from the funds accounted for in the item *administrative costs*. As an effect of rounding, the items appear to match better than they actually do.

Net income or loss for the year is the sum of the totals of the three sections. As in any double-entry accounting system, the net income or loss equals the difference between the change in assets and the change in liabilities. It has been volatile, ranging from -8.2 percent of GDP (2008) to 12.9 percent (2010). The volatility is largely a reflection of the variation in the indexation of the pension liability.

Policy Responses to the Economic Crises and the Effect on the NDC Scheme

The economic crises and their effect on the NDC scheme resulted in several policy responses, as outlined in the following subsections.

POLICY RESPONSES TO NEGATIVE INDEXATION OF THE INKOMSTPENSION IN 2010

At the outset of 2008, the solvency ratio was very close to unity, with the sum of the contribution asset and the buffer fund exceeding liabilities by 0.26 percent, a balance ratio of 1.0026, and a marginal surplus of 0.6 percent of GDP (see table 21.1). Record-high growth of 6.2 percent in the income index, attributable mainly to the healthy increase in nominal per capita wages during the years preceding 2009, increased liabilities substantially to 12.0 percent of GDP at the end of 2008. However, the contribution asset almost kept pace with the high indexation. Thus, the primary cause of the large net loss that year (-8.2 percent of GDP) was mainly a substantial fall in equity prices in 2008, resulting in a negative return equal to 6.1 percent of GDP. Because of the low initial solvency and the sizable loss, the scheme posted its first-ever negative closing results brought forward as of December 31, 2008: -7.6 percent of GDP. Liabilities exceeded assets by 3.28 percent, for a balance ratio of 0.9672, which would reduce income indexation—whatever that would turn out to be—by 3.28 percentage points in order to restore financial balance. The balance ratio to be applied in 2010 was published in the 2008 *Orange Report* in April 2009 (Swedish Social Insurance Agency 2008).

In light of the buffer fund losses, policy makers questioned the wisdom of allowing the value of the buffer fund at a single point in time—the last trading day every year—to affect the indexation of accounts and benefits. Alternative calculation methods, including the use of an average fund value during the year or over several years, had indeed been discussed in the bill proposing the legislation on the automatic balancing mechanism. In 2009, the government, supported by the Pensions Group,³⁰ proposed that the balance ratio be calculated from the average of the values on December 31 of the past three years. This change would lessen the indexation reduction from a single year's loss in buffer fund assets, with the one drawback that those reductions would continue for a longer period.

The change was enacted despite criticism from experts.³¹ Consequently, the balance ratio increased from 0.9672 to 0.9826, thereby reducing the balancing effect in 2010 from 3.28 to 1.74 percentage points (table 21.5). With an adjustment for an income index growth rate of only 0.3 percent in 2010 and with the advance rate of return of 1.6 percentage points already incorporated in the annuities, the final indexation of inkomstpension benefits was still –3.0 percent in 2010.³² Had the legislation not been changed, the indexation would have been –4.5 percent. Likewise, because the consumer price index fell by 0.8 percent, the indexation of the guaranteed pension was also nominally negative in 2010.

The second policy response was to reduce taxes for retirees age 65 and older. The purpose, however, was not only to deal with the negative indexation of the inkomstpension. Since 2006, workers had received tax reductions that elicited rather vivid criticism, mainly from retirees who demanded equal taxation of wages and pensions. The government did not officially cite the negative indexation to justify the tax reductions for retirees in 2010. The tax cut more than compensated those with the lowest NDC pensions—and consequently a large guaranteed pension—for the NDC pension reduction. Retirees with higher NDC pensions and little or no guaranteed pension suffered a loss in pension income net of taxes. Pension income after taxes decreased by approximately 1 percent for an average retiree, whereas the loss was greater for retirees with higher pensions.

The negative indexation of the inkomstpension reduced annual benefits by some SKr 6.0 billion, which in turn led to increased guaranteed pensions and housing allowances at an estimated cost of SKr 0.3 billion. The tax cut reduced annual tax revenue by an estimated SKr 3.5 billion.³³

POLICY RESPONSES TO CONTINUED NEGATIVE INDEXATION OF THE INKOMSTPENSION IN 2011

The 2008 financial crisis ushered in a recession that slowed earnings and employment growth through 2009. As described earlier, contributions to the pension system fell

TABLE 21.5 Annual change in key *inkomstpension* variables, 2005–12

	Annual change (%)							
	2005	2006	2007	2008	2009	2010	2011	2012
Buffer fund return	17.5	10.7	4.3	–21.6	19.3	10.3	n.a.	n.a.
Income index	2.4	2.7	3.2	4.5	6.2	0.3	1.9	4.9
Balance ratio effect	Balance ratio > 1, no effect					–1.7	–4.5	+0.24
Account indexation	n.a.	2.7	3.2	4.5	6.2	–1.4	–2.7	5.2
Benefit indexation	n.a.	1.1	1.6	2.8	4.5	–3.0	–4.3	3.5
Consumer price index (June–June)	n.a.	0.8	1.5	1.7	4.4	–0.9	0.9	2.8

SOURCE: Swedish Social Insurance Agency, various years.

NOTE: n.a. = not applicable.

0.2 percent. This development, coupled with the decision to smooth the value of the buffer fund (which in turn partially postponed the elimination of the deficit incurred in 2008), put further strain on the system's solvency. The shortfall of assets relative to liabilities at the end of 2009 increased from 7.6 percent to 10.4 percent of GDP, whereas the balance ratio by the new definition (0.9549) now showed a deficit of 4.5 percent of liabilities.

A large share of this substantial deficit is attributable to the three-year smoothing of the income index. When there is a shift from high growth in earnings to low growth—as between 2008 and 2009—the smoothing of the income index causes the pension liability to increase, while at the same time, the growth of the contribution flow—and thus the contribution asset—slows. The accounting correctly reflects that the liability has received a high indexation while the contribution asset has stopped growing. Thus, the intention to smooth income indexation accentuated the volatility of the scheme's solvency.³⁴ Because the solvency of the system may—through the balancing mechanism—affect indexation, this smoothing of the default indexation may increase the volatility of the secondary indexation. In February 2010, the Swedish Social Insurance Agency proposed that the government initiate an inquiry on how to reduce financial volatility (and thus benefit volatility) derived from the design of the income index. The agency also proposed a minor technical change in legislation to reduce the volatility of the balance ratio (Ehnsson et al. 2010). In June 2011, the government decided, with the support of the Pension Group, to commission the Swedish Social Insurance Agency to analyze that and some other calculation rules. The final section of this chapter returns to those issues.

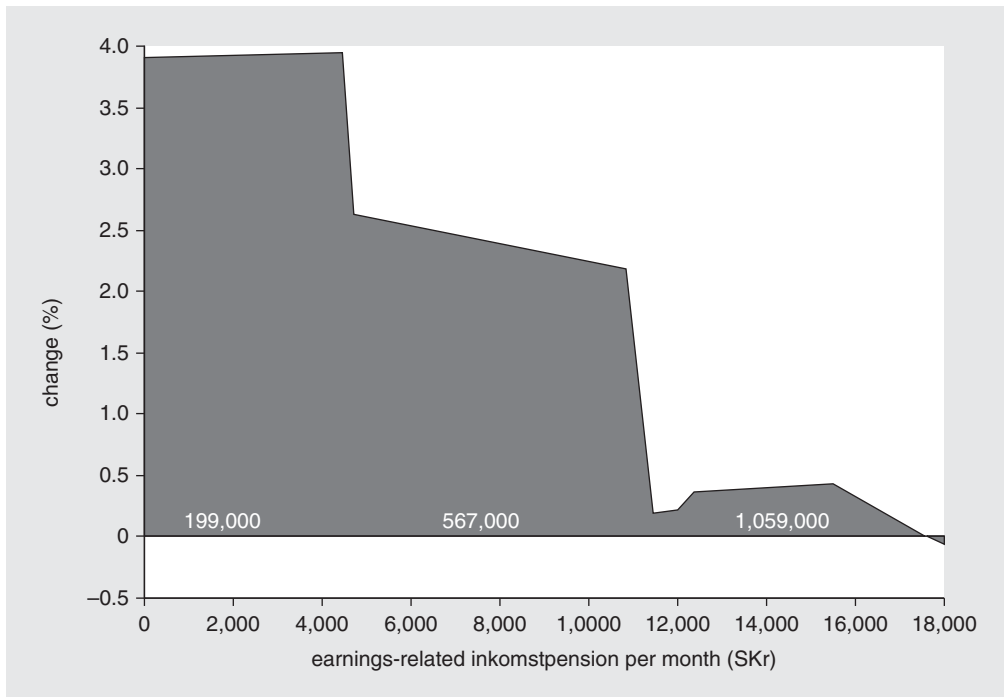
In late July 2010, the income index for the following year was finalized as an increase of 1.9 percent. With a balancing mechanism reduction of 4.5 percentage points, the account balances were indexed at -2.7 percent, while NDC pensions were indexed at -4.3 percent (-2.7 percent reduced by 1.6 percentage points). At the same time, guaranteed pension limits were increased by 0.9 percent, reflecting an equivalent increase in the consumer price index over the period from June 2009 to June 2010.

In September 2010, general elections were held in Sweden. Pensions were debated, however, the main focus was not the negative indexation but the continuing differential tax treatment of pensions relative to earnings. The parties in the government coalition as well as the opposition promised to reduce taxes for retirees. However, the government proposal entailed only a reduced difference, whereas the opposition proposed complete elimination of the difference in taxation in the long run. The coalition government remained in power after the election, but now as a minority government. The promised reduction of the tax differential was enacted after the election.

The tax reduction resulted in an increased net public pension for nearly all retirees, despite the 4.3 percent decrease in the pretax NDC pension (figure 21.1). As the guaranteed pension rose with the consumer price index increase (0.9 percent), the percentage increase net of tax was the highest for those for whom the guaranteed pension provided a large share of their total pension.

CRITICISM OF THE AUTOMATIC BALANCING MECHANISM

In Sweden, there has been little or no academic or other criticism of the assumptions used for evaluating assets and liabilities in the automatic balancing mechanism. Nor have the mechanics of the balancing mechanism been extensively debated. The most vocal

FIGURE 21.1 **Change in net *inkomstpension* after tax, 2011 relative to 2010**

SOURCE: Swedish Social Insurance Agency.

NOTE: The number of retirees in each income bracket is shown on the zero axis.

criticism comes from the former director general of the National Social Insurance Board, Karl Gustav Scherman. His principal view has been that the automatic financial balancing mechanism should be abolished and that the political process—and thus parliament—should again assume the responsibility for continuously monitoring the scheme's finances and benefit provisions. New opposition to several aspects of the public pension plan, not only the balancing mechanism, came from the major retiree organizations in March 2011. These organizations demanded extensive changes in the overall public pension system (PRO et al. 2011). One of several proposed changes was to abolish the automatic balancing mechanism. The Social Democratic Party, which remained in opposition after the 2010 general election, called for an analysis of ways to strengthen the finances of the NDC scheme. The government has agreed to do this.

However, neither Scherman nor the retiree organizations have explicitly criticized the accounting and the assumptions on which it is based, nor have they criticized the mechanics of the balancing mechanism. The lack of methodological criticism may be due more to the perceived complexity of the accounting and its assumptions than to acceptance of their appropriateness.

In contrast to the silence at home, there has been some international criticism. Auerbach and Lee (2009) analyzed the rules of the Swedish system and made some suggestions for improving them. Vidal-Meliá and Boado-Penas (2010) analyzed and compared the

contribution asset measure relative to an alternative method for valuation of the flow of contributions. They found that the contribution asset measure compares favorably to the alternative method. In “Improving Sweden’s Automatic Pension Adjustment Mechanism,” Barr and Diamond (2011) discuss aspects of the automatic balancing mechanism. They focus on the automatic balancing mechanism rather than the accounting rules that guide balancing. They argue that the automatic balancing mechanism could be given a design that would reduce volatility as well as improve the apportionment of the adjustment burden between retirees and workers. Barr and Diamond also criticize the level of the real rate of return used when notional pension capital is converted to a pension.³⁵

In the current recession, Sweden has found that smoothing the income index entails significant costs. In some scenarios, the three-year moving average used for the income index produces significant volatility in the financial position of the NDC pension plan. For that reason, the Swedish Social Insurance Agency proposed that the government investigate alternative ways to design the indexation.³⁶ The study, along with some other technical reviews, is under way.

Concluding Comment

The accounting method used in the Swedish inkomstpension system gives prompt and detailed information on relevant financial aspects of this national PAYG pension scheme (the 2010 income statement and balance sheet were published in February 2011). The accounting method, a new form of actuarial evaluation, presents the financial position of the system by comparing accrued pension liability with the value of the flow of contributions at a particular point in time that is estimated without projections. Another innovation is that a form of double-entry bookkeeping is applied to a PAYG pension plan, resulting in a unified balance sheet and an income statement resembling financial statements based on traditional accounting.

The accounting method has served relatively well as a means of communicating with policy makers and, through media, with the insured Swedish public. The net income or loss each year, as well as the surpluses and deficits brought forward, is reported annually, more or less in the same way as an insurance company. The ways in which Swedish media report on public pension issues and the issues raised in public debates have been changed by the introduction of double-entry bookkeeping. Long-term solvency issues have been given greater importance than before. Thus, the Swedish experience may be cited in support of claims that the significance of double-entry bookkeeping is not limited to its technical features but also extends to its rhetorical or pedagogical aspects (see Carruthers and Espeland 1991).

Although any conclusions from the first decade of this pension scheme are necessarily tentative, the financial and economic crisis clearly has had a significant negative impact on the NDC scheme—or rather on the insured covered by the system. Largely because of the delayed response to contribution flow changes in the income index, this impact has been transmitted through the balancing mechanism. Without smoothing, the negative impact of the crises would have been passed along to a much greater extent through the income index. The core policy response in the pension legislation has been to retain the basic rules of the system, in particular the automatic balancing mechanism, to ensure the financial stability of the pension scheme. The smoothing of the buffer fund value legislated in 2009 was a technical change rather than a change of principle. However, the fact that a change in

the rules was hastily legislated to accommodate an adverse development is arguably inconsistent with the rule-based ambitions for the NDC scheme.

In addition to the pension legislation, tax cuts have been enacted to limit the effect of the reductions in NDC pensions. The political pressure for tax reductions was due not only to the negative development of NDC pensions, but also to retiree demand for equal taxation of income from work and pensions. Even after the tax reductions, tax rates remain higher in 2011 for retirees than for workers, though the gap has been narrowed.

Because NDC benefit reductions have been partially offset by tax reductions, one can question whether the Swedish pension plan has withstood the test of coping with benefit reductions in a recession. Sorting out this issue is a complex task because the political pressure for tax reduction has also been generated by earlier tax deductions directed only at workers. If net benefit reductions—that is, reductions in gross benefit not offset by tax cuts—are not politically acceptable, then the financially stable pension system, which in years of positive earnings growth will increase the real value of benefits, will be a threat to sustainable government finances. The long-term net financial effects on consolidated government finances resulting from the negative balancing, the possible future increase in indexation, higher guaranteed pensions, and the tax reductions can be estimated only on the basis of assumptions—including the magnitude of tax reductions that would have been required had the balance mechanism not been triggered. To a large extent, these assumptions will be arbitrary.

Even considering the tax reductions, it is striking that the pension cutbacks were accepted, given the context: reductions of both real and nominal benefits at the start of an election year and a second real and nominal reduction announced during the election campaign. The seemingly strong political will and ability to adhere to the principles of the financially stable pension plan can probably be explained, first, by the broad-based political agreement on pensions in Sweden and the political capital invested in this consensus. Second, the existence and design of the guarantee, which protected the retirees with the lowest benefits, have been important for acceptance of the reduction in NDC pensions. Third, and more tentative, the logic of the NDC pension system and its accounting method, as well as the transparent presentation of all factors underlying the result, has probably contributed to political and public acceptance of benefit cutbacks. Obviously, the logic of the pension system and its accounting rules would not necessarily stand by themselves in adverse times. Nonetheless, political support can be gained more easily if there are hard and clear numbers that can help policy makers and voters understand economic realities.

Although benefit volatility is the obvious downside of a defined contribution pension plan, financial sustainability is the equally obvious upside. However, reducing (somewhat) the volatility of indexation without undermining the financial stability of the scheme is nevertheless feasible, if done in a manner consistent with the philosophy and accounting principles of the NDC system. In particular, it should be possible to shift the burden of adjustment from the balance ratio to the income index. Such improvements may be made after the analyses commissioned by the government and the Pensions Group have been completed in 2012. Nevertheless, even with such improvements, an automatic, financially stable pension system with a fixed contribution rate requires that benefits be reduced in adverse times unless sufficient resources are set aside to consolidate the pension scheme—that is, to accumulate and maintain a surplus in the system.³⁷ If benefits are not to be reduced, the government and taxpayers must subscribe to some sort

of guarantee. One reason Swedish legislators replaced the defined benefit scheme with an NDC scheme was that they realized that a sufficiently large-scale public pension plan cannot be insured—not even by a government—against unfavorable economic or demographic developments.³⁸ Acknowledging that fact, Swedish policy makers considered it preferable to distribute uninsurable risks, *ex ante* and transparently, among the insured as a collective. In a political context of high taxes, relatively high pensions, and substantial protection for low-income retirees, this approach still makes sense.

Annex 21A: Income Statements and Balance Sheets and Other Information in Swedish Kronor

The first year for which accounts were compiled was 2001. The quality of the income statement for that first year suffered from effects related to phasing in the new rules and phasing out the old ones. Quality that year also suffered from the lack of opening balances for balance sheet items and from inexperience in extracting information from the administrative records to perform the calculations. For those reasons, the income statement for 2001 is disregarded, although a corrected closing balance for 2001 is used, with a consequential correction of the income statement for 2002. The income statements and balance sheets through 2010 are shown in Swedish kronor in tables 21A.1 and 21A.2, respectively. Table 21A.3 shows the value of the change in life expectancy in Swedish kronor. Table 21A.4 gives the income index, and table 21A.5 shows the Swedish GDP.

Annex 21B: Example of Difference between Premium Reserve and Pay-as-You-Go Pension Schemes in Regard to the Financial Impact of Increases in Life Expectancy

A three-age overlapping generation model is used to illustrate the difference in the financial impact of changes in mortality in a premium reserve pension scheme and in a pay-as-you-go pension scheme. To demonstrate the effects of changes in mortality, the model is extended from three to four ages.

In the example, the life of an individual is divided into three (four) periods of equal length. All individuals work for exactly two periods, at ages 1 and 2, and all are retired for the entire third (and fourth) period, age 3 (and 4). All are born on the first day of each period; all birth cohorts are of equal size; and there is no fertility-driven population growth, no migration, and no preretirement mortality. There is no technological progress, and growth in income and return on capital are zero. Under those assumptions, the contribution base for the pension system is constant. All financial transactions are made at the end of each period.

Wages are 48 for each cohort of working age, for a contribution base of 96. The contribution rate is set at 25 percent. Thus, the prefunded, or notional, account of a cohort at the end of age 1 will be 12 and at the end of age 2 will be 24. Because retirees before the increase in longevity die after having received their pension at age 3, no pension liability applies to retirees before the change in mortality.

Because the retirement period is only 1, the pension benefit—the financially balanced annuity—will be 24, for a replacement rate of 50 percent. Pensions and contributions will be 24 in both the premium reserve and PAYG pension schemes.

TABLE 21A.1 **Income statements, 2002–10**

	Amount (SKr billions)								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
<i>Change in fund assets</i>									
Pension contributions	161	165	172	180	184	190	203	203	205
Pension disbursements	-152	-155	-165	-169	-176	-186	-199	-217	-220
Return on funded capital	-85	82	65	115	83	38	-194	136	85
Administrative costs	-2	-2	-3	-2	-2	-2	-1	-2	-2
Total	-78	89	69	123	89	41	-191	120	68
<i>Change in contribution asset</i>									
Value of change in contribution revenue	174	160	142	163	237	193	395	-115	232
Value of change in turnover duration	74	12	0	-49	-13	-22	-33	-1	-19
Total	247	172	142	114	224	171	361	-115	213
<i>Change in pension liability^a</i>									
New pension credits and ATP points	-168	-173	-245	-190	-191	-194	-218	-214	-215
Pension disbursements	152	155	163	169	176	186	199	217	220
Indexation or change in value	-276	-228	-162	-162	-194	-268	-385	-64	165
Value of change in life expectancy	-6	-11	-18	-37	-33	-17	-27	-23	-25
Inheritance gains arising	6	7	8	9	9	10	11	11	11
Inheritance gains distributed	-7	-8	-8	-9	-10	-11	-12	-13	-13
Deduction for administrative costs	1	1	2	2	1	2	1	1	1
Total	-297	-256	-260	-217	-242	-293	-431	-84	145
Net income or loss for the year	-127	6	-49	20	71	-82	-261	-79	425

SOURCE: Swedish Social Insurance Agency, various years.

NOTE: ATP = Allmän tilläggspension.

a. A negative item increases the pension liability, and a positive item decreases it, by the amount shown.

The total pension liability in both the premium reserve scheme and the NDC PAYG scheme will be constant at 36, of which 12 applies to cohort age 1 and 24 to cohort age 2. The premium reserve scheme will have tangible assets of 36. The NDC scheme will have zero tangible assets.

TABLE 21A.2 **Balance sheets, December 31, 2001–10**

	Amount (SKr billions)									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<i>Assets</i>										
Fund assets	565	488	577	646	769	858	898	707	827	895
Contribution asset	5,046	5,293	5,465	5,607	5,721	5,945	6,116	6,477	6,362	6,575
Total assets	5,611	5,780	6,042	6,253	6,490	6,803	7,014	7,184	7,189	7,469
<i>Liabilities and results brought forward</i>										
Opening results brought forward	n.a.	179	52	58	9	28	100	18	-243	-323
Net income or loss for the year	n.a.	-127	6	-49	20	71	-82	-261	-79	425
Closing results brought forward	179	52	58	9	28	100	18	-243	-323	103
Pension liability	5,432	5,729	5,984	6,244	6,461	6,703	6,996	7,428	7,512	7,367
Total liabilities and results brought forward	5,611	5,780	6,042	6,253	6,490	6,803	7,014	7,184	7,189	7,469

SOURCE: Swedish Social Insurance Agency, various years.

NOTE: n.a. = not applicable.

TABLE 21A.3 **Value of change in life expectancy, decomposed for different parts of the liability, 2002–10**

	Amount (SKr billions)									
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2002–10
ATP, active (DB)	0	-3	-6	-12	-11	-5	-7	-5	-4	-53
ATP, retired ^a	-6	-8	-11	-23	-19	-11	-17	-15	-17	-127
Inkomstpension, active (NDC)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0
Inkomstpension, retired (NDC)	0	0	0	-1	-2	-2	-3	-3	-5	-16
Total	-6	-11	-18	-37	-33	-17	-27	-23	-25	-197

SOURCE: Swedish Social Insurance Agency, various years.

NOTE: ATP = Allmän tilläggspension; DB = defined benefit; n.a. = not applicable; NDC = notional defined contribution.

a. The initial ATP benefit is calculated according to the ATP defined benefit rules, but benefits after age 65 are indexed by the rules of the new system, including provisions for balancing. Thus, the liability to ATP retirees has NDC properties, and in the estimation of the true NDC liabilities, actuarial projections are not used.

TABLE 21A.4 **Income index, 2001–12**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Income index	103.20	106.16	111.79	115.64	118.41	121.65	125.57	131.18	139.26	139.74	142.34	149.32
Change (%)	n.a.	2.87	5.30	3.44	2.40	2.74	3.22	4.47	6.16	0.3	1.9	4.9

SOURCE: Swedish Social Insurance Agency, various years.

NOTE: n.a. = not applicable.

TABLE 21A.5 **Swedish GDP, 2001–10**

	Amount (SKr billions)									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GDP	2,348	2,444	2,545	2,661	2,769	2,994	3,126	3,204	3,089	3,301

SOURCE: Data from Swedish National Institute of Economic Research.

NOTE: GDP = gross domestic product.

The contribution asset of the PAYG scheme is calculated as turnover duration multiplied by the flow of contributions. The expected money-weighted average age of contributors is 1.5, and the expected money-weighted average age of retirees is 3, for a turnover duration of 1.5 periods. Thus, the contribution asset of the PAYG plan will be 36 (24×1.5). (Because the economy and demographic factors in the example are in a steady state, *expected* money-weighted average ages are equal to *actual* average ages.³⁹)

The solvency ratio of the premium reserve plan is 100 percent. The balance ratio of the PAYG pension plan is 1.00.

Assume that pension plan operators have perfect advance knowledge of mortality. When members of the first birth cohort who will double their life expectancy as retirees are about to retire, the longer life expectancy is known, and the annuity is calculated for a life span of two periods.

In both the premium reserve and NDC schemes, pension payments will drop to 12 when the cohort with a prolonged life span retires. In the subsequent period, pension payments will be back at 24, now with a payment of 12 to each of the two retired cohorts.

The pension liability in both schemes will increase to 48, because there will now be an additional pension liability of 12 to the retired cohort that has one more payment to receive—the pension to be paid out at age 4. The changed—prolonged—payment schedule has increased the pension liability, whereas pension payments in the new steady state will be back at the original level of 24.

As pension payments for one period drop from 24 to 12—while contributions remain at 24—the premium reserve will grow from 36 to 48, matching perfectly the new, higher pension liability in that scheme. The solvency ratio is 100 percent throughout the change.

The PAYG scheme also will have an accumulation of tangible assets as the buffer fund grows from 0 to 12. Contributions will again perfectly match pension payments after one period when there are two birth cohorts, each receiving a pension of 12, and total benefit payments will be back at 24. A PAYG pension plan is distinguished by the lack of any requirement to hold prefunded assets to back its pension liability. Because the assets of 12 in the buffer fund will remain there as long as the new steady state prevails, the PAYG pension plan will now record a surplus. How large is that surplus? The longer life expectancy has raised the expected average age of retirees from 3.0 to 3.5, thereby increasing turnover duration by 0.5 and thus increasing the contribution asset from 36 to 48. The new contribution asset matches the new pension liability—logically, because contributions and pension benefits match perfectly. However, the buffer fund of 12 represents a surplus, relative to the original pension liability of one-third (12/36), equal to the relative increase in turnover duration. Relative to the new pension liability of 48, the surplus is one-fourth, for a balance ratio of 1.25.

The increased life expectancy caused the same increase in the pension liability in the premium reserve scheme as in the NDC PAYG pension scheme. The slower amortization of the liability increased prefunded assets in line with the increased liability. The same slowdown in liability amortization in the PAYG pension scheme resulted in the same accumulation of assets. Because prefunding to finance the pension liability is unnecessary in this case, it represents a positive return in that scheme (however, there are cases where buffer fund assets are required to finance the pension liability).

In the PAYG scheme, the existence of this return on contributions from the increase in life expectancy is *not* related to an assumption of perfect foresight, nor to the design of the pension plan as an NDC scheme. This return will always exist in any PAYG pension plan when there are changes that prolong the period of disbursement, thus changing the structure of the pension liability so that it increases. The solvency effect of higher life expectancy depends, however, on whether, how, and when the pension plan adjusts benefits according to changes in life expectancy. If benefits are adjusted downward more slowly or not at all, the increase in the pension liability will be greater, and the effect on the buffer fund, relative to the case with perfect foresight of mortality changes, will be negative. If the adjustment is slow enough or nonexistent, the effect of increased life expectancy will exceed the increase in the contribution asset that such change also entails. In such cases, the solvency of both the premium reserve pension plan and the PAYG pension plan will decrease. If the same adjustment of benefits applies in both types of schemes—and if the assumed returns are equal—the pension liabilities of both schemes will increase by exactly the same amount. However, the net effect on solvency will always be less in the PAYG pension scheme, by a magnitude equal to the positive effect of longer turnover duration.

Thus, increases in life expectancy are cheaper to finance in PAYG pension schemes than in premium reserve pension plans. Cheaper financing implies lower increases in the contribution rate, less of an increase in the retirement age, or a more limited reduction of monthly benefits. This conclusion is valid assuming that the return on contributions in PAYG pensions schemes is the same as in premium reserve pension plans. In some other circumstances, the peculiarities of PAYG financing are disadvantageous relative to premium reserve financing. For example, delayed entry to the labor market will entail financial strain—a negative return—for PAYG pension schemes. That return can be measured with equal precision by turnover duration. No such effect exists in a premium reserve plan.

Notes

The author would like to thank Edward Palmer for his strong encouragement and support to bring this paper to life.

1. Detailed principles, including some legislation, for the new pension scheme were adopted in 1994. The principal legislation was enacted by parliament in 1998.
2. For a definition of automatic financial balance, see chapter 23 of this volume by Boado-Penas and Vidal-Meliá.
3. The old defined benefit scheme, ATP (Allmän tilläggspension), is being phased out over a period ending in 2017. Until then, the accounting will use projections for the accrued ATP liability for active workers. As of December 31, 2010, this liability represented 7 percent of the total pension liability.
4. The *automatic balancing mechanism* is defined by Vidal-Meliá, Boado-Penas, and Settergren (2010) as a set of predetermined measures established by law to be applied immediately as required according to the solvency indicator. Its purpose, through successive application, is to provide what could be called *automatic financial stability*, which can be defined as the capacity of a pension system to adapt to financial turbulence without legislative intervention.
5. For a theoretical explanation of the accounting method, see Settergren and Mikula (2005); Boado-Penas, Valdés-Prieto, and Vidal-Meliá (2008); and Vidal-Meliá, Boado-Penas, and Settergren (2009, 2010). See also chapter 23 of this volume.
6. See, for example, Disney (2001) and Holzmann, Palacios, and Zviniene (2004), and for a critical assessment, see Franco, Marino, and Zotteri (2004); Takayama (2004); and Vidal-Meliá and Boado-Penas (2010).
7. The other method is to project and compare future flows of contributions, benefits, and buffer fund size. Such projections of payments can be discounted to stocks of assets and liabilities. Normally, such actuarial evaluations lack an income statement that explains quantitatively the reasons for a change in financial position from the last projection. Although the annual actuarial evaluations of the U.S. Social Security Administration (2011, 72) do provide such information, it is not in the format of an income statement.
8. See, for example, the annual actuarial evaluations published by the U.S. Social Security Administration (2011).
9. See Settergren (2007) for a discussion on how the Swedish accounting method relates to more traditional actuarial evaluations.
10. Of all retirees, 42 percent receive some guaranteed pension. Roughly a third of them will be completely insulated from the effects, positive or negative, of the indexation of their NDC pensions. For the remaining two-thirds receiving guaranteed pensions, the benefits will be increased (reduced) by 52 percent of any reduction (increase) in their NDC pension.
11. The first year for which accounts were compiled was 2001. The quality of the income statement for that first year suffered from effects related to the phasing in of the new rules and phasing out of the old ones. Quality that year was also adversely affected by the lack of opening balances for balance sheet items and the inexperience of those extracting information from administrative records to perform the calculations. For these reasons, the income statement for 2001 will be disregarded, but a corrected closing balance for 2001 is used.
12. The pension liability estimate for a closed group need not consider only *accrued* obligations. Often, closed-group pension liability estimates include both currently accrued and future

accrued pension credits of insured persons in the closed group. The accrued pension liability in the Swedish accounting system includes only the liability accrued until the last day of the accounting period.

13. The calculation of the pension liability to retirees also takes into account the fact that indexation of benefits will include a 1.6 percent reduction of the change-in-income index. The reason for the reduction is that the annuity is calculated at an interest rate of 1.6 percent.
14. To reduce volatility in the ratio of the contribution asset to the pension liability, contributions are smoothed in a way similar to the smoothing used for the income index. Also to reduce volatility, the turnover duration used is the moving median of three years' turnover duration. For information on the smoothing methods used for the income index and the contribution asset, see the 2008 *Orange Report* (Swedish Social Insurance Agency 2008, 78, 85).
15. These are the First AP Fund, Second AP Fund, Third AP Fund, and Fourth AP Fund. There is a fifth fund, which is small, receives no contributions, and pays no pensions. Oddly, it is designated the Sixth AP Fund.
16. The contribution to the fully funded premium pension, close to 1 percent of GDP, is not included, nor are contributions or taxes that finance disability benefits, the guaranteed pension, or survivor benefits. Furthermore, the ceiling for pensionable income in the public pension system (NDC and FDC) is relatively low, partly explaining why a significant share of pensions in Sweden is provided by quasi-mandatory occupational pensions. Contributions to occupational pensions are in the range of 3 to 4 percent of GDP, and occupational pension payments are close to 2 percent of GDP.
17. The demographic, economic, and other assumptions for the long-term projections are described in the *Orange Report* (Swedish Social Insurance Agency, various years).
18. The average increase in consumer prices over the same period was 1.5 percent.
19. The *Orange Report* has a section titled "Costs of the Old-Age Pension System," which provides more detailed cost information, including, for example, information on asset management fees (Swedish Social Insurance Agency, various years).
20. If C denotes contributions and TD turnover duration, and t is year, the value of change in contribution revenue for a given year = $[C(t) - C(t - 1)] \times [TD(t) + TD(t - 1)]/2$ and the value of change in turnover duration for a give year = $[TD(t) - TD(t - 1)] \times [C(t) + C(t - 1)]/2$.
21. For a classic early reference see Samuelson (1958).
22. The ages of entry into the labor force appear to have increased slightly, and relative wages of younger workers seem to have decreased. This situation could be explained, at least partially, by increased immigration to Sweden. Adult immigrants may push up the average age of entry into the labor force, thereby decreasing turnover duration. Nevertheless, the positive effect of immigration on contributions should be greater than its potential negative impact on turnover duration.
23. Andrews (2008) and Robalino and Bodor (2009) have claimed that turnover duration must be flawed as a measure for the value of the contribution flow because greater longevity will also increase turnover duration and thus the contribution asset. The effect of increased life expectancy on solvency, through both assets and liabilities, in a pay-as-you-go pension scheme is perhaps counterintuitive. One reason the effect is difficult to understand may be that most analysts—who are used to dealing with assets and liabilities—have had their training and experience with premium reserve plans. In such schemes, increased life expectancy has a different effect on solvency.
24. For the period from 1981 to 2003, Settergren and Mikula (2005) report an average increase of 0.4 percent per year in turnover duration, but they attribute virtually all of that increase to increased life expectancy.

25. The value of new ATP points has been significant until very recently. From now on, the value of new ATP points will be insignificant, and after 2017, no ATP points can be earned.
26. The data are measured annually as a five-year moving average of experienced mortality.
27. The projected negative impact on pensions of younger cohorts is presented in the 2010 *Orange Report* (Swedish Social Insurance Agency 2010, 30). It is the monthly amount—not the sum of pension payments—that will be lower for younger cohorts if they retire, voluntarily or not, at a fixed age when life expectancy is increasing.
28. To be present, this windfall gain needs younger people to discount the benefit payments at the same rate as the rate of indexation of benefits or at a lower rate. With a higher discount rate, increased life expectancy will make younger people economically worse off.
29. Different NDC pension plans deal differently with inheritance gains. Vidal-Meliá and Boado-Penas (2010) analyze whether a survivorship dividend (inheritance gains) should be included as an extra return in the notional rate used in the accounting of NDC systems or whether it should be dealt with by other means.
30. The Pensions Group is the permanent committee that consists of members of parliament who represent the five parties originally supporting the pension reform. The committee is thus backed by some 85 percent of the members of parliament. It is chaired by the minister of social insurance and entrusted with the task of managing the pension reform agreement.
31. A majority of the institutions asked to comment on the proposal criticized the change. The change results in other drawbacks aside from the risk of longer periods of reduced indexation. For example, a longer period of adjustment increases the probability of good income growth for workers at the same time as it reduces growth of NDC benefits. An additional argument against the proposed and subsequently legislated change was that alternative, more efficient smoothing mechanisms were available.
32. It is somewhat misleading to say “minus” 3.0 percent because indexation is calculated as $[\text{income}/\text{balance index}(t) / \text{Income}/\text{balance index}(t - 1)] / 1.016$.
33. The figures are outlined in a Ministry of Finance memorandum issued on September 15, 2009.
34. In an attempt to synchronize the contribution asset estimate with the indexation of liabilities, the accounting method also smoothed the contribution flow over a three-year period. The result is not entirely convincing.
35. For a comment on Barr and Diamond (2011), see Settergren (2011).
36. The proposal was made in a memorandum dated February 26, 2010.
37. The inkomstpension scheme accumulates surpluses when the system has a positive net income and balancing is not activated.
38. The introduction of the FDC scheme was motivated partly by other reasons.
39. Turnover duration is an expected measure in the same sense as life expectancy is an expected measure. Life expectancy will coincide with the actual average age of deceased persons only in a case in which birth cohorts are of equal size and mortality at each age has been constant from the time the oldest living cohort was born.

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CHAPTER 21

COMMENT

Jukka Lassila

The aspect I like most about the Swedish nonfinancial (notional) defined contribution (NDC) system is that postponing corrective measures becomes very difficult once financial troubles have been observed and acknowledged. Postponement would require a new reform. From my Finnish viewpoint, this situation is enviable. The Finnish earnings-related pension system—our main source of old-age income—habitually postpones measures, and when they are approved, they are too small. Fiscal sustainability of pensions is the worry in Finland and in most other European countries, but less so in Sweden.

Ole Settergren describes in detail the Swedish NDC's accounting system, the fiscal problem diagnosed by the system at the end of 2008, and the remedy that the automatic adjustment rules prescribed. He also gives the main elements of the political debate and the resulting decision to change some of the rules and to reduce taxes on pensions to partly compensate for the decline in benefits. This chapter is an informative assessment of an original and innovative system. It is especially valuable for anyone searching for good mechanisms to keep less than fully funded pension systems on sustainable paths. The chapter shows that the automatic balancing mechanism flagged a problem of solvency because of the decline in the market value of the buffer fund. As a result, the indexation factor for account balances and pensions had to become negative. The system passed a heavy political test: the remedy was swallowed even though it tasted very bad. But the chapter raises questions about whether the cut in benefits was needed or whether it could have been avoided with under different rules that would reduce the volatility of the indexation factor.

The Swedish diagnostic test relies on observed and recorded events. The obvious alternative is to perform assessments of the future development of the system. This alternative was explicitly ruled out in Sweden. Interestingly, Canada—the other country where postponing decisions has been made difficult—relies entirely on projections.

In the Canada Pension Plan (CPP), the Office of the Chief Actuary makes a triennial evaluation of the financial future of the system.¹ The results include projections of the income, expenditures, and assets of the CPP over the next 75 years. If the actuarial report projects that the scheduled (legislated) contribution rate is insufficient for long-term sustainability and the federal and provincial ministers of finance cannot reach an agreement on the solution to restore sustainability, the CPP's insufficient rate provisions would apply. The contribution rate would then be increased by half of the gap over three years, and the inflation adjustments to benefits in pay would be temporarily frozen. At the end of three years, a new review would be performed. Thus, the marching order is different from that in Sweden: in Canada the automatic rules step in only after the politicians have opted not to make some other decisions that would deal with the problem. But in both countries, rules are triggered if a financial problem is observed.

Unlike in Sweden, Canadian authorities can judge the implications of asset market shocks that affect the sustainability of the pension system. However, they must worry that

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a true fiscal problem might not be acknowledged in time because it is hidden behind too optimistic assumptions. To avoid this potential error, an independent panel of actuaries reviews the chief actuary's evaluation, and the results of the review are published.² The members of the latest independent panel were Canadians, but they were chosen by a foreign authority, the United Kingdom's chief actuary, who later also evaluated the work of the independent panel. Thus the supervisor's work is supervised by a body whose work is also evaluated. This approach may not be foolproof, but it certainly makes it more risky for the supervisor to be intentionally optimistic.

When the balance ratio was reduced, Swedish pensions were cut. One can understand and sympathize with the outcome. Sweden has invested a lot in explaining its pension system to its citizens, and Settergren rightly acknowledges the importance of the rhetorical and pedagogical issues involved. The credibility of Sweden's system would have been seriously compromised if the brake had not been applied. But experience has made clear that the NDC rules themselves are the reason negative asset returns led to the tough political test. The Canadian system, whose assets are both higher in relation to pension liabilities and invested in a riskier portfolio than those in Sweden, went on as before despite the shock. In the CPP's forward-looking approach, the assumption of a long-term real rate of return of 4 percent might sound less realistic than before, but it remains a matter of opinion. The CPP's two most recent reviews started at the end of 2006 and 2009, so they happened to avoid the worst times in equity markets. The next review will start at the end of 2012.

The Finnish earnings-related pension system is, in many respects, similar to the Swedish one. We have significant funds, but the system is still mostly pay-as-you-go, and longevity adjustments of pension benefits—an idea we copied from Sweden—are in operation. Recent low asset yields have led to discussions as to whether something should be done for the pension system. Under the CPP-type adjustment system, we would have done something many years ago—namely, we would have increased contributions or cut benefits. Had that balancing happened, we would now be able to do what the Canadians are doing: nothing. Had we opted for an automatically stabilizing NDC, the detailed rules would have determined if any brake would be triggered. But we opted instead to postpone decisions that would remedy the financial sustainability problems. Both Canadians and Swedes have made better choices. Settergren's article, though, has made me favor the Canadian approach.

Notes

1. See Office of the Chief Actuary (2010) for an example of an actuarial report.
2. See Andrews, Brown, and McGillivray (2011) for an example of such a report.

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Annuities and Life Expectancy in NDC

Juha Alho, Jorge Bravo, and Edward Palmer

What distinguishes nonfinancial (notional) defined contribution (NDC) from other pay-as-you-go schemes is that it offers the promise of intergenerational fairness. Every individual in every generation pays the same percentage of lifetime earnings into the universal system. What individuals get out of the system depends on the amount noted on their account and the life expectancy of their cohort at retirement. The balance on the NDC account at retirement constitutes the retiree's claim on future income. In the standard model, this claim is converted into a stream of payments over the individual's whole life—that is, a life annuity—using a projection of life expectancy at retirement. To attain the NDC promise of intergenerational fairness, the aggregate of lifetime payments to a birth cohort should equal the value of the cohort's account balances at retirement, discounted with the internal rate of return. Ideally, each cohort pays for itself, and the aggregate of account balances is just enough to cover the *idiosyncratic risk*—that is, the fact that some individuals will live fewer years than their life expectancy and some will live more.

Of course, the longevity of a cohort can be known only *ex post*, and counting on a life expectancy projection made at the time of retirement to coincide with the actual outcome is a tall order. Instead, when the books are closed at the end of the day, an aggregate cohort surplus or deficit will exist. If the difference between the projected and actual values of life expectancy is random over a longer period of time, the expected value of the surplus or deficit is zero. For a given estimate of life expectancy used to compute annuities, a risk exists that all the members of the cohort together will outlive their combined means—that is, the cohort's combined capital at retirement. This type of risk is known as a *systematic risk*.

The historical track record shows that the error has been made in the direction of systematically underestimating life expectancy for well over half a century. This problem brings two issues to the table. The first is to identify the source of this systematic error and then determine how to minimize it. A pension system is a social construction and should not be designed solely on the hope that the model used to project mortality and life expectancy will provide an estimate that agrees with the outcome. System design should contain a clear rule for risk distribution. Broader questions are as follows: Who should

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bear the risk? Should the cost of the residual systematic longevity risk be borne solely by pensioners, through some form of successive adjustment of their annuities? If so, what should the annuity model that generates this outcome look like, and what are the results of using such a model for the lifetime welfare of older pensioners? Alternatively, because NDC is a mandatory public scheme, should the government (general taxpayers) instead bear the risk? This chapter focuses on these questions.

Countries with long, ostensibly accurate historical data series can use statistical time series modeling of mortality to project life expectancy. Presently, one of the most widely used models is that developed by Lee and Carter (1992) or one of its many derivatives (e.g., Lee and Miller 2001; Booth, Maindonald, and Smith 2002; De Jong and Tickle 2006; Haberman and Renshaw 2006; Girosi and King 2007; Dowd, Blake, and Cairns 2010). The large genre of Lee-Carter models consists of two components: one captures the overall trend in population mortality, and the other distributes this trend by age, giving higher weights to ages where mortality change is greater during the estimation period. The appeal of the model is its relative simplicity.

This chapter examines how the Lee-Carter model and some simple variants of the model perform in providing country projections, in conjunction with the observed phenomenon of accelerating mortality improvement for the older population. The chapter provides new evidence on why the standard models do not perform satisfactorily and discusses what might be done to improve their performance. The chapter's most important finding is that the cause of error arising from the present time series modeling of mortality is generated by periods with accelerating improvement in mortality, which is and will continue to be typical for the age groups constituting the pool of pensioners. The chapter examines how different ways of modeling the process may help.

The next step is to examine models for distributing the residual systematic error. This chapter begins by examining models presented in the recent literature on financial annuities and evaluating the outcome for the welfare of annuitants of a class of annuity models that distributes residual systematic risk within the insurance pool as the cohort ages. The models proposed in the literature are all variable annuity models that pass the cost of outcomes that diverge from projections on to the survivors in a cohort—that is, successively older pensioners. The outcomes of using variable annuities of the sort proposed in the literature are examined using the relatively long time series data available for the Scandinavian countries. This chapter's key finding substantiates what one would expect. Models that distribute the systematic error in life expectancy to survivors in an insurance pool as it becomes known decrease the welfare of older pensioners. This finding suggests that a government implementing a mandatory NDC pension scheme should think carefully about annuity design and the associated distributional implications.

The outline of the chapter is as follows. This next section provides a background for the discussion. The section that follows discusses analytical aspects of mortality change and life expectancy, and the section after that provides some analysis of the capacity of current state-of-the-art modeling to provide mortality and life expectancy projections that do not lead to substantial losses for the insurer. The penultimate section discusses the financial insurance literature on annuity models and provides estimates on how they perform when tested on historical data from four Scandinavian countries. The final section provides concluding remarks.

Background

The consequence of a systematic error in projecting life expectancy is that it creates a cohortwise deficit or surplus that is passed on to cohorts other than the one for which the outcome arises. An important goal of annuity design in all defined contribution schemes, including NDC, is thus to minimize the systematic error. Because NDC is a politically mandated scheme, having a socially acceptable rule for the distribution of the residual error is also important, because the method chosen will affect the relative welfare of cohorts. Before examining the technicalities of the task, this section presents an overview of the issues within the context of NDC.

CONSEQUENCES OF MISJUDGING THE LIFE SPAN OF PENSIONERS

The deficits or surpluses associated with under- or overestimating life expectancy are dealt with in present NDC schemes either with or without a solvency ratio. This section begins with a scheme that uses a solvency ratio together with a balancing mechanism and then describes one that does not.

An NDC scheme with a solvency ratio, of which to date the Swedish scheme is the only example, balances assets and liabilities by adjusting liabilities when imbalance arises. The balancing mechanism can be symmetric, adjusting for both positive and negative deviations from balance between assets (A) and liabilities (L), or asymmetric, as in the Swedish system, which balances only for $A/L < 1$ with positive adjustments up to the actual path of the index of the per capita wage. Underestimation of life expectancy leads to benefit payments beyond those covered by supporting assets. Overestimation leads to payments that are too low.

In the solvency ratio approach, if the system were otherwise in exact equilibrium ($A = L$), systematic underestimation of life expectancy for pensioned cohorts causes the ratio of assets to liabilities to fall below unity, causing a downward adjustment of the accounts of all workers and pensioners, thereby spreading out the consequence to all workers and pensioners in the insurance pool. In contrast, with symmetric balancing, systematic overestimation of life expectancy transfers money from the accounts of the cohorts whose pensions were underestimated to other cohorts. The goal is to minimize the scale of transfers resulting from one-sided systematic error. This goal follows from the premise that in a social insurance perspective the optimal outcome is a random outcome where all cohorts are expected to neither win nor lose.

With the exception of Sweden, countries introducing NDC pension schemes have not used the solvency ratio with an associated balancing rule, and Sweden has an asymmetric balancing rule (balancing only occurs in response to a solvency ratio below unity). Other NDC countries have no explicit rule to maintain balance. Instead, surpluses and deficits, to the extent they occur, are absorbed by the general budget, meaning that implicitly the government, as the insurer, and ultimately the taxpayers bear the risk (or benefit) of misjudged life expectancy. Participants in a national pension scheme and taxpayers are largely the same people. However, because personal taxes are based on *total* personal income, the individual outcomes of distributing the systematic risk to taxpayers will differ considerably from a distribution within the pool of pensioners. A comment that is in order here is that even if a country is not using a solvency ratio approach, it is nevertheless

in keeping with the principles of NDC to create an accounting framework that makes internal transfers explicit.

THE INSURER'S PROBLEM

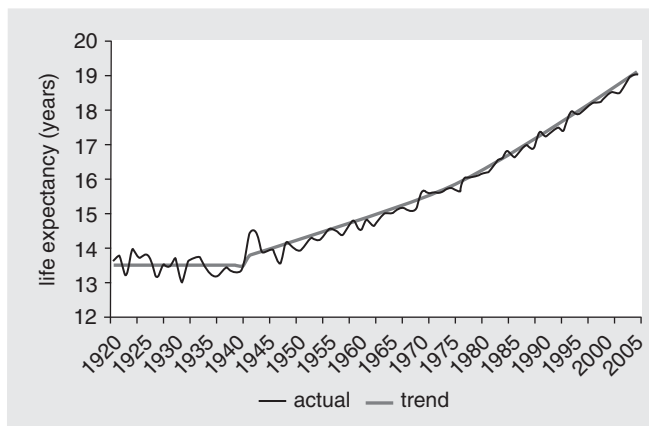
The dilemma confronting the analyst responsible for projecting life expectancy can be illustrated with data for life expectancy at age 65 for Sweden from 1920 (figure 22.1). In the 20-year period from 1920 to 1940, life expectancy of Swedes at age 65 fluctuated more or less randomly, showing no clear tendency toward increasing. Statistical modeling based on a flat development yields a projection of more of the same. With this picture, one can easily understand how up to a decade of change might have been needed to convince researchers of an upward trend. Once researchers realized that a change was occurring, two questions remained: for how long and with what degree of intensity?

From around 1940, something triggered an upward trend that has continued ever since, going through two stages. The first continued into the 1970s. In the 1970s, this upward trend began, in fact, to accelerate, possibly spurred by a reduction in smoking and a number of technological breakthroughs in medicine that Sweden was wealthy enough to implement for the general population. Similar trends can be expected in developing countries that devoted greater attention to healthy habits and implemented advanced health care technology.

The picture of Swedish life expectancy at age 65 also illustrates two methodological points. First, statistical time series models will take some time to pick up the force of the change from a flat development to an upward trend. Even more important for the annuity provider, capturing only the direction of change is not sufficient. The real challenge is for the estimation procedure used to capture an increase (decrease) in the rate of change. The tendency toward acceleration-deceleration will underlie a systematic error in estimating the strength of the trend.

Second, the Swedish data indicate that the process of acceleration is not short lived. The general upward trend in life expectancy at age 65 in Sweden has been going on since the end of the 1930s (i.e., for about 75 years). As of 2010, the upward thrust of life expectancy shows no indication of slowing down. Nonetheless, official projections have tended to assume a slowdown in the coming half century. Given probable continued advances in medical technology and in the absence of dramatic negative events, Swedish life expectancy may continue to increase for many decades to come, with future acceleration occurring in the most advanced ages. This pattern undoubtedly signals the path of the future for developing countries too.

FIGURE 22.1 **Period of life expectancy at age 65, Sweden, 1920–2005**



SOURCE: Authors' calculations.

At least since the seminal work on time series analysis of Box and Jenkins (1976), the thinking has been that statistical models of historical time series data should be based on 50 or more periods (in this case, years) of observations. This view is based on considerations of model choice and accuracy of empirical data characteristics. As suggested by figure 22.1, using shorter data periods may seem attractive instead. Clearly, a 20-year estimation period would have done a better job of tracking the actual changes in figure 22.1 than a 50-year estimation period. But short data periods are likely to lead to increased estimation errors and erratic updates, especially for long forecast horizons. The considerable concern among demographers about selecting the appropriate starting point for a projection (i.e., the most recent outcomes or an average of a longer period) attests to this dilemma.

STRATEGIES FOR DISTRIBUTING THE LONGEVITY RISK

Longevity risk is a systematic risk that is inherent in all pension schemes. Among the characteristics of different schemes is how they distribute risks. In defined benefit (DB) schemes, the implicit assumption is that the risk is borne by wage earners or the insurer, but not directly by the pensioner. If the insurer bears the risk, rational behavior would lead to hedging on the amount of the annuity payments by using a life expectancy factor that is thought to be sufficient to leave a sure surplus at the end of the cohort's days. Even in defined contribution (DC) schemes, such as NDC and financial defined contribution (FDC) schemes, the insurer defines a benefit (i.e., the annuity) at retirement. Hence, the set of problems is the same as in DB schemes. Seen in this light, the advantage of DC over DB is that the time horizon of uncertainty is considerably shorter. This factor is undoubtedly one of the reasons for the increasing popularity of DC schemes, especially in private insurance. Because an NDC scheme is a public mandatory pension scheme, the distribution of the longevity risk explicitly becomes a policy issue.

From a statistical point of view, a prudent strategy for the insurer to follow in granting annuities would be to use the upper bound of the estimate of life expectancy. The principle behind this approach is that the individual annuitant should bear the risk. This principle is in concord with the general principles of NDC, but it is a blunt instrument because the expected outcome of this strategy is that the insurer is the winner—and that no consideration is given to the distribution of outcomes. What are some of the alternatives, other than granting annuities that are clearly so low that the likelihood that the insurer will lose money is minimal? To frame the question, envisage that people exit from the labor force with an NDC benefit up to, for example, 70 years of age. In the beginning, fixing the annuity first at age 70 and letting it be variable with respect to new estimates of life expectancy up until then is not reasonable. The annuity adjustment that may be needed up to this point may, in fact, be very small—an adjustment of at most 1 or 2 percent. This outcome may not be as bad as it first sounds. Why? First, the counterfactual to this form of variable annuity is a heavily hedged fixed annuity granted at a younger age. Second, in theory, errors can occur in both directions, even if currently underestimation seems to be the major risk for all countries for a long time to come. Third, in a pure NDC scheme, the combined outcome of indexation with the internal rate of return and the effect of a variable annuity on the benefit payment determines the final outcome, which can be expected to be nearly always positive as long as a country's economic processes convert productivity increases into real wage increases. A later section explores the

ramifications of a variable annuity. However, before turning to that analysis, the following section presents the analytical aspects of mortality change to give an idea of the dimension of the problem.

Analytical Aspects of Mortality Change

Forecasting mortality is generally believed to be easier than forecasting fertility, let alone migration. Yet a historical look shows that forecasts have systematically overestimated mortality and underestimated life expectancy (e.g., Alho 1990; Oeppen and Vaupel 2002). Here the nature and causes of uncertainty in mortality developments are examined, and the statistical approaches commonly used by demographers and actuaries to derive projections of future life expectancy are discussed. The section proceeds in four steps. First, it discusses inherent limitations in the accuracy of historical mortality data. Second, it presents evidence of the systematic misjudgment of mortality trends. Third, it shows how statistical extrapolation methods help improve the accuracy of projections. Fourth, it indicates possible ways forward for further improvement in applying time series analysis to projections of mortality and life expectancy, to take a step forward in creating more certain annuities.

FACTORS LIMITING THE ACCURACY OF MORTALITY DATA

Let D_{xt} be the number of deaths in age x during year t , and let K_{xt} be the average number of x -year-olds during t . Then, the *age-specific mortality rate* is defined as $\mu_{xt} = D_{xt}/K_{xt}$. From a statistical point of view, this equation is the simplest of possible estimators of the true underlying hazard of death μ_{xt} . Unfortunately, several factors will almost certainly limit the accuracy of such a simple estimate, some of them potentially very seriously.

What are the problems encountered in using this simple estimate of the underlying hazard of death? To begin with, data may be inaccurate or poor and unrepresentative in coverage. Second, irregularities in age patterns and time trends caused by various external forces occur such that populations sharing the same background can display distinctly different patterns of change. Third, unsystematic variation may occur in mortality not shared by individuals (i.e., Poisson variability). All of these factors can limit the accuracy of mortality data. The section begins by examining data accuracy.

Data coverage and errors. The usual cause of data inaccuracy is errors in data collection. The practical problem for the demographer or actuary attempting a statistical analysis of mortality and estimation of life expectancy using historical data is that the true values of either D_{xt} or K_{xt} are not the values provided in the country's national statistics. In countries that rely on censuses for population estimation, estimates of intercensal populations are based on the registration of births, deaths, and migration. The quality of these data depends on the quality of the institutional infrastructure the country has set up to collect, register, and communicate data to a central database. In fact, even if recorded deaths are complete, the resulting mortality rates may still be erroneous because of errors in birth or migration registration (cf., Alho and Spencer 2005, 297–98).

The source of the problem is easy to understand and, in principle, easy to remedy, although the institutional infrastructure required to maintain data with 100 percent coverage may require more resources than a country is willing to allocate for that purpose.

According to the *World Health Statistics* (WHO 2010), register coverage of births and deaths is almost complete in most high-income countries. Birth coverage is often better than death coverage, but both are estimated to be only 25 to 50 percent of full coverage in low-income countries. With some exceptions, the coverage of registers of European Union countries is within the range of accuracy of 90 to 100 percent. According to the same World Health Organization report, registers in highly populated countries such as China, India, and Indonesia cover only about 25 percent of deaths. These findings suggest that countries with poor register coverage that are considering introducing an NDC pension scheme must also consider developing adequate institutional procedures to register statistics to support such a system.

Errors in registering migration confound death statistics for the simple reason that a person born in a country (region) may have left the country (region) without registering his or her exit. These people “never die” in the national (regional) statistics and thus contribute to an upward-biased estimate of life expectancy. A well-known recent example that caused and is still causing problems for statistical agencies in states of the former Soviet Union and Central and Eastern European countries is the considerable migration unleashed by the transition from a planned to a market economy.

In large regions such as the European Union, with free population movement, mandatory reporting to national, regional, or local authorities in conjunction with address changes becomes a necessity. Some evidence indicates that local-level reporting is the most successful means for achieving the highest level of migration coverage. For example, Sweden, after many unsuccessful years of requiring individuals to report changes of address to a national authority (the tax authority), now requires municipalities to register all changes and report them to the national statistical office on a monthly basis.

Finally, in countries without registers, mortality estimates are sometimes based on survey data, which means sampling error enters into the picture. Clearly, when problems of the nature discussed here occur, one cannot expect to have long time series with good-quality data for forecasting.

Time trends and irregularities in age patterns. Regardless of the country examined, inspection of age-specific mortality rates shows that irregularities occur in both the age patterns and the time trends of mortality. Among the changes that are better understood—albeit difficult to incorporate into life expectancy projections—are changes in early life events and infant and child hygiene, changes deriving from increased control over the spread of contagious diseases, and changes in unhealthy habits such as smoking and use of substances (alcohol, narcotics, etc.). Contagious diseases are the major cause of deaths in low- and middle-income countries (WHO 2010), and significant changes in individual habits and health care practices are likely to have a major long-term effect on longevity and life expectancy in developing low- and middle-income countries. The emergence of strains of drug-resistant bacteria and new communicative diseases, such as AIDS, is a threat for all countries.

The sources of variation in life expectancy can be much more subtle, however. Variation can be associated with widespread changes in consumption patterns or individual behavior. Even if identifiable, these factors may still be difficult to incorporate into a mortality projection. An example of temporary changes in behavior came about with the breakdown and restructuring of the economies of the states of the former Soviet Union

and of Central and Eastern European countries following the fall of the Soviet Union. During a period of almost two decades after the beginning of the transition, mortality among older working-age men from suicide and accidents at the workplace, often associated with increased substance abuse, increased dramatically. However, whether and in what way such factors could be of use in forecasting is unclear.

Health technology and medication breakthroughs are also important, but the effects will clearly be determined by how affordable these innovations are. There are links between educational opportunities, health, and mortality (WHO 2010). A link also exists between contagious diseases as the cause of death and a country's level of income, according to the World Health Organization report. Generally speaking, life expectancy is high in countries with high income, where income determines affordability of health care. Statistical analysis also suggests that educational change (Lutz, Goujon, and Doblhammer-Reiter 1998; Lutz 2009) and economic development (Hanewald 2009) are long-term determinants of mortality change.

Especially for countries that are not among the current leaders, consideration of developments in smoking, alcohol misuse, health care services and general public health awareness, education, and economic development is likely to be critical. Conceivably, these developments could be incorporated into models of life expectancy along the lines suggested by Girosi and King (2008).

Data quality and statistical modeling. Individuals may share the same background characteristics and live in similar surroundings but still face different risks because their daily lives are different. This idea can pertain to individuals in different countries, regions of a country, age groups, occupations, and so on. Statistical theory indicates that in estimating the mortality rate when either the population, K_{xt} , or the hazard rate, μ_x , is small, the accuracy of the estimate—in this case of mortality—can be poor. A frequently used statistical model that picks up such variation is the Poisson distribution. Assuming deaths are approximately Poisson-distributed random variables, $D_{xt} \sim Po(\mu_{xt} K_{xt})$ (e.g., Alho and Spencer 2005). Under this model, the expected count of deaths, $\mu_{xt} K_{xt}$, equals the variance of the count. It follows that the coefficient of variation of the number of deaths is $(\mu_{xt} K_{xt})^{-1/2}$. This coefficient is important if one is examining the development of the mortality of a population (e.g., women 65 years of age) from year to year.

To develop a feeling for the possible magnitude of error that can arise because of small populations or very low mortality rates (hazards) in populations, consider the case where the expected number of deaths is 100, so the coefficient of variation is 0.1. Then the expected relative variation is 10 percent from year to year. This projection could come about if $\mu_{xt} = 0.01$, which is very roughly the average mortality in Europe across all ages, and $K_{xt} = 10,000$, which might be the number of males or females, in a single year of age, in a country with a population of about 1.5 million, under current life tables. However, if $\mu_{xt} = 0.0001$, which is roughly the hazard of death in the Nordic countries for people 5 to 15 years of age, assuming a Poisson distribution, this figure is comparable to the level of uncertainty in the mortality rate of a country of 150 million people in that age range. This example illustrates how application of the Poisson distribution allows statements about small populations to be made more certain.

A conclusion is that in most countries of the world, mortality estimates are inaccurate (in relative terms) in young ages because of Poisson variation alone. Similarly,

estimates for small countries are likely to deviate considerably from the underlying hazard. Greater accuracy can be attained for descriptive purposes, for example, by using five-year age groups or five-year observation intervals in time, which can reduce the effect of Poisson variation.

As previously discussed, many causes for changes in age-specific mortality are possible, but they are hard to pinpoint and even harder to work with in a forecast. A statistical model for dealing with this sort of variation in the data treats the mortality hazard itself as a random variable, $\mu_{xt} = r_{xt} + \varepsilon_{xt}$, where r_{xt} is a smooth function of age and time, and the error term has zero expectation, $E[\varepsilon_{xt}] = 0$ and variance $Var[\mu_{xt}] = \sigma_{xt}^2$. Unlike Poisson variation, this source of uncertainty need not have a close connection to the size of the population. To see this, note that now $E[D_{xt}] = r_{xt} K_{xt}$, and $Var[D_{xt}] = r_{xt} K_{xt} + \sigma_{xt}^2 K_{xt}^2$. Therefore, the coefficient of variation is $\sqrt{\sigma_{xt}^2 + r_{xt} / K_{xt}} / r_{xt}$. Consequently, random variation in the rates can (and often does) dominate Poisson variation, in practice. Because random variation in the mortality rates is typically autocorrelated across age and time, aggregation along either axis can primarily smooth the effect of this source of uncertainty but not eliminate it.

A LEGACY OF SYSTEMATIC UNDERESTIMATION OF LIFE EXPECTANCY

For some time, demographers have underestimated the force of change in human longevity, as is borne out by studies of official projections in a large number of countries. In a study of Dutch forecasts, Keilman (1990) found that mortality forecasts systematically predicted too small numbers of the elderly. Similar findings from other countries have been reported by, among others, Alho (1990); Bongaarts and Bulatao (2000); and Keilman, Crujisen, and Alho (2008). To see how the underestimation comes about, consider two historical examples that were chosen here because the forecast reports far surpass most other efforts in clarity and meticulous attention to detail.

In a forecast of Swedish mortality, Sven D. Wicksell (1926, 92, 105, 123) compared age-specific mortality from 1816 to 1840 with mortality from 1911 to 1915. He noted a dramatic decline and assumed that *at most* a similar improvement could still take place. Wicksell's assumption was that mortality would initially decline fast but slow down asymptotically: in the younger ages by around 1960, in the working ages from 1970 to 1990, and then in the oldest ages by 2025. The implication was that life expectancy (both sexes combined) would increase from the value of 58 years in 1911 to 1915 to a maximum of 69.5 years, where it would remain forever. In retrospect, one knows that the average of the Swedish male and female life expectancies in 2009 was 81 years. Thus, the increase was $81 - 58 = 23$ years, *twice* the amount of Wicksell's forecast.

In a forecast involving the United States, Whelpton, Eldridge, and Siegel (1947) assumed that the increase of native white male life expectancy from 62.6 years in 1939 to 1940 would stop at 68.6 years around 1990. In fact, white male life expectancy in 2003 was 75.3 years, an increase *more than twice* that assumed by Whelpton, Eldridge, and Siegel.

Examples from other countries (e.g., Modeen 1934) and other periods (cf., Keilman, Crujisen, and Alho 2008) show that Wicksell (1926) and Whelpton, Eldridge, and Siegel (1947) were actually bold among their contemporaries. This forecast is also visible in the forecast reports of the two studies, in which the authors seek to explain how such an optimistic development might be realistic. Why exactly both studies assumed that the

observed declines in mortality would come to a halt is unclear, apart from such assumptions being in accordance with prevailing conceptions.

Support for a law of diminishing returns for mortality appears to have been widely held. Ever-increasing resources were thought to be needed to achieve improvements similar to those in the past. But the mortality forecasts of Wicksell (1926) and Whelpton, Eldridge, and Siegel (1947) turned out to be too high, because (a) the relative declines in the mortality of those of young and working ages have continued and (b) the rates of decline in older ages have increased. In fact, the conclusion to be drawn is that simply allowing past declines to continue would have made mortality forecasts more accurate (e.g., Alho 1990). This observation speaks in favor of trend-based statistical modeling.

PATTERNS OF MORTALITY DECLINE

This section begins by again referring to Oeppen and Vaupel (2002). According to their research, best-practice life expectancy in 1840 was 45 years, and this finding was for Swedish women. According to their study, best-practice life expectancy rose from this time almost linearly to 85 years in 2000, when Japanese women were in the lead. The speed of increase has been roughly a constant two and one-half years per decade. This section takes a closer look at what lies behind this sort of development by computing age-specific mortality rates for the population 45 and older for a selection of countries, using data from the Human Mortality Database.¹

Five-year age groups have been constructed to provide a clearer graphical description that is less influenced by Poisson and other forms of random variation. In this section, the emphasis is on Sweden, with the goal of highlighting qualitative shortcomings of some commonly used extrapolation techniques. The next section provides a more systematic analysis.

Let m_{xt} be the age-specific mortality rate² in age $x = 45, \dots, 99$ for years $t = 1900, \dots, 2007$. To smooth the patterns of change, the data were first aggregated to five-year age groups and five-year periods, and averaged. Thus, age groups $j = 1, \dots, 11$ correspond to ages 45–49, ..., 95–99, and periods $i = 1, \dots, 21$, correspond to years 1903–07, ..., 2003–07, for the countries that have the complete dataset for this period. The mortality measure we will examine is defined as

$$\bar{m}_{ij} = \frac{1}{25} \sum_{x=45+5(j-1)}^{45+5j-1} \sum_{t=1903+5(i-1)}^{1903+5i-1} m_{xt}. \quad (22.1)$$

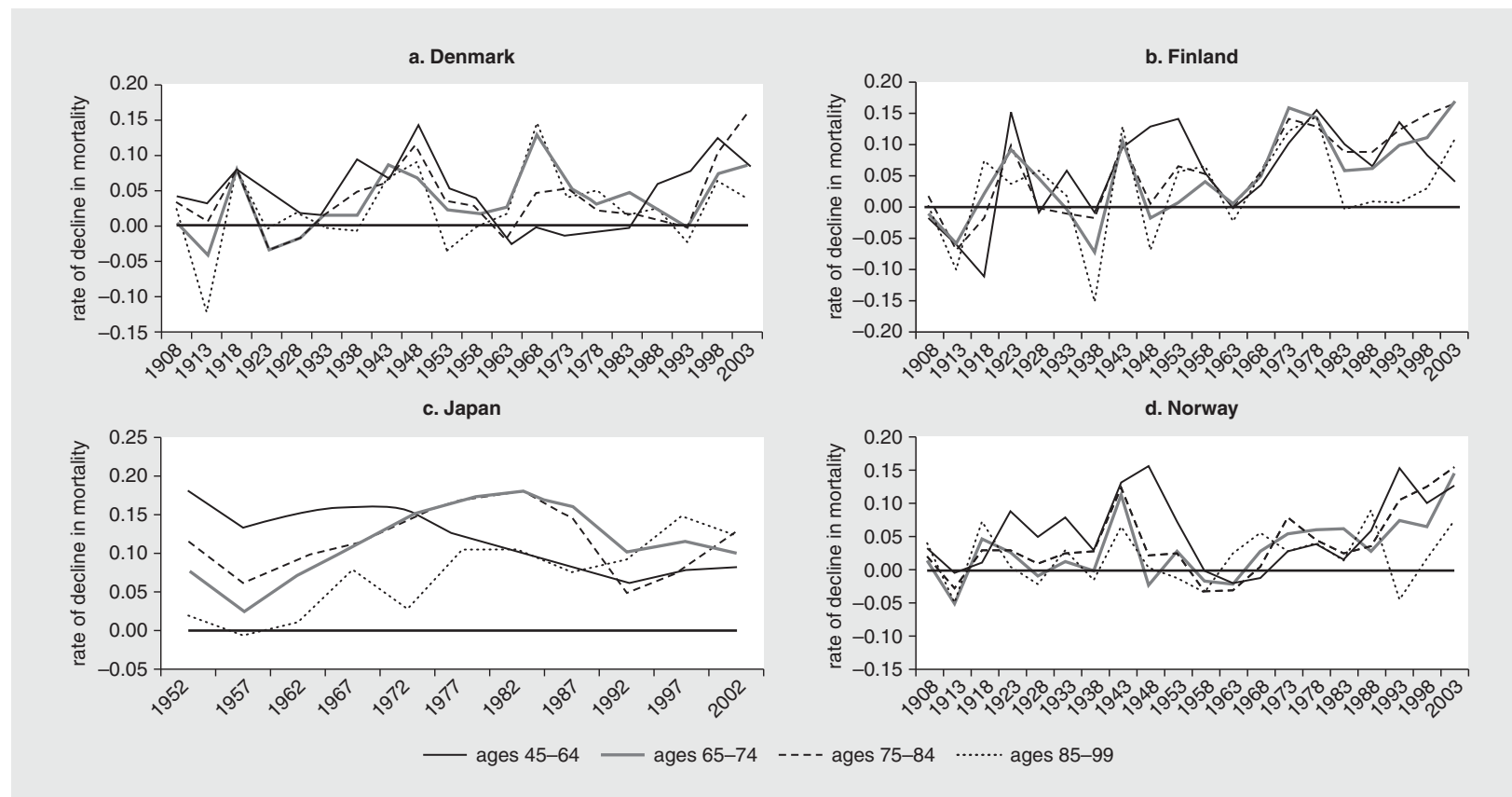
The rate of decline in mortality in age j at time i is then defined as

$$d_{ij} = \log(\bar{m}_{ij}) - \log(\bar{m}_{i+1,j}). \quad (22.2)$$

Rates of decline, even when computed from such aggregated measures, are still fairly erratic for descriptive purposes. For this reason, four age groups have been created: 45–64 ($j = 1, 2, 3, 4$), 65–74 ($j = 5, 6$), 75–84 ($j = 7, 8$), and 85–99 ($j = 9, 10, 11$).

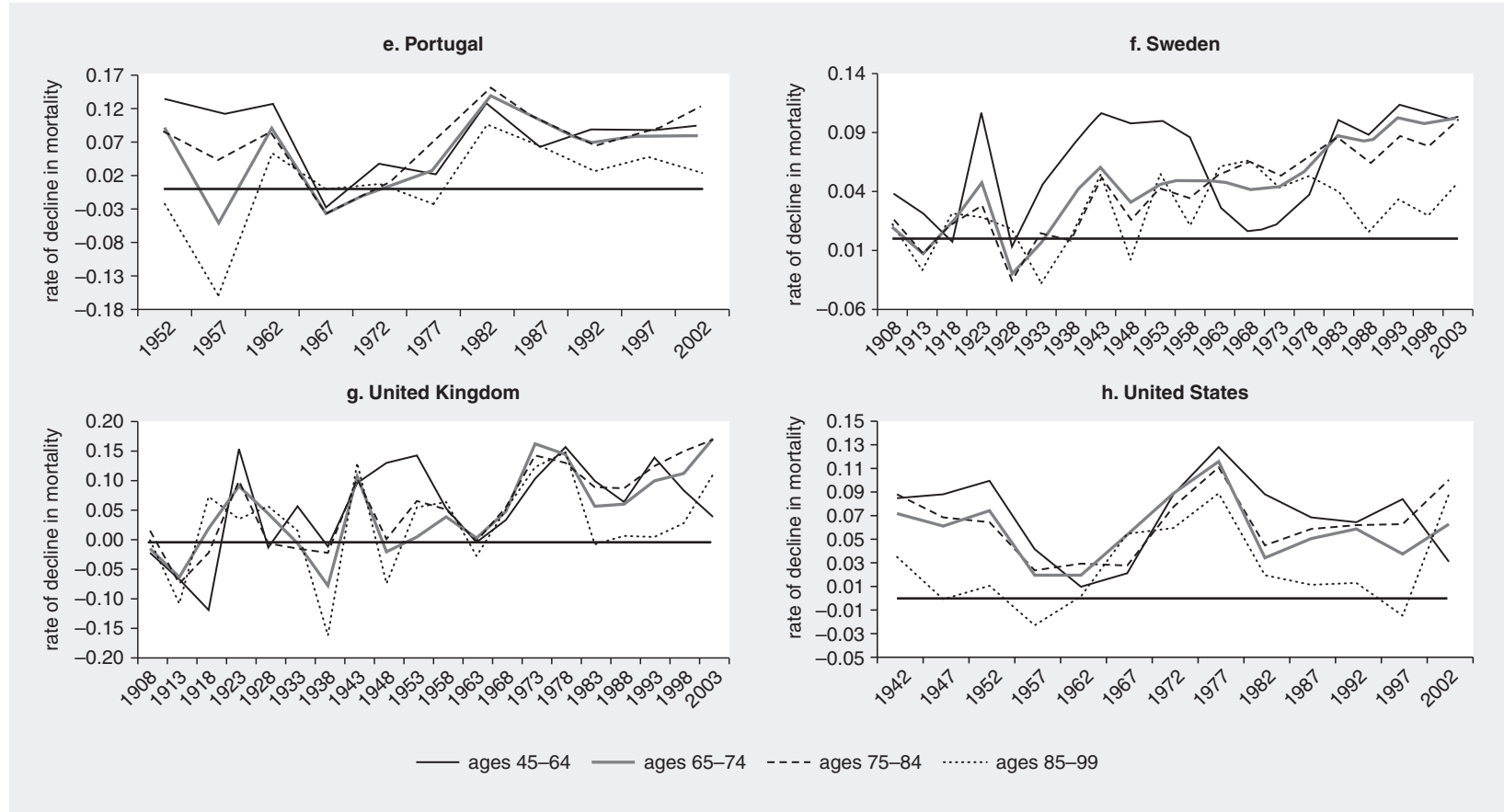
Figure 22.2 displays the rates of decline for 8 of the 37 countries at present included in the Human Mortality Database. Among the choices (italicized here) are *Japan* (rated third), which represents the present life expectancy leader, although it comes after Macao SAR, China (rated first), and Andorra (rated second) (UN 2009). France (rated 9th), *Sweden* (rated 10th), and Switzerland (also rated 10th) are the European leaders, with almost the

FIGURE 22.2 **Rate of decline in mortality, age groups 45–64, 65–74, 75–84, and 85–99**



(continued next page)

FIGURE 22.2 Rate of decline in mortality, age groups 45–64, 65–74, 75–84, and 85–99 (continued)



SOURCE: Authors' calculations.

same life expectancy prospect at birth. The other countries included are three other Scandinavian countries, *Denmark* (rated 48th), *Finland* (rated 38th), and *Norway* (rated 23rd); *Portugal* (rated 51st); the *United Kingdom* (rated 37th); and the *United States* (rated 47th).

The choice of countries is *not* based on any form of systematic selection criteria other than that all are high-income countries with high levels of general education and health care. Of course, showing similar figures for low- and middle-income countries would have been interesting, but the data are not available. The countries included in the panels of figure 22.2 all represent the top quarter of the international life expectancy ranking.

Generally, what the country figures suggest is that countries with similar life expectancy rankings may be involved in quite different development processes. This observation is no less interesting because it includes countries with very close geographic proximity. In fact, the four Scandinavian countries clearly illustrate that individuals may share the same background characteristics and live in similar surroundings but still face considerably different longevity risks. A clear indication exists of an accelerating decline in mortality in Portugal and the United Kingdom but not the United States, even though these three countries have close life expectancy rankings. This observation suggests that Portugal and the United Kingdom will show greater near-future gains in life expectancy than will the United States.

Examination of the panel of diagrams in figure 22.2 yields several additional and interesting observations for the purpose of projecting life expectancy. When one looks at Sweden (panel f), one of the leaders in increasing longevity for over a century, one sees what was already observed in figure 22.1: the rates of decline in mortality do *not* appear to have been constant. Fluctuations in average values could be viewed as being random; however, on closer inspection, a process of systematic change appears to be taking place. Increasing rates of decline in mortality started in age group 45–64 in the 1930s to 1950s; thereafter, age groups 65–74 and 75–84 have been in the lead. The oldest age group is yet to manifest similar rates of improvement, but one may logically assume accelerated improvement will continue upward in the ages.

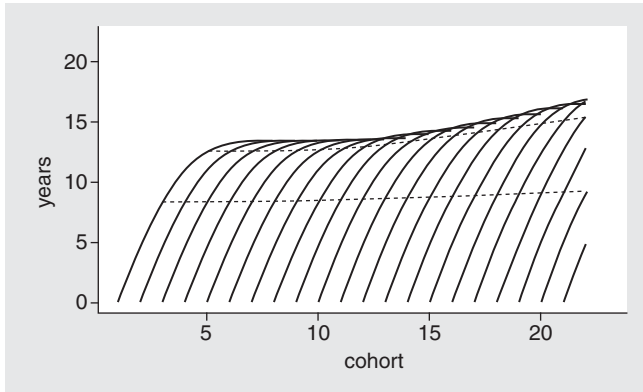
Japan (panel c), which has data for the post–World War II period only, can be viewed as a leading indicator of what is to come for other countries. Here one sees that the rate of decline in mortality among people 65–74 and 75–84 years of age accelerates from the year for which data are available, 1952, and that it continues for about another 30 years. In addition, the panel for Japan clearly shows an increase in the rate of decline in mortality for the oldest age group, which sets Japan apart from the other leaders. This finding is strong evidence that one can expect a future acceleration in the rate of decline of the very oldest in other countries.

In many actuarial and pension applications, the primary concern is on survival rather than mortality. For definitional purposes, it is convenient to consider continuous age and time. Let $\mu(x, t)$ be the force of mortality in exact age x at exact time t .³ The remaining cohort life expectancy for those in age x at time t is formally defined as

$$c_x(t) = \int_0^{\infty} \exp\left(-\int_0^z \mu(x+y, t+y) dy\right) dz. \quad (22.3)$$

Cohort life expectancies have been estimated using the data aggregated to five-year age groups. Thus, the figures presented here are consistent with each other. Figure 22.3 shows how life expectancy has accrued for 15 Swedish cohorts. A notable feature is the

FIGURE 22.3 Remaining cohort life expectancy at age 65 in Sweden: Five-year (21) cohorts who reached age 65 in periods 1903–07, ..., 2003–07



SOURCE: Authors' calculations.

NOTE: Dashed lines indicate accrual to ages 75 and 85, respectively.

clearly cannot be optimal. In fact, for the countries studied, a forecasting method will not perform appropriately if it does not account for the nonlinearities observed. As the next section shows, the failure to account for nonlinearities lies behind much of the error in mortality and, hence, life expectancy projections.

In sum, the pictures of mortality decline from several countries among the leading quartile of countries in life expectancy, with the possible exception of the United States, show tendencies toward an accelerated decline in mortality in the older ages. This finding has important ramifications for determining the divisors used in computing annuities in all the countries examined. This section has taken a closer look at Sweden and Japan, two of the current leaders in life expectancy. The evidence from Sweden shows accelerating rates of decline in mortality through age 84, but with no clear tendency toward acceleration from age 85. Examination of data for the world's most recent leader in life expectancy from birth, Japan, shows strong acceleration in mortality decline from ages 45 to 84 from the early postwar period for at least three decades, which is then followed by acceleration for the age group 85 and older.

The tentative conclusion from this rough examination of data is that countries likely will follow the examples of Japan and Sweden. Studying the examples of the leaders can help increase understanding of the sort of modeling that is needed to produce better life expectancy projections in general.

STATISTICAL MODELING OF MORTALITY CHANGE

This section moves into some issues and examples of statistical modeling of mortality change. In nearly all applications, mortality rates are computed for the two genders separately. Nevertheless, this section continues with single-gender notation. It takes the age-specific rates m_{xt} in ages $x = 0, 1, \dots, \omega$ during years $t = 1, \dots, T$ as the observed data. The aim is to forecast for subsequent years $T + 1, T + 2, \dots$. A fairly general formulation postulates that for some monotone transformation g it is true that

$$g(m_{xt}) = g_{xt} + e_{xt}, \quad (22.4)$$

faster-than-linear increase, especially after age 75. The development in ages 65–74 is difficult to distinguish from figure 22.3, but by considering life-years lost (details not shown), one sees that the increase in life expectancy has been faster than linear in ages 65–75, as well. In view of the data shown, any forecasting method that does not lead to at least a linear increase in the forecasts for the remaining life expectancy in ages 65 and older

where $e_{xt} \sim N(0, s_{xt}^2)$. This representation can approximately be connected with the random rates model described earlier by taking $g_{xt} = g(r_{xt})$, $e_{xt} = g'(r_{xt})\varepsilon_{xt} + e_{xt}^p$, and $s_{xt}^2 = g'(r_{xt})^2 \sigma_{xt}^2 + r_{x,t} / K_{xt}$, where the terms e_{xt}^p and $r_{x,t} / K_{xt}$ represent Poisson variation and its variance, respectively. These formulas still omit the effect of uncertainty caused by imperfect data collection, which can generate biased estimates and a poorer fit.

The bilinear model of Lee and Carter (1992),

$$g(m_{xt}) = a_x + b_x k_t, \tag{22.5}$$

uses the logarithmic transformation, $g = \log$, and makes further assumptions for the identifiability of the terms on the right-hand side. If one assumes that $\sum_t k_t = 0$, then one has the least-squares estimator $\hat{a}_x = \sum_t g(m_{xt}) / T$. If one then centers the data to form a $(1 + \omega) \times T$ matrix with elements $g(m_{xt}) - \hat{a}_x$ and assumes a second identifying condition $\sum_t k_t^2 = 1$, the least-squares estimators of the remaining parameters b_x and k_x are given by the largest singular value and the corresponding singular vectors of the centered matrix. Such estimates are maximum likelihood estimators, if one is willing to assume that $s_{xt} \equiv s$, independently of x and t . In most applications, other identifying conditions have been used, but these conditions conceal the maximum likelihood property of the method.

The feature that makes the model stochastic is that Lee and Carter (1992) further assumed that the time index k_t was randomly generated according to the formula $k_t - k_{t-1} = d + \eta_t$, where d is a constant to be estimated from the data, and $\eta_t \sim N(0, \sigma_\eta^2)$ are unpredictable (i.e., independent) perturbations with a volatility parameter σ_η^2 that is estimated from the data. In other words, it is assumed that the time index is a *random walk with a drift*. The two most important features of this model are that it can incorporate a systematic declining trend (when $d < 0$) and that it assumes that the variance of the unpredictable variation increases linearly with time. More generally, the perturbations can be modeled using autoregressive integrated moving average (ARIMA) processes, but qualitatively this method has been found to make relatively little difference.

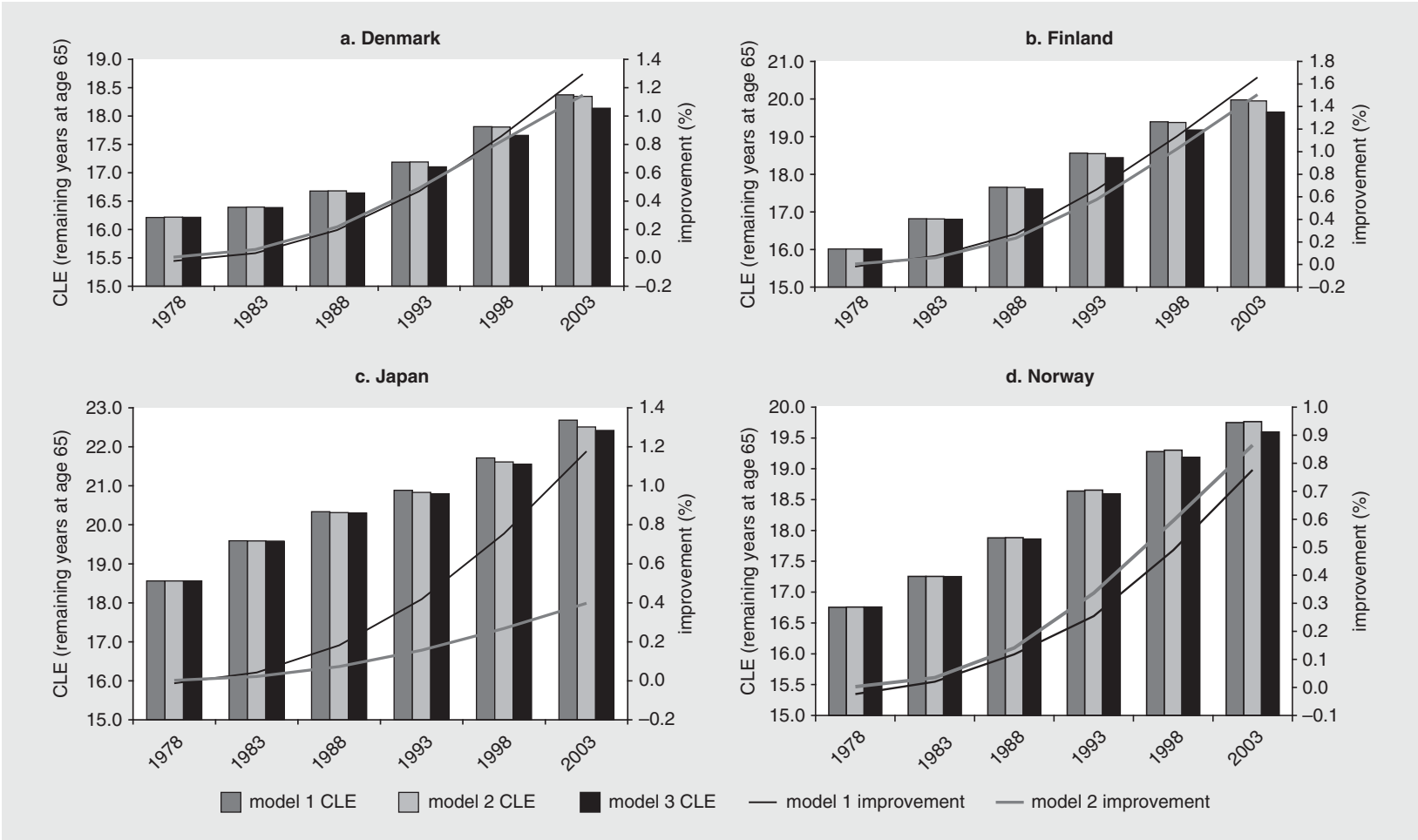
Given that the estimates of the model parameters are optimized to provide a least-squares fit for the whole transformed data matrix, there are opportunities for refinement. In the original proposal of Lee and Carter (1992), time indexes were reestimated to match exactly the observed number of deaths in each year of observation. It has been noted that for actuarial purposes, matching period life expectancy may make more sense.

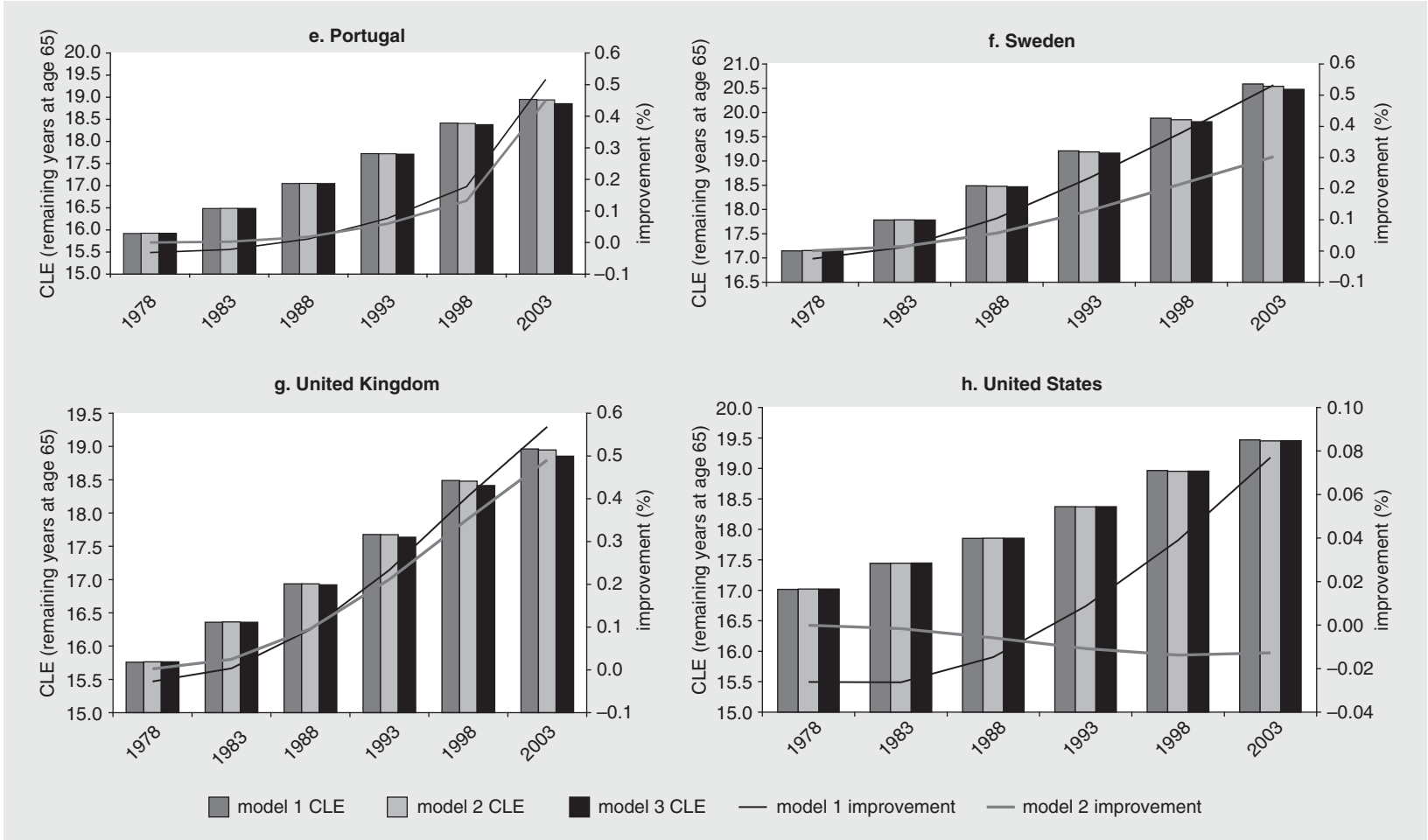
Most attempts at improving the Lee-Carter proposal have concentrated on better estimation of the bilinear terms on the right-hand side of the model $g_{xt} = a_x + b_x k_t$. However, taking $g = \log$ is not the only viable choice. One alternative starts from the actuarial estimator of the one-year probability of death, $q_{xt} = 2m_{xt} / (2 + m_{xt})$. A natural bilinear model is then $\text{logit}(q_{xt}) = a_x + b_x k_t$. This model corresponds to using the transformation $g(m_{xt}) = \log(2m_{xt} / (2 + m_{xt}))$, which is model 1 to be examined here.

In figure 22.4, this model is compared with two other models for the eight countries examined in figure 22.1. Model 2 is the Lee-Carter model adjusted to period life expectancy at age 65, and model 3 is the basic Lee-Carter model. The data are five-year age groups in ages 65–99. Both of the adjusted methods (models 1 and 2) yield higher remaining cohort life expectancies at age 65 and are in better agreement with the data in all of the eight countries that were estimated; however, the difference for the United States is very minor.

Models 1 and 2 are compatible with the trend acceleration in mortality improvement in figure 22.3, whereas the original Lee-Carter model is not. (Note that the scales in

FIGURE 22.4 Forecasts of remaining cohort life expectancy at 65 using three variants of the bilinear model





SOURCE: Authors' calculations.

NOTE: CLE = cohort life expectancy.

the right y-axis scales vary, depending on the strength of the improvements.) Hence, the results are as expected, using the two proposed alternatives. The exception is the United States, which in figure 22.2 shows no clear tendency toward acceleration and, hence, no improvement from using the two model proposals.

FORECASTING WITH POOR OR MISSING DATA

As noted previously, many countries do not have mortality data series that would allow researchers to use methods of the type discussed in the previous section. Nevertheless, forecasts will have to be made for purposes of pensions and other social planning. In essentially all cases, the countries with poor data are not at the forefront of mortality decline. Thus, typically many other countries whose mortality decline occurred earlier can thus be used as leading indicators in forecasting.

An ambitious attempt at formal modeling in this context was performed by Girosi and King (2008), who developed an elaborate Bayesian model that allows for the “borrowing of strength” from neighboring countries or countries with similar social or economic levels of development. A less formal but much used approach is to find countries whose mortality at some past point in time was similar to the current mortality of the country of interest. Using one such lead country or an average of several well-chosen countries can yield a forecast that is well anchored in empirical data.

For example, in their forecast of China, Li et al. (2009) corrected United Nations estimates of current population for the underreporting of girls to estimate the population in 2005; combined census estimates with survey data to estimate fertility trends; complemented census data on mortality from 1982, 1990, and 2000 with nationwide mortality survey data from 1973 to 1975 to estimate mortality at those times; and then used United Nations estimates and survey data to assess international migration. The data were used to establish age- and sex-specific mortality levels in 2000 and rates of mortality decline in 2000 to 2005. Li et al. then assumed that the rates of decline would converge to current European levels by 2060.

INCORPORATING ESTIMATES OF UNCERTAINTY

Some researchers believe that the trend and possibly even major fluctuations can be successfully forecast with epidemiologic or other knowledge of health behavior. An example is knowledge of the prevalence of smoking. Smoking is known to influence mortality because of cancer and cardiovascular diseases in the future, so changes in smoking prevalence could be seen as a leading indicator of the trend of future mortality. However, to benefit from this link, one needs to be able to quantify a relationship between the prevalence of smoking and subsequent mortality. Even if such a relationship can be quantified, the improvement in forecasting accuracy may be small if the trend in smoking prevalence produces a smooth change in mortality that is captured by standard statistical extrapolation methods.

In the absence of modern computer power, earlier forecasters typically computed a baseline forecast and plausible upper and lower forecast variants. However, the upper and lower limits were rarely used in decision making. Why they were not used is not entirely clear, but one reason may be that what is “plausible” to one person may not be to another. In addition, what it means to combine plausible assumptions for mortality

with plausible assumptions for fertility is not clear—and how plausible is the combination? In this sense, the upper-lower variant method lacked an objective basis. Moreover, as discussed in detail by Alho, Crujisen, and Keilman (2008), the use of variants suffers from a host of problems related to their probability interpretations. Most researchers have concluded that for a serious description of forecast uncertainty, more sophisticated tools are needed.

Törnqvist (1949) appears to be the first researcher to formulate the problem in probabilistic terms, specifying upper and lower forecast variants to represent the same amount of deviation from the most likely forecast. Thus, for example, an 80 percent prediction interval for life expectancy would be constructed in such a way that chances would be four in five that the future value would be inside the interval and one in five that it would fall outside. Given the technology of the day, Törnqvist specified uncertainty statements by judgment. Modern statistical techniques allow such probability statements to be based on empirical data (cf., Alho and Spencer 2005). Notably, uncertainty estimates can be based on the analysis of errors of past forecasts (e.g., Keilman 1990). Such estimates are statistically defensible as long as the current forecasts are not worse than those made before. Alternatively, statistical time series techniques provide estimates of uncertainty as a by-product of the fitting procedure. Although the two approaches are based on different principles, their judicious application typically leads to very similar results.

Decision making that aims at taking future risks seriously must clearly rely on empirical estimates of uncertainty (cf., Tuljapurkar 2005). Although this chapter cannot go into detail, some qualitative findings from the application of statistical uncertainty assessment to demographic forecasting stand out:

- Uncertainty increases over time.
- Uncertainty is similar for males and females.
- Uncertainty in mortality rates is similar to uncertainty in fertility rates.
- Errors in mortality and fertility forecasts are similar in close ages but may differ in ages that are far from each other.
- Errors in mortality forecasts are not related to fertility forecasts in industrial countries.
- Forecast errors in smaller countries tend to be larger than errors in larger countries.
- Forecast errors are much larger than is generally believed.

Some of these findings may come as a surprise to many readers. A contributing factor is that error analyses are rarely published or even mentioned in policy discussions or in the media, despite their high relevance in risk analysis and policy. Thus, mortality forecasting is generally believed to be much easier than fertility forecasting. What seems to be true, however, is that the forecasting of survival is much easier than the forecasting of fertility. The difference is, of course, that a large relative error in a mortality forecast typically leads to only a small relative error in survival forecast, because the level of mortality is very low in most ages.

Finally, a feature of the Lee-Carter approach is that it includes a random walk component describing the uncertainty that remains after the mean of the rate of decline has

been estimated. Several newer proposals for improving on aspects of the original proposal already referred to also include this feature (e.g., Lee and Miller 2001; Booth, Maindonald, and Smith 2002; De Jong and Tickle 2006; Haberman and Renshaw 2006; Girosi and King 2007; Dowd, Blake, and Cairns 2010). The Lee-Carter genre of models all use error assessments that rely on time series techniques.

Annuity Models and Systematic Risks

The message of the previous sections is that one can do a pretty good job of projecting life expectancy, but nevertheless one may in the end be faced with a remaining systematic error of 5 to 10 percent of total pension costs. This section reviews the standard fixed-level annuity model and discusses alternative longevity risk–hedging strategies. Theoretically, the NDC (or FDC) benefit can be formulated as a fixed-level life annuity, based on an individual's capital balances at retirement, or can be a variable annuity. What is important for NDC is that either cohorts cover their own costs, at least on average, or given that this circumstance is unlikely to occur, the insured or the insurer covers the residual risk. It is straightforward to conceive of a model that allocates the residual risk to the insurer (i.e., the government) either by default or by design. A method of doing so with rule-based transparency is by creating an NDC bond (see chapter 19 of this volume). In this chapter, the alternative is examined: devising an annuity model where the pensioners bear the systematic longevity risk. The examination focuses on a class of models of variable annuities recently proposed in the financial literature that minimize insurer risk by distributing the systematic cohort risk solely among cohort members.

THE STANDARD ANNUITY MODEL

Given an individual's account balance (capital), C , at the time of retirement, the individual's life annuity, B , is computed (approximately) as

$$B = \frac{C}{\sum_{t=0}^{\infty} (1+i)^{-t} {}_t p_x}, \quad (22.6)$$

where the denominator is composed of two components: the internal rate of return, i , and the unit value of a whole life annuity as determined by the survival probability of being alive at age $x + t$. By denoting mortality in age x at time t as $\mu(x, t)$, one finds that the survival probability for someone retiring at exact age x in exact time τ is ${}_t p_x = \exp\left(-\int_0^t \mu(x + y, \tau + y) dy\right)$.

The future internal rate of return i is not known when the annuity is granted, either in the case of an NDC scheme or in the case of a standard financial annuity. Instead, in an NDC scheme, the annuity can be indexed annually with the internal rate of return, or it can be front-loaded with a rate approximated by the expected rate of return and then adjusted annually for actual deviations from this rate, because the system cannot afford to pay more than the actual outcome. For example, Sweden computes the annuity on the

basis of annual per capita wage growth of 1.6 percent and then adjusts annuities paid out for deviations of the outcome from this norm. Compared with a prefunded FDC scheme, where gender-specific life tables are frequently used,⁴ in countries where NDC schemes have been introduced, the annuity factor is calculated using unisex life tables, thus introducing an explicit redistribution mechanism from people expected to live a shorter life (the male population) to those expected to live longer (the female population).

Longevity risk is a systematic risk and therefore cannot be eliminated by economic diversification. Hence, annuity providers must manage the remaining systematic risk. In FDC schemes, insurers charge a risk premium to provide appropriate solvency capital and reduce the risk of default. Such a premium can also be charged within NDC schemes, but other alternatives exist. For example, an NDC scheme with a balancing mechanism distributes the systematic longevity projection errors within the insurance collective; however, the burden is likely to be borne by cohorts much younger than those who have given rise to the imbalance, because the true outcome emerges with a considerable lag as the cohort ages. Also, even without explicit balancing, an NDC scheme may nevertheless maintain equilibrium status by not distributing the mortality credits of contributors or not granting a full internal rate of return to annuitants.⁵ Even this means of financing the longevity risk has a distributional consequence that brings into question the principle that each cohort should bear its own pooled risks. However, the very nature of the risk—that it may be driven by accelerating declines in mortality in older ages—necessarily pushes it off onto the oldest members of every birth cohort if one adheres strictly to the principle that each cohort pool should be self-financing.

The following section will address these questions within the context of NDC, discussing some of the alternative strategies that have recently been proposed in the literature to manage longevity risk within FDC schemes.

SHARING LONGEVITY RISK THROUGH LONGEVITY BONDS

Generally speaking, two types of approaches can be pursued in managing longevity risk. The first involves hedging the risk while retaining it, mostly through portfolio diversification. For instance, insurance companies can reinforce portfolio diversification effects within an annuity portfolio and explore natural hedging opportunities by combining portfolios with complementary cash flows (e.g., life insurance contracts and annuities), thereby reducing (but not eliminating completely because of basis risk) the impact of negative mortality scenarios. Alternative natural hedging solutions involve international diversification, which exploits the evidence that suggests that mortality shifts observed in different countries are not perfectly correlated, and socioeconomic diversification, which makes use of the idea that mortality shifts affect different socioeconomic groups differently. Finally, diversification may be boosted through swap agreements between parties with complementary longevity risk exposures.

The second approach involves reducing or eliminating the risk by transferring it to another party. The risk can be transferred to the insured, but if it remains in the hands of the insurer—for example, in the form of an NDC bond (see chapter 19 of this volume)—or is sold to the market by the government in the form of longevity bonds (LBs) (e.g., Blake, Cairns, and Dowd 2006; Blake, Cairns, Dowd, and MacMinn 2006; Bravo 2007). Financial LBs are essentially financial instruments with a stochastic maturity in which

future (principal or coupon) cash flows depend on the realization of a survivorship index of a selected birth cohort (see, e.g., Blake and Burrows 2001; Blake, Cairns, and Dowd 2006). The survivorship index gives the proportion of the initial reference population that is still alive at time t .

There are a number of arguments for and against government issuance of financial LBs. For example, Blake and Burrows (2001), Blake (2003), and Brown and Orszag (2006) argue in favor of government issuance of LBs, invoking some of the classic arguments for government intervention (public goods, externalities, market failures, adverse selection, intergenerational issues, etc.). Specifically, these proponents of government LBs argue that they are motivated by market failure or incompleteness; that spreading the longevity risk over a large number of taxpayers will eliminate the uncertainty in pricing longevity risk on the market; that states contribute to the increase in longevity and, therefore, should bear some of the associated risk; and that government LBs will allow more efficient intergenerational risk sharing. The argument is that whereas financial markets can spread risk across risk bearers and time, only governments have the unique power to allocate risk across both current (born) and future (unborn) generations.

Governments could also issue inverse longevity bonds (ILBs), financial instruments in which the (increasing) coupons are an inverse function of a survival index of a given cohort. These securities would be comparable to conventional inverse floaters whose coupon payments depend inversely on market interest rates. In this case, the bond would be designed to be a hedge to the issuer, which would benefit from a situation in which the survival index is higher than anticipated (conversely, the buyer gains if the index is lower than anticipated). The ILB should be a long-term bond with stochastic maturity equal to the time of death of the last survivor from the reference cohort, which means that it would make payments for as long as any member of the reference cohort is still alive. The bond would thus protect the issuer against any unanticipated improvements in mortality up to maturity (cohort extinction).

The attractiveness of this sort of bond to financial market investors is still to be proven, however. One might argue that investment banks and hedge funds may be interested in buying this bond and have a short position on longevity risk because it has low correlation with traditional market risk factors. Thus, the combination of a low beta parameter, a potentially positive alpha parameter, and an acceptable rate of return, including some compensation for the market price of longevity risk, might mean longevity-linked securities could be an attractive investment within a diversified portfolio. In this scenario, once the market is developed, it would also attract other market stakeholders—namely, speculators betting on future longevity prospects and arbitrageurs.

The issuance of LBs or ILBs in both NDC and FDC pension schemes raises some questions that must be addressed. First, the valuation of these contingent claim securities is based on a survivor index. These indexes suffer from a number of problems. They are constructed from data published infrequently and subject to reporting errors. As has been demonstrated in the preceding section, mortality data are subject to substantial variation over shorter periods of time; hence, historical data need to be smoothed, which creates uncertainty due to modeling. Indexes are also subject to integrity and contamination risk. Moral hazard problems may arise (data providers have much earlier access to data than investors). Finally, survivor indexes involve projections of future mortality and are thus

subject to all the modeling difficulties addressed in the preceding section. In sum, marketed longevity-linked securities involve significant valuation problems, both because one cannot use standard nonarbitrage arguments to price (because of market incompleteness) and because serious modeling issues exist. For these reasons, it is not at all clear how one would estimate reliably the market price of longevity risk so that LBs and ILBs could become attractive market instruments.

POOLED ANNUITY FUNDS AND GROUP SELF-ANNUITIZATION

In standard-level annuities, annuity providers bear all longevity risk. Piggott, Valdez, and Detzel (2005) and Valdez, Piggott, and Wang (2006) have proposed an alternative annuity structure in which pool participants are insured against the idiosyncratic risk but bear the systematic longevity risk. The idea is to construct a pooled annuity fund (PAF), considering groups or cohorts of retirees, and follow a group self-annuitization strategy. PAFs have many similarities with standard annuities in that the funds released by the participants who die are redistributed among the survivors, participants renounce the possibility of leaving a bequest to a designated survivor or claiming a lump sum, the decision to purchase PAF units is irreversible, and the surviving members of the pool enjoy the return on investments. The crucial difference is that benefit payments are linked to the mortality experience of the group and, as such, leave annuitants' incomes and consumption possibilities exposed to the uncertainty associated with the systematic mortality risk of the group. The institution managing the PAF acts only as an account manager. It bears neither the investment risk nor the longevity or mortality risk. In other words, PAFs transfer aggregate longevity risk from annuity providers to fund participants, offering an alternative to LBs that does not pass the risk off to the government (insurer).

PAFs present, at least in their pure format, a number of potential sources of disutility that need to be addressed. First, with systematic longevity risk, a pure PAF is expected to pay decreasing annuity benefits. The possibility that annuitants can see their payments dropping below a reasonable value may spread discontent among pensioners who were not aware of the potential uncompensated effect of future mortality improvements on their apparently guaranteed income. The distribution of future mortality (and investment) rates is ignored in this arrangement, and no allowance is made for risk aversion and for different subjective discount rates between workers and pensioners.

Second, as in other variable annuity contracts, the annuitant does not know in advance the rate of return of the pool; hence, he or she carries some risk. PAFs without additional guarantees are structured so that individuals share both mortality and investment risk in upside and downside times.

Third, in a limiting situation, no payments will be available for people who survive beyond the highest attainable age assumed in the life table used to price the contract; that is, individuals might end up with no resources to fund consumption. This situation violates the two basic postulates of a proper pension scheme: to protect the individual from outliving his or her resources and to provide longevity insurance over a full life.

Fourth, annuity providers do not bear any kind of risk: neither the longevity or financial risks, nor the systematic or idiosyncratic risks. The survivors bear all the risks. The advantage of a PAF over self-insuring is that risk exposure is borne by the pool of

retirees and is smoothed out over a long time horizon. In addition, because mortality and investment returns are largely uncorrelated, there is some chance that a negative return on investments may be partially offset by a positive inheritance effect or vice versa. In other words, the effects of the overall risk exposure could be reduced in the pooling structure. In a PAF, all annuity portfolio losses are shared among the survivors in the insured cohort (rather than among future cohorts or taxpayers at large). This scenario in itself can be considered undesirable, because the annuity pool members may already have nearly exhausted their human capital and thus have limited ability to earn more income to maintain a planned consumption level. What remains then is only to adjust their consumption in late life to their increasing longevity.

VARIABLE ANNUITIES AND INCOME DRAWDOWN PROGRAMS

One group of private insurance products that may be appropriate in a financial context but is clearly inappropriate in the NDC context is phased withdrawals. The literature abounds with models that appeal to individuals who prefer more consumption now at the expense of consumption in the future or who have low levels of risk aversion. Phased withdrawals, transfer consumption possibilities to the present, leaving only minimal benefits at the end of life. Clearly, this sort of arrangement is unattractive from the societal point of view if it opens the door to moral hazard.

Milevsky (2005) has proposed a deferred inflation-adjusted life annuity contract called *advanced-life delayed annuity* (ALDA). This product would be acquired at a given (young) age, would be paid over a long period by installments, and would have no cash value (lump-sum) payment or survival benefit. In such a contract, the deferment period can be seen as a deductible because the policyholder finances his or her consumption without the help of saving converted into an annuity until some advanced age (e.g., 80 to 90 years old), after which the insurer starts paying the annuity, provided that the annuitant is still alive. The ALDA is thus very similar to the decision to claim an NDC benefit where the retirement age is a choice variable. Postponing the retirement age, fully or partially, in an NDC scheme means that the insured individual must use his or her own private resources to cover the waiting years. Because this decision occurs at the juncture of the working age to the retirement age, the individual can still cover current consumption using his or her own human capital to earn market income or he or she can draw on private saving prior to claiming the annuity.

In Milevsky's ALDA, the life expectancy factor used in computing the annuity is published. Individuals adapt their choice of retirement conditional on this number and personal preferences. By postponing the option to claim a life annuity, individuals voluntarily leave their capital balances in the equity market. Because the life expectancy index figure is publicly available, the annuitant is able to adjust his or her consumption level during the deferment period. One can also think of alternative indexing mechanisms for the ALDA, for example, by adjusting the benefit commencement date according to the evolution of a given longevity index. This approach could be compared to indexing the minimum age at which an NDC benefit can be claimed to a life expectancy index. In essence, the ideas behind the ALDA are similar to those already discussed extensively for an NDC scheme. The difference is, of course, that the NDC scheme participant can have no rate of return gain equivalent to keeping money in the equity market in an FDC scheme by postponing retirement, albeit

one could imagine that the NDC provider could publish *ex post* the development—and perhaps even a projection—of the internal rate of return.

An alternative strategy that can be considered for an NDC scheme is to transfer some of the longevity risk to younger pensioners through a variable annuity that is revised at specific ages. The annuity would be a standard-level annuity adjusted periodically (e.g., every five years) to accommodate new information on the longevity prospects of the insurance pool. With a minimum pension age of, for example, 65 years, revisions could be made every five years up to a ceiling age such as 80 years. Alternatively, an index could be revised at shorter intervals. Of course, the closer the longevity projection is to reality, especially in the younger years, the closer annuities come to being fixed annuities. After the ceiling age, the government (taxpayers) would take over the entire risk. Alternatively, the remaining risk could be transferred to scheme participants still in the accumulation phase.

Financial pension schemes and variable annuity contracts can include protection mechanisms in the form of minimum benefits and value or return guarantees. The difficulty with financial guarantees is that they usually come at the expense of higher returns, because the guarantee must be based on a “safe” investment—for example, sovereign debt instruments. Guarantees can also encourage undesirable behavior. For example, a high guarantee might be sufficient to encourage some people on the margin to retire earlier. At the other extreme, if individuals have command over their own portfolio investment decisions, a high guarantee could encourage more speculative behavior. Perhaps the best form of guarantee is that the government (taxpayers) bear the systematic longevity risk from a certain age, as, for example, an NDC bond (already discussed) does.

In sum, what most of the methods for dealing with the longevity risk proposed in the literature and used in practice by companies in the private insurance market have in common is that they pass on the longevity risk to plan participants. In countries that have NDC schemes, the scheme may be the main or only pension for a large percentage of the population. In that case, the general population will not be able to postpone claiming an annuity to a very advanced age. Neither is considering products with voluntary phased withdrawals that allow people to claim a large percentage of their total accounts when young—say, in the age range of 65 to 80 years—feasible. What is left, then, for the insurer is to use very conservative life expectancy estimates in computing life annuities from a younger age; to use methods that entail periodically revising annuities to keep payments in line with new longevity estimates, or to pass on remaining risk to younger scheme participants or the government.

Estimated Effects of Adjusting Annuities with Changing Life Expectancy

This section examines the consequences for the insurer and the insured of variable instead of fixed annuities, i.e., annuities that are periodically revised. The overriding questions being addressed are whether one can counteract the effect of accelerating (decelerating) changes in mortality on the finances of the insurer and, if so, what the consequences are for the individual. The procedure examined for creating a variable annuity is tantamount to creating a new life insurance pool, PAF, as discussed previously, for the remaining

survivors at specified ages or indexing annuities with periodic adjustments based on revised life expectancy estimates.

THE FRAMEWORK OF THE ANALYSIS

The analysis is limited to the four Scandinavian countries: Denmark, Finland, Norway, and Sweden. The advantage in studying these countries is that they have a long time series of mortality data, dating back at least to 1903 for all four countries. The long historical time series makes possible the comparison of actuarial estimates with actual outcomes for a large number of cohorts covering a lengthy period of time.

This section's strategy is to examine the consequences of granting fixed annuities compared with revising annuities at five-year intervals using mortality data for people turning 65 years old in 1943, 1948, 1953, 1958, 1963, 1968, and 1973. Cohorts are followed up to the age of 100, which means the last cohort examined is that which reached 65 in 1973 and whose surviving members in 2007 had turned 99 years old.

Like the insurer's actuary, to perform this exercise, one has to make some decisions about the method chosen to project life expectancy, given current statistical knowledge and available data. The first decision is the choice of statistical model and the second is the choice of estimation period. The model chosen to estimate life expectancy for this exercise is the original Lee-Carter model already presented. The reason for this choice is that actuarial groups and government statistical agencies frequently choose this model these days. This choice enables the study of the performance of a widely used model.

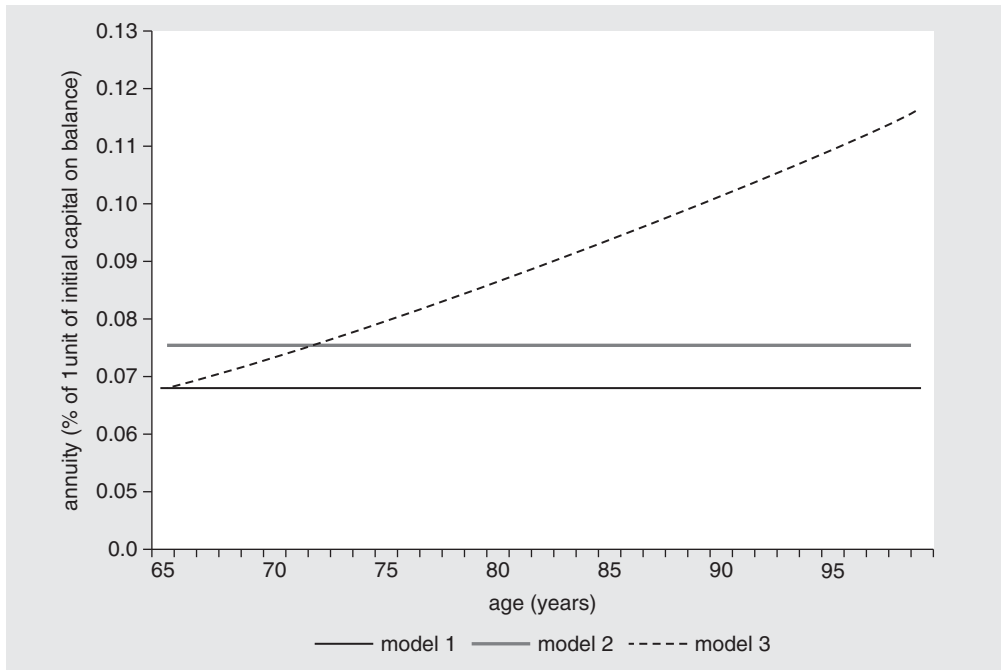
The Lee-Carter model is fitted for each country using the full length of the database for each new revision, which means that all estimates start with the data point 1903 and the length of the estimation period increases with each new estimate. Data were first aggregated to five-year age groups and averaged over five years to create a smooth series. Table 22A.1 in annex A presents an overview of the setup of the estimation periods. An alternative strategy was tested that estimated the Lee-Carter model with data from only the most recent 25-year period up until the year when the cohort turns 65. This procedure did not, however, yield a decisively better result.

Figures 22A.1 to 22A.4 in annex 22A show the projection errors for the four countries as a percentage of the de facto final outcome for the cohort. Values below zero mean that the projection underestimated mortality and, hence, life expectancy. The results tend to reflect the picture of the changes in the rate of decline in mortality looked at earlier in figure 22.2 in the discussion on projecting mortality. The picture that this exercise presents is that the model predominantly underestimates longevity.

RESULTS

In practice, private insurers and countries running NDC and other public pay-as-you-go schemes can and do construct annuities in many ways. Figures 22.5 and 22.6 compare fixed and variable annuities for three possible ways of incorporating a rate of return into the annuity calculation, including not doing it at all. The examples are constructed on the basis of the actual life profile from ages 65 to 100 for the cohort of Swedes who turned age 65 in 1958.

FIGURE 22.5 Annual benefits: Fixed annuity at age 65 with different indexation rules



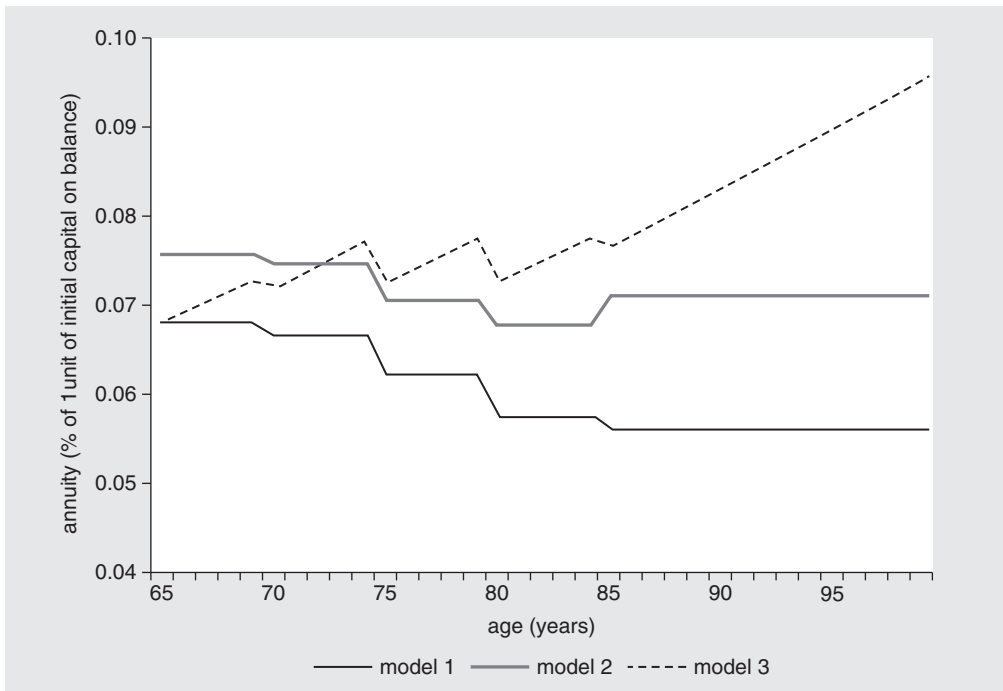
SOURCE: Authors' calculations.

NOTE: Model 1 = no indexation; model 2 = annuity front-loaded with an annual return of 1.6 percent (standard annuity model); model 3 = basic annuity indexed annually with a return of 1.6 percent.

The fixed annuity is fixed for life at age 65. The variable annuity is also fixed at age 65 but is then revised in accordance with new life expectancy estimates at ages 70, 75, 80, and 85, when it is then fixed for the remaining life of the annuitant. The three models of incorporating the internal rate of return or indexation into benefits are as follows:⁶

- Model 1 is the basic annuity *without* a rate of return or indexation, determined solely by (a) the amount of capital on the individual's account and (b) the estimated life expectancy of the retiring cohort at the assumed retirement age of 65. This approach provides a benchmark for examining the results of different means of indexation.
- In model 2, the annuity is front-loaded with a lifelong rate of return. For purposes of illustration, annual rates of 1.6 and 3.0 percent are chosen. This example illustrates the standard annuity model used especially in private, prefunded insurance schemes.
- Model 3 starts out with the same annuity value as model 1 but follows the yearly indexation procedure used for many public pay-as-you-go schemes, with no front-loading with a lifetime return but instead with successive yearly indexation over the cohort's entire life.

FIGURE 22.6 Variable annuity models



SOURCE: Authors' calculations.

NOTE: Model 1 = no indexation; model 2 = annuity front-loaded with an annual return of 1.6 percent (standard annuity model); model 3 = basic annuity indexed annually with a return of 1.6 percent.

Among NDC schemes currently in operation, Italy and Sweden combine model 2 with model 3—that is, the annuity is both front-loaded and indexed. Other original NDC countries currently use some variant of model 3, such as price indexation (e.g., Chłoń-Domińczak, Franco, and Palmer 2012).

Tables 22.1, 22.2, and 22.3 show the financial outcomes relative to the funds available when the entire cohort's capital is put into the insurance pool at an assumed age of retirement for all at age 65. The first and most important conclusion is that the variable annuity reduces *both* deficits and surpluses for almost all pools of new pensioner cohorts in all four countries. The few exceptions can be surmised to be driven by the age distribution of longevity, but in the examples examined here, the differences between the financial outcomes for the fixed and variable annuities are small.

Figures 22.5 and 22.6 show how the individual models distribute benefits throughout the life of the annuitant. What is noteworthy is that the variable annuity without front-loading creates an unstable benefit profile. This instability is a result of incorrect projections associated with accelerating (and decelerating) improvements in mortality in one or more of the older age groups, either shortly before or after the model has been estimated. This feature of mortality development is present in all four countries—albeit with different time profiles. Among the four countries, the acceleration in the decline in mortality came the earliest in Sweden, where the effect of the introduction of the variable

TABLE 22.1 **Relative deficits or surpluses under the fixed and variable model without any form of indexation: Model 1**

Year	Sweden		Norway		Denmark		Finland	
	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)
1943	3.20	-0.42	0.13	-0.89	-1.36	-0.38	-3.37	-0.28
1948	-4.99	-0.38	-2.61	-0.41	-4.36	-0.48	-0.63	-0.19
1953	-3.25	-0.02	1.52	-0.83	-2.97	-0.01	-2.77	-0.31
1958	-7.02	-0.26	0.39	-0.61	-4.60	-0.09	-6.34	-0.21
1963	-6.23	-0.05	-2.42	-0.62	-5.08	0.11	-11.19	0.25
1968	-1.94	-0.30	-0.12	-0.41	-0.51	0.14	-8.32	-0.12
1973	-3.76	-0.32	-5.46	-0.51	-1.50	-0.43	-9.60	-0.12

SOURCE: Authors' calculations.

TABLE 22.2 **Relative deficits or surpluses under the standard fixed and variable model: Model 2**

Year	Sweden		Norway		Denmark		Finland	
	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)
1943	9.15	0.42	4.77	0.06	2.38	0.52	0.79	0.46
1948	-2.30	0.34	0.44	0.51	-2.05	0.23	4.44	0.45
1953	0.06	1.06	6.74	0.14	0.39	1.05	1.19	0.34
1958	-5.44	0.81	5.33	0.36	-1.75	1.03	-3.77	0.45
1963	-4.21	1.18	1.45	0.40	-2.31	1.46	-10.56	1.27
1968	-2.84	0.92	0.10	0.74	-0.62	1.59	-12.68	0.99
1973	-0.90	0.95	-3.17	0.69	2.49	0.91	-9.04	1.12

SOURCE: Authors' calculations.

covers almost the entire estimation period. What model 2 suggests is that this effect can be counteracted by an internal rate of return that is greater than the effect of variable annuity adjustment arising because of errors in projecting life expectancy in periods of accelerating and decelerating mortality.

Of course, the positive effect of a sufficiently higher rate of return will completely counteract the negative effect of the longevity adjustment on the lifetime profile of the variable annuity.

The models have different distributional outcomes. Models 1 and 2 favor younger annuitants, and model 3 favors older ones. The annuity in model 2 accounts for the fact

TABLE 22.3 Relative deficits or surpluses under the fixed and variable annuity model with indexation: Model 3

Year	Sweden		Norway		Denmark		Finland	
	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)	Fixed (%)	Variable (%)
1943	5.6	-0.74	0.2	-1.55	-2.4	-0.66	-5.9	-0.49
1948	-8.7	-0.66	-4.6	-0.71	-7.6	-0.83	-1.1	-0.32
1953	-5.7	-0.04	2.6	-1.44	-5.2	-0.02	-4.8	-0.54
1958	-12.2	-0.45	0.7	-1.07	-8.0	-0.15	-11.1	-0.37
1963	-10.9	-0.09	-4.2	-1.07	-8.8	0.19	-19.5	0.44
1968	-9.1	-0.51	-5.7	-0.71	-6.6	0.24	-21.6	-0.20
1973	-6.6	-0.57	-9.5	-0.88	-2.6	-0.74	-16.7	-0.20

SOURCE: Authors' calculations.

that more money will come in the future; therefore, a higher constant stream is possible from the beginning, which is distributed equally to all participants over their entire life. In model 1, any internal rate of return that arises remains with the insurer, which means that deficits are overstated and surpluses understated. In a private financial scheme, this situation suggests that the insurer is making an excess profit. In a government NDC scheme, it suggests that money is left over, which is contributed to general government revenues.

Model 3, with the fixed annuity, is the most expensive of all three models, and it is not actuarially cost neutral. Hence, an NDC scheme based on model 3 goes beyond the actuarially fair standard annuity in its “promise”—given the initial capital of the cohort pool, actual life expectancy, and the internal rate of return. For that reason, it requires either an externally financed subsidy or a balancing mechanism that distributes the extra cost among the participants. In both cases, the outcome is likely to be in favor of those with long lives. A balancing mechanism distributes the cost among all or some participants, depending on the distributional rule accompanying the country's specific balancing mechanism. Without balancing, the government must cover the risk that new funds will be needed—or must collect subsidy revenues. The two mechanisms will generally have different distributional profiles.

In sum, the variable annuity does its job financially. It brings the actual payments for the entire insurance pool very close to the funds available, given the insurance pool's initial capital, the development of life expectancy, and the rate of return. Generally speaking, the procedure reduces the residual deficit for the standard annuity model to below 1 percent. The remaining error in the examples occurs because the annuity is fixed from age 85. The error is greater—but still generally less than 1 percent with the straightforward indexation procedure. The higher the rate of return is in the standard annuity model, the more likely it is that the annuitant will not have to experience a benefit

decline attributable to the repercussion of reestimating life expectancy in the variable annuity model.

As for individual results, if the standard front-loaded variable annuity model is used, the negative effect on lifetime benefits and utility of the downward adjustment associated with recalculating annuities is counteracted by an internal rate of return that is sufficiently high. There can be no guarantee, however, that this scenario will be the case in practice, because periods may exist in which low internal rates of return coincide with extraordinary improvements in life expectancy, thereby creating stress from both factors.

Summary and Conclusions

In the ideal NDC world, every birth cohort pays for itself through intracohort distribution of mortality credits, and when the last life has expired, aggregate cohort account balances should, in principle, turn out to have been just enough to cover the annuities paid. Or, viewed over the complete lives of a number of cohorts, the net deficit or surplus is expected to be and is generally zero. The purpose of this chapter has been to discuss why such an ideal scenario is unlikely and what can be done about it.

The point of departure was the documented difficulties countries have with projecting life expectancy for the calculation of annuities. The chapter identified an important source of error—namely, that caused by accelerating decline in mortality. The pattern appears to run over time from younger to older cohorts and is at present confounding the statistical estimates of mortality that governments and actuaries use to project the life expectancy of and annuities for pensioners. Japan, one of the world leaders in the life expectancy ranking, is now experiencing acceleration in life expectancy among people age 85 and older. Many other countries in the top-50 ranking examined are also experiencing acceleration in mortality improvements, but at lower ages.

The overriding conclusion of this study is that reduction of the systematic longevity risk has to begin with better statistical models for projecting life expectancy and that these models must be designed to capture accelerating improvement in mortality. More generally, statistical models must be improved by incorporating alternative ways of viewing the data. Systematic underestimation of improvements in life expectancy must stop, and a more normal order must be established with unbiased estimates that are sometimes too high and sometimes too low. Regardless of how good estimation procedures can be, some degree of residual uncertainty will always remain, which should be characterized quantitatively using empirical data. Indeed, if one is to use statistically computed life expectancy factors to calculate annuities, access to high-quality data on mortality is a must. Predictive uncertainty cannot be eliminated completely, but rational decision making under uncertainty can be made more feasible.

This chapter has discussed the sharing of the longevity risk through longevity bonds. The most straightforward way to do so is by adopting NDC bonds to cover the system's liabilities. Then, by definition, even liabilities that arise because of forecasting error are covered. In essence, the NDC administration would use state-of-the-art technology to produce the best projection possible, and the residual error would be covered through the bond. The NDC bond passes the residual risk on to the government (taxpayers).

An alternative is to borrow ideas from the financial literature on PAFs for a single cohort or group self-annuitization for several cohorts. In a PAF, the future value of annuity benefits remains constant over the whole contract unless deviations from expected mortality rates are observed. In such a case, the remaining capital is distributed among survivors. In a system built up around solvency ratio and internal balancing, such as the Swedish asymmetric system, a PAF offers a choice to passing on the longevity error to future cohorts through future balancing. However, this strategy can be problematic in a public mandatory pension context because it means older members of the cohort who have already exhausted their human capital will be the ones who pay. Hence, the PAF covers the individual mortality risk but not the systematic risk that the group as a whole will live too long. If a country were to choose this approach, individuals interested in a smooth consumption path over the life cycle would have to save as young pensioners to provide for themselves as older pensioners. Under such a circumstance, the system does not fully cover the risk of being one of those who lives the longest.

To cope with this drawback of a PAF, the policy maker could consider running the system as a PAF up until some more advanced age (e.g., age 80) and then fixing the annuity for those still in the insurance pool. Another alternative is to consider a capped PAF in which the pensioners bear only a fraction of the demographic uncertainty. For example, the factor determining the percentage covered by the participants (the government) could decrease (increase) with time. In this perspective the PAF is a sort of variable annuity. The chapter also discussed the pros and cons of other possible ways of creating variable annuities suggested in the financial literature. Perhaps the simplest approach would be an adjustable longevity annuity—a standard-level annuity that is adjusted periodically to take new information into account, for example, every five years.

The chapter then turned to the question: what does a variable annuity mean for the distribution of the residual risk? A simple variable annuity was devised with periodic five-year adjustments to investigate what the deferment of fixing the annuity would mean for the distribution of the residual risk between the insurer and the risk pool participants. Long time series data from Denmark, Finland, Norway, and Sweden were used for birth cohorts claiming an annuity at the age of 65 from 1943 through 1973, where each annuitant cohort was followed up to the age of 99 (the last cohort was 99 years old in 2007).

The analysis demonstrated that Scandinavian insurers would have lost money on fixed annuities from age 65, seen over the entire historical period examined here, had they followed a simple statistical trend-based procedure as embodied by the Lee-Carter model. With variable annuities, both insurer deficits and surpluses can become minimal if the annuity is adjusted into higher ages (here age 85). In the standard annuity model, the downward adjustments in annuities that necessarily follow readjustments as the annuitant ages can be counteracted by a sufficiently high internal rate of return. Of course, both mortality improvement and the rate of return are exogenously determined, so if the insurer (the government in an NDC scheme) wants to guarantee a nondeclining annuity, it will have to cover the risk through general revenues.

The results show that prescribing a generic model that will minimize the systematic risk and, in addition, fit all countries in all phases of development—and, hence, the losses for both the insurer and the insured—is impossible. This result is not encouraging,

but neither is it surprising. The results also show that some party has to bear the residual risk, which will always be present. The example without an internal rate of return shows that the annuitant clearly bears the risk. In reality, the insurer (the government) can afford to pay the internal rate of return, which, if high enough compared to the necessary annuity adjustments in the variable annuity model, can counteract the negative effect on the benefit of older annuitants. Of course, better prediction models will help minimize the residual systematic risk, but statistical modeling will never be perfect. This chapter's examination of the data for four countries suggests that the models proposed in the current finance literature shift the risk from the insurer to the participants such that older members in the cohort are likely to bear an increasing share of the residual systematic risk because they go through a longer series of adjustments. This distribution is socially undesirable; the younger population has more capacity to adjust. The alternative, to spread the residual risk among general taxpayers through an NDC bond or some similar mechanism, may, in the end, prove to be the only socially acceptable alternative.

Annex 22A: Tables and Figures for Analysis of the Estimated Effects of Adjusting Annuities with Changing Life Expectancy

Table 22A.1 in annex A presents an overview of the setup of the estimation periods used in modeling mortality under the Lee-Carter method. Figures 22A.1 to 22A.4 in annex A show the errors in projected remaining life expectancy for the four countries studied.

Annex 22B: Model Setup

This annex shows details of the setup of the three annuity models discussed in the chapter, both with a fixed annuity and with a variable annuity.

THE FIXED ANNUITY MODELS

Model 1: The fixed annuity model without indexation. The initial annual benefit at age 65 is determined by the initial account balance and the projection of the remaining cohort life expectancy at age 65. It remains the same for all future years after age 65.

Mathematically, the model is expressed as follows:

$$B_{65,t} = \frac{c_{65,t}}{\widehat{cle}_{65,t}} \quad (22B.1)$$

$$B_{x,t} = B_{65,t} \text{ for } x > 65, \quad (22B.2)$$

where $C_{65,t}$ is the initial account balance of an individual of t cohort at the beginning of age 65, and $\widehat{cle}_{65,t}$ is the projected remaining life expectancy of t cohort at age 65.

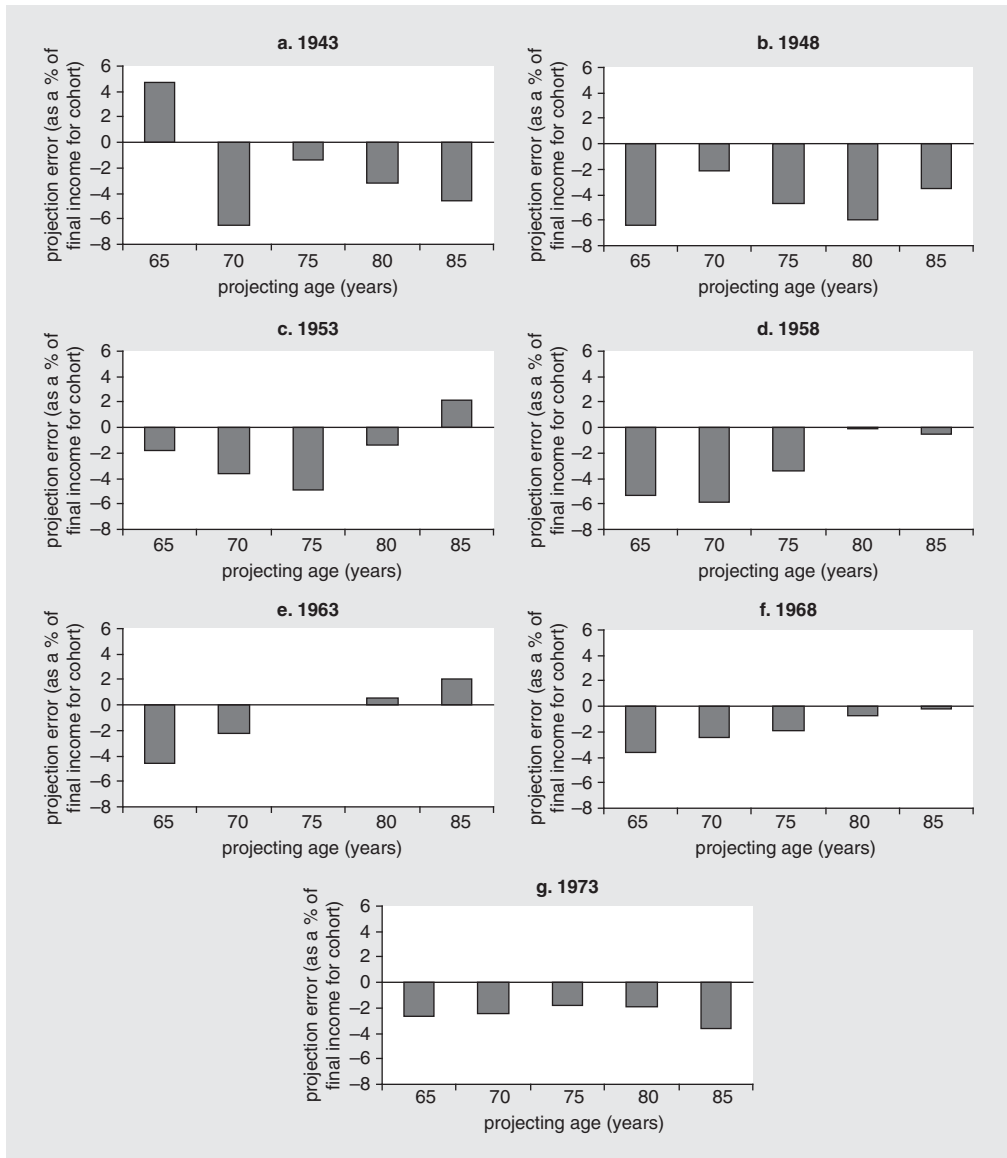
Model 2: The standard fixed annuity model. The initial annual benefit at age 65 is determined by the initial account balance, the projection of the remaining cohort life

TABLE 22A.1 **Overview of the use of historical information in modeling mortality with Lee-Carter model**

Cohort ID	Data periods for estimation using the entire data series					Data period for estimation using 25-year data				
	65	70	75	80	85	65	70	75	80	85
1943 Cohort	1903–42	1903–47	1903–52	1903–57	1903–62	1918–42	1923–47	1928–52	1933–57	1938–62
1948 Cohort	1903–47	1903–52	1903–57	1903–62	1903–67	1923–47	1928–52	1933–57	1938–62	1943–67
1953 Cohort	1903–52	1903–57	1903–62	1903–67	1903–72	1928–52	1933–57	1938–62	1943–67	1948–72
1958 Cohort	1903–57	1903–62	1903–67	1903–72	1903–77	1933–57	1938–62	1943–67	1948–72	1953–77
1963 Cohort	1903–62	1903–67	1903–72	1903–77	1903–82	1938–62	1943–67	1948–72	1953–77	1958–82
1968 Cohort	1903–67	1903–72	1903–77	1903–82	1903–87	1943–67	1948–72	1953–77	1958–82	1963–87
1973 Cohort	1903–72	1903–77	1903–82	1903–87	1903–92	1948–72	1953–77	1958–82	1963–87	1968–92

SOURCE: Authors' calculations.

FIGURE 22A.1 **Error in projected remaining cohort life expectancy by the basic Lee-Carter model of Sweden**



SOURCE: Authors' calculations.

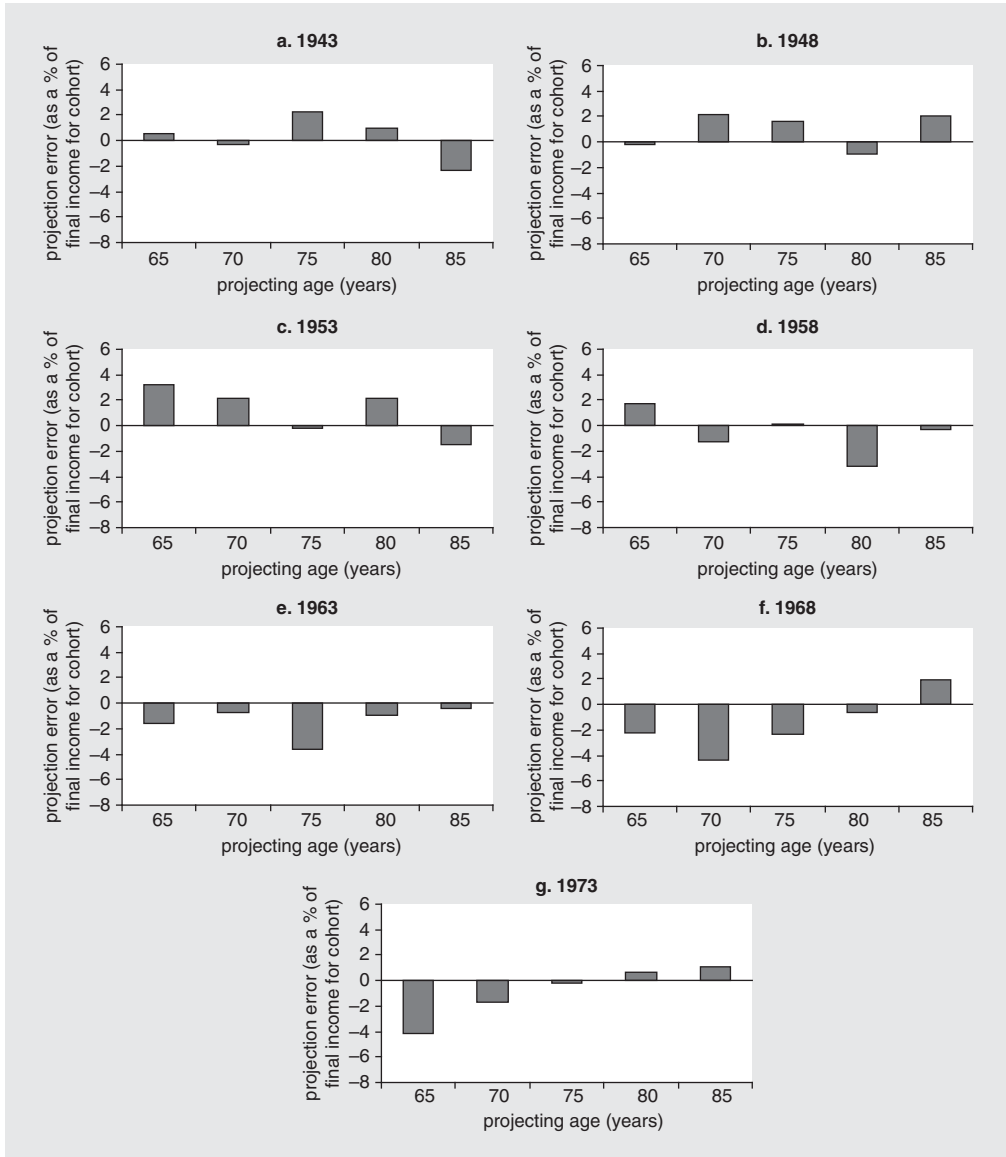
NOTE: Positive percentage means overestimation and negative percentage means underestimation.

expectancy at age 65, and the internal rate of return (1.6 percent per year). It remains the same for all future years after age 65.

Mathematically, the model is expressed as follows:

$$B_{x,t} = \frac{C_{x,t}}{\sum_{y=x}^{99} (1+r)^{-y+65} \cdot {}_y p_x} \text{ for } x \in \{65, 70, 75, 80, 85\} \quad (22B.3)$$

FIGURE 22A.2 **Error in projected remaining cohort life expectancy by the basic Lee-Carter model of Norway**



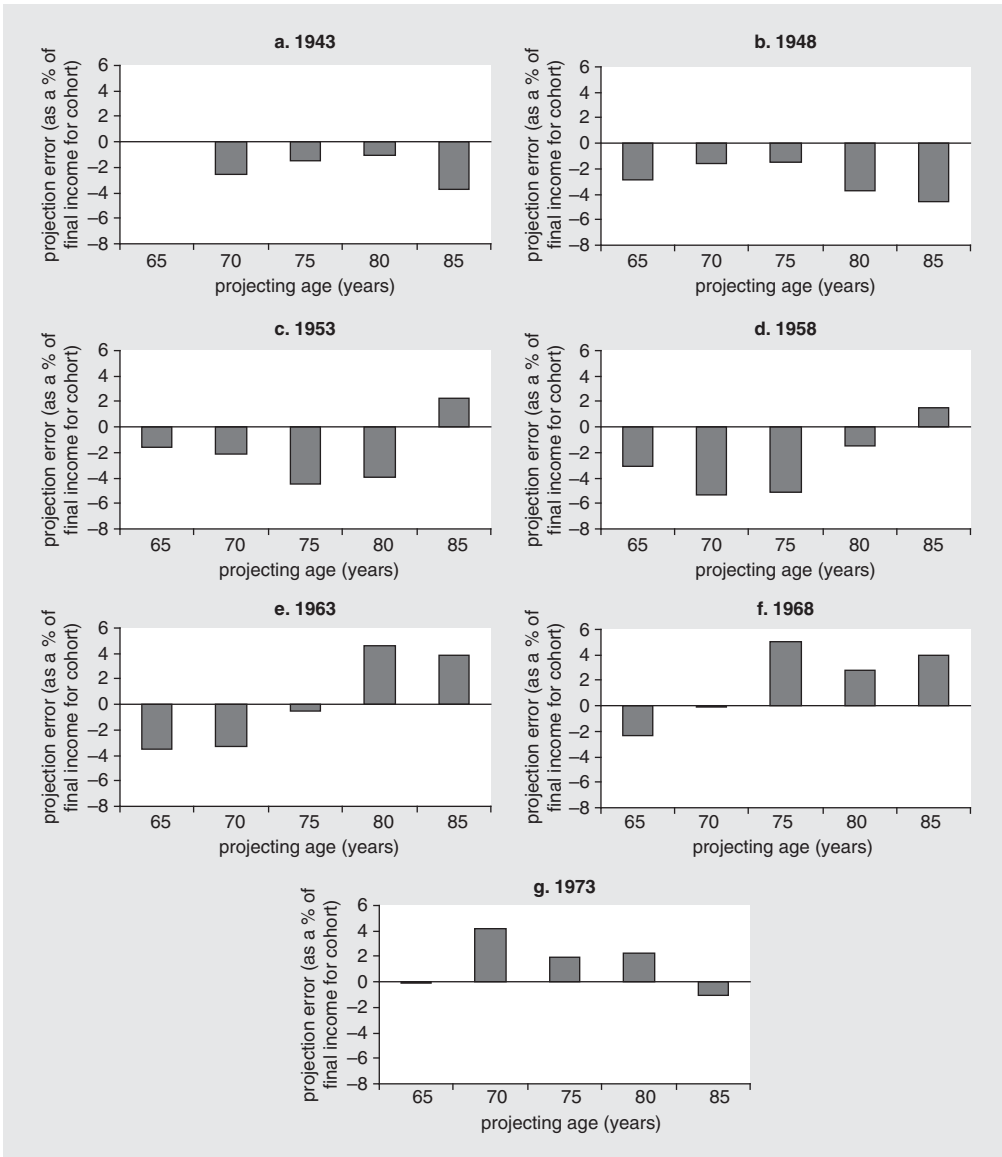
SOURCE: Authors' calculations.

NOTE: Positive percentage means overestimation and negative percentage means underestimation.

$$B_{x,t} = B_{65,t} \text{ for } x > 65. \tag{22B.4}$$

Model 3: The fixed annuity model with indexation. The initial annual benefit at age 65 is determined by the initial account balance and the projection of the remaining cohort life expectancy at age 65. It grows at the rate of 1.6 percent per year for all future years after age 65.

FIGURE 22A.3 Error in projected remaining cohort life expectancy by the basic Lee-Carter model of Denmark



SOURCE: Authors' calculations.

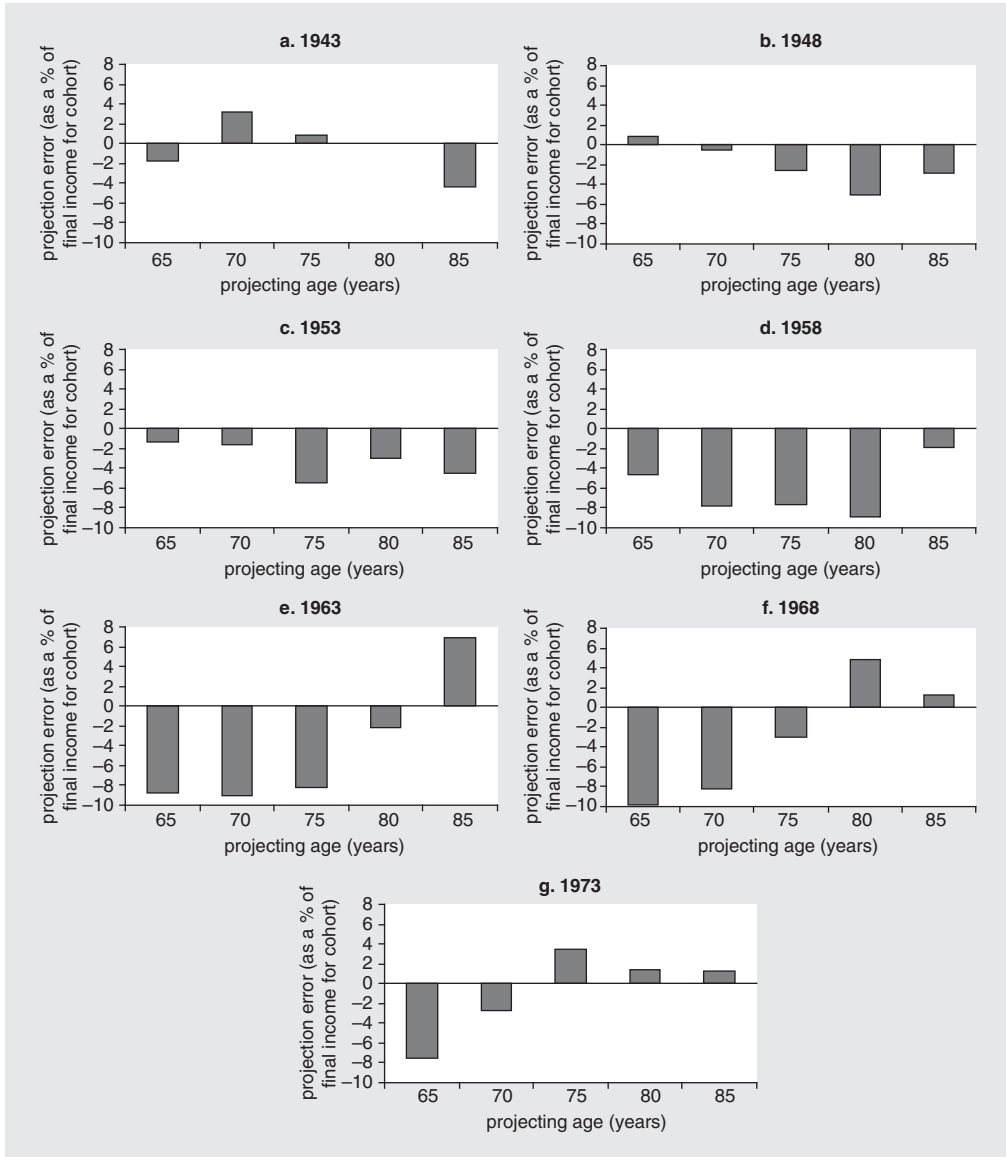
NOTE: Positive percentage means overestimation and negative percentage means underestimation.

Mathematically, the model is expressed as follows:

$$B_{65,t} = \frac{c_{65,t}}{cle_{65,t}} \tag{22B.5}$$

$$B_{x,t} = B_{x-1,t} \times (1+r), \text{ for } x > 65. \tag{22B.6}$$

FIGURE 22A.4 **Error in projected remaining cohort life expectancy by the basic Lee-Carter model of Finland**



SOURCE: Authors' calculations.

NOTE: Positive percentage means overestimation and negative percentage means underestimation.

THE VARIABLE ANNUITY MODELS

Model 1: The variable annuity model without indexation. The initial annual benefit at age 65 is determined by the initial account balance and the projection of the remaining cohort life expectancy at age 65. It remains the same for the following four years from age 66 to age 69. At the beginning of age 70, it is adjusted according to the new projection of remaining cohort life expectancy at age 70 and the account balance at age 70, which

is updated by redistributing the money from deceased individuals to survivors every year. This process is repeated every five consecutive years up to age 85.

Mathematically, the model can be expressed as follows:

$$B_{x,t} = \frac{C_{x,t}}{\widehat{cle}_{x,t}} \text{ for } x \in \{65, 70, 75, 80, 85\}. \quad (22B.7)$$

$$B_{x,t} = B_{x-1,t} \text{ for } x \in [66, 69] \cup [71, 74] \cup [81, 84] \cup [86, 99]. \quad (22B.8)$$

$$C_{x,t} = 1 \text{ for } x = 65. \quad (22B.9)$$

$$C_{x,t} = (C_{x-1,t} - B_{x-1,t}) \div \frac{l_x}{l_{x-1}} \text{ for } x \in [66, 99]. \quad (22B.10)$$

Model 2: The standard variable annuity model. The initial annual benefit at age 65 is determined by the standard annuity formula. It remains the same for the following four years (ages 66–69). At the beginning of age 70, the annual benefit is adjusted by applying the remaining cohort life expectancy and the account balance at age 70 to the standard annuity formula. The account balance is updated every year by redistributing the money from deceased individuals to survivors, and the money grows at the same rate of return. This process is repeated every five consecutive years up to age 85.

Mathematically, the model can be expressed as follows:

$$B_{x,t} = \frac{C_{x,t}}{\sum_{y=x}^{99} (1+r)^{-y+65} \cdot {}_y p_x} \text{ for } x \in \{65, 70, 75, 80, 85\} \quad (22B.11)$$

$$B_{x,t} = B_{x-1,t} \text{ for } x \in [66, 69] \cup [71, 74] \cup [76, 79] \cup [81, 84] \cup [86, 89]. \quad (22B.12)$$

$$C_{x,t} = 1 \text{ for } x = 65. \quad (22B.13)$$

$$C_{x,t} = \left[(C_{x-1,t} - B_{x-1,t}) \times (1+r) \right] \div \frac{l_x}{l_{x-1}} \text{ for } x \in [66, 99]. \quad (22B.14)$$

Model 3: The variable annuity model with indexation. The initial annual benefit at age 65 is determined by the projection of the remaining cohort life expectancy at age 65 and the initial account balance. From age 66 to age 69, the annual benefits grow at the rate of 1.6 percent (r) per year. At the beginning of age 70, the remaining cohort life expectancy is reestimated, and the account balance is reevaluated. On the basis of these two new estimates, the annual benefits are adjusted. This process is repeated every five consecutive years up to age 85.

Mathematically, the model can be expressed as follows:

$$B_{x,t} = \frac{C_{x,t}}{\widehat{cle}_{x,t}} \text{ for } x \in \{65, 70, 75, 80, 85\} \quad (22B.15)$$

$$B_{x,t} = B_{x-1,t} \times (1+r) \text{ for } x \in [66,69] \cup [71,74] \cup [76,79] \cup [81,84] \cup [86,89]. \quad (22B.16)$$

$$C_{x,t} = 1 \text{ for } x = 65. \quad (22B.17)$$

$$C_{x,t} = \left[(C_{x-1,t} - B_{x-1,t}) \times (1+r) \right] \div \frac{l_x}{l_{x-1}} \text{ for } x \in [66,99]. \quad (22B.18)$$

Notes

The authors are grateful to Yuwei de Gosson de Varennes for her invaluable assistance in performing the calculations and producing the figures for this chapter.

1. The Human Mortality Database is a collaborative project of the Department of Demography at the University of California at Berkeley and the Max Planck Institute for Demographic Research. It can be accessed at <http://www.mortality.org>.
2. The *age-specific mortality rate* is the ratio of the number of deaths in age x during year t to the person-years lived in age x during year t , as defined previously. The estimates are based on combined male and female data.
3. This is what the age-specific mortality rate estimates.
4. In private insurance, annuity providers may even adopt multidecrement life tables, incorporating additional risk factors (smoker status, benefit amount, socioeconomic category, etc.).
5. In principle, Latvia and Poland have chosen this approach.
6. Annex 22B shows more specific details.

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CHAPTER 22

COMMENT

Heikki Oksanen

Chapter 22, by Juha Alho, Jorge Bravo, and Edward Palmer, first, very usefully documents the difficulties in projecting life expectancy, establishing statistically the fact that it was the *acceleration* of the increase in the past that caused the projections to be systematically biased downward. Second, it discusses the various ways of applying variable annuities to nonfinancial (notional) defined contribution (NDC) pensions. The aim of analyzing them is to arrive close to the ideal of treating each successive generation fairly, especially by adjusting NDC pensions so that the number of years in retirement, affected by longevity but not fully known in advance, is duly taken into account and total pension income matches, without systematic error, the contributions paid by the scheme members.

As to the first issue, the chapter discusses statistical methods for eliminating the bias caused by acceleration of the life expectancy increase in the past. Alho, Bravo, and Palmer are certainly right in concluding that the observation of acceleration in the most advanced countries can be fruitfully used to improve the projections for most other countries, because they lag and will presumably follow the same pattern. The authors note but do not really look closely into the real factors behind past acceleration, rather confining themselves to the view that the return on the additional effort in terms of forecasting accuracy may be small and already captured in the improved statistical method, which does not require data on the underlying factors. However, we should be wary of this conclusion, because acceleration clearly will not continue forever, as also noted by the authors with reference to Japan, where it has now shifted to the oldest cohorts. Therefore, the thorniest issue will be to correctly predict the moment when the acceleration ceases. This issue is naturally a general and unavoidable problem with all projections when we do not fully know the underlying factors, not to speak about their paths in future: we tend to adjust the projection only when a sufficient amount of diverging data has accumulated, and as a consequence, at the turning point, we make an error in the other direction.

Trying to look more carefully at the factors driving longevity increase is naturally costly, and expected costs and benefits should be balanced also in research, but here one alleviating factor is that better knowing the underlying mechanisms can also be useful for many purposes other than just improving projection accuracy.

The chapter discusses the issue of uncertainty in life expectancy projections in the context of NDC annuities. To keep it in perspective, I would like to address this issue against the bigger picture of transfers across generations, commenting first on public policies other than public pensions and stressing that the uncertainty about life expectancy

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easily causes even greater problems for types of public pension systems other than NDC and that private fully funded defined contribution (DC) systems are exposed to this uncertainty.

The Big Picture

In European welfare states over the 30 years after World War II, public policies contributed to creating unprecedented prosperity for the existing generations and potentially laying the foundations for well-being for all future generations. Both moral philosophy and welfare economics fall short in providing a framework for the normative questions as to what was fair across generations in the past and also what will be fair in the future, given apparently irreversible issues such as the exhaustion of nonrenewable energy sources and the exposure of the globe to climate change. To express this problem in a technical way, we can say that we do not have an indisputable social discount rate for making comparisons across generations in (potentially) growing economies, especially because growth is partly endogenous and partly exogenous.

Although we are not able to express the choice between alternative public policies on energy and climate in terms of stocks of wealth, we can probably agree that these are the most important policy areas with respect to what we leave behind to future generations. However, the public pension system is the policy area that is quite clearly the next most important in terms of potential effects on intergenerational transfers and fairness. In this area, we can put a rough number on the ongoing or potential redistribution across generations, starting from the effects brought about by establishing the public pension systems in European welfare states after World War II. Let us think in terms of generations succeeding each other at 30-year intervals (the average age of mothers when giving birth; also the average age of pensioners is roughly 30 years more than the average age of workers). In Western Europe after World War II, pay-as-you-go (PAYG) public pension systems were established over a period of roughly 30 years. The implicit pension debt to be carried over to the next generation, even in European welfare states, where the burden is relatively moderate, is 200 to 300 percent of annual gross domestic product (GDP). Without pension reforms, under the demographic change taking place in the next few decades, this debt can be projected to grow by 100 percent of GDP.

Letting such an increase in the implicit pension debt happen would break actuarial neutrality across generations, which can be regarded as a relevant benchmark for intergenerational fairness; that is, generations pay in what they get out (as the authors describe the basic principle of NDC). Also, any realistic reforms partially privatizing public pension systems (or their reversal) would reduce (or increase) implicit public debt by the order of magnitude of 50 percent of GDP (for illustrative calculations, see Beetsma and Oksanen 2008). Furthermore, in the United States, the relative size of the public pension system is about half that in Europe. So in various ways, we can come to the conclusion that over one generation, one conceivable set of pension system rules may end up with 100 percent of GDP more implicit public debt than another.

The increase in gross public debt over the current economic and financial crisis could also be noted here as a reference. In the European Union and the euro area, the increase from 2007 to 2010 was 20 percentage points of GDP. It came about in a short

period, but maybe we should view it as a result of overconsumption over the past 10 to 15 years, originating from financial innovation and too relaxed monetary policy (breaking the Taylor rule) in the United States, a problem that needs to be dealt with within the next 10 to 15 years. Because the time span is half a generation, its order of magnitude is very significant but still less than some conceivable effects of population aging and pension reforms on implicit public debt.

Projection Errors Drive Expenditures in All Pension Systems

Naturally, public defined benefit (DB) pension systems are at least as vulnerable to longevity change as NDC systems—and probably more vulnerable because the link between benefits and longevity is weak, is subject to difficult political bargaining, and is thus easily delayed.

Also, in private DC systems, the pension provider encounters the same problems as the one discussed in the chapter, and the residual risk has to be dealt with in one way or another by the insurer and the beneficiary. Furthermore, the generations are not isolated from each other even under a private DC scheme: assume that one generation retires later as a consequence of its increased life expectancy. Then the supply of labor increases and affects the interest rate and thereby the return on pension saving of the next generation. So, even if analyzing pension systems is useful—DC, NDC, and others—defining the actuarial values of contributions paid and benefits received by each generation, using an agreed rule for the discount rate, this approach never incorporates all of the spillover effects of pension policies across the generations. We should therefore bear in mind that equalizing the present values of contributions and benefits is a technical benchmark, very useful for providing a frame of reference, but acceptable reasons to deviate from it can always exist.

The Advantages of NDC and the Relative Magnitude of Life Expectancy Uncertainty

An NDC scheme can be seen as an enhanced form of public DB system that incorporates (quasi-)automatic adjustments that are desired or even necessary in all DB systems. An increase in life expectancy is one such factor, and the automatism in NDC systems as compared to required discretionary parameter changes in most DB systems is an improvement that should be welcomed even if uncertainty of life expectancy change in the future poses a problem also under NDC. For example, I would not be very worried about the effects of the uncertainty caused by unknown mortality at young ages, because it is probably much less important than the uncertainty of fertility rate or migration.

In all NDC systems established in Europe, the rules were not fully settled at the time they were launched. The Swedish NDC was probably the most developed, but even there, the automatic adjustment mechanism had to be set up afterward, and even after its introduction, some ad hoc adjustments were made for its implementation. In Poland, going

back and forth with indexing of the pensions in payment has had greater repercussions than the life expectancy uncertainty illustrated in the chapter.

Alho, Bravo, and Palmer very usefully discuss the alternative models for variable annuities for dealing with life expectancy uncertainty. For example, they show that the pension provider that would have used the common benchmark model with fixed the annuities at age 65 over the period from 1943 to 1973 would have suffered a loss from the projection error amounting on average to roughly 2 to 3 percent of the pension payout for each cohort for Denmark, Norway, and Sweden, and roughly 4 percent for Finland. The cohort-specific extreme values range from an 11 percent loss for the pension provider in Finland to a gain of 3 percent in Sweden (see table 22.1).

For a rough comparative calculation, we could assume that the capital value of total pension payouts (i.e., the implicit pension debt to pensioners, disregarding the accrued rights of workers because they are transformed into NDC annuities only at retirement) is about 100 to 150 percent of GDP. According to this calculation, the error they demonstrate amounts to 4 to 15 percent of GDP over the 30-year period. This result should be compared to the 100 percent of GDP identified as the order of magnitude resulting from other key factors and decisions on the size of the public pension system or on possible reforms of the DB pension systems (remember that we are here measuring the capital values over a generation—30 years—in terms of annual GDP). Clearly, the life expectancy projection error is dwarfed by the other conceivable factors at play.

The proposal on variable annuities discussed by the authors makes a lot of sense. One could think of, for example, capping the correction made to the pension caused by a revised life expectancy projection. This strategy would share the consequences with pensioners and, through the pension provider, the rest of society, including, if so decided, future generations, through public debt and thereby reduced aggregate saving. Changes capped at, say, 5 percent of the level of pensions in payment could be deemed acceptable because many other uncertain factors could affect the real income level of the pensioner by a similar amount.

Conclusion

Putting the life expectancy projection error into perspective with other relevant factors determining transfers between successive generations, with the result that it is relatively small, should not lead us to undervalue the importance of improving demographic projections, eliminating any systematic errors, and finding better ways to deal with the consequences of the residual errors. All these steps are important and do not have to be costly; improved life expectancy projections can possibly be produced as a by-product of the routine work of demographers and statisticians.

NDC is a useful improvement to public pension systems. Like any constructed system, it will never be perfect for all possible circumstances, and it may require some adjustments when unforeseen systematic factors come into play. However, improving the underlying projections so that as many factors as possible are automatically dealt with is always the better course and will meet with better acceptance by the people affected. This

way the functioning of an NDC can be improved, adding to its superiority over other public pension system rules.

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The Actuarial Balance of the PAYG Pension System: The Swedish NDC Model versus the DB-Type Models

María del Carmen Boado-Penas and Carlos Vidal-Meliá

According to Settergren (2008), one useful way of reaching the objective of better designed and managed public pensions is to provide improved information on the financial situation of the programs. In many countries, reporting mechanisms in public pay-as-you-go (PAYG) pension systems, whether nonfinancial (notional) defined contribution (NDC) or defined benefit (DB), are underdeveloped. This situation makes it difficult to assess how the pension system interacts with the demography and the economy, precludes an informed public debate on challenges and reform needs, and leads to misconceptions about the pros and cons of alternative system designs. For Bovenberg (2003), transparency about objectives and agreement on risk sharing constitute a key requirement for a well-designed pension system. Explicit agreements as to how to share risks become even more important as population aging makes pension systems more vulnerable to shocks such as unexpected increases in longevity or inflation. Being explicit about risk sharing by (a) setting clear rules and (b) having more transparent accounting facilitates the enforcement of an intergenerational contract and reduces the political risks affecting the financial sustainability of PAYG pension systems.

The so-called actuarial balance of PAYG pension systems provides a suitable answer to those issues (Boado-Penas 2010). It also supplies a positive incentive to improve financial management by eliminating or at least minimizing the traditional mismatch between the planning horizons of electors and politicians—often only four years—and those of the system itself. The minimum time horizon should be the system's turnover duration, the normal value of which varies between 30 and 35 years, although actuarial reports often contemplate a minimum horizon of 75 years.

A very detailed annual actuarial balance—an actuarial report, in fact—has been compiled in the United States since 1941 (Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds 2009). Since 2002, it has included a stochastic methodology. The so-called U.S. actuarial balance is prepared by the U.S. Social Security Administration. It is similar to publications issued by Japan (AAD 2005a, 2006; Sakamoto 2005) and the United Kingdom (GAD 2010) every five years; Canada every three years since 1966 (Office of the Chief Actuary 2007, 2008); and Finland every

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two years (Elo et al. 2010). But it is not a *balance sheet* in the traditional accounting sense of the term, with a list of assets and liabilities.

Compiling an official actuarial balance sheet has been normal practice in Sweden since 2001 (Settergren 2001). This actuarial balance sheet has until now attracted little attention from academics. This lack of interest is surprising given that the literature suggests many methodologies to analyze the sustainability of pension systems or to forecast aggregate spending.¹ Given available information, only in the cases of Japan and Spain has an actuarial balance sheet, with its typical structure of assets and liabilities, been used by researchers.² At the official level, the actuarial balance sheet has not been used outside Sweden.

The aim of this chapter is to show the benefits of reporting an actuarial balance in defined contribution (DC) and DB PAYG pension systems to improve transparency, credibility, and solvency. The chapter also aims to discuss methodological issues. The specific models studied are the Swedish NDC model and the U.S. DB model. The chapter briefly examines the Japanese DB model as well, because it includes certain features of the other two systems. Moreover, it looks at some other examples of DB pension systems, including those of Canada, Finland, Germany, and the United Kingdom.

The chapter contributes to fill a gap in the literature. A book by Plamondon et al. (2002), *Actuarial Practice in Social Security*, was a first attempt at conceptualizing the actuarial balance of the PAYG system, though obviously it did not include the Swedish NDC model. Neither is this model mentioned in the report by Lefebvre (2007). The article by Boado-Penas, Settergren, and Vidal-Meliá (2011) does include a conceptualization of the Swedish and U.S. models and highlights the advantages that they could bring in the case of Spain.

The section following this brief introduction describes the Swedish model as an NDC pension system, especially taking note of the balance sheet and the actuarial income statement, the basic assumptions, the actuarial aspects, the most recent results, and the advantages and disadvantages. The next section discusses the basic aspects of DB pension systems that report an actuarial balance, focusing on the pension systems in the United States and Japan. The chapter ends with a discussion of how DC and DB methods compare on some important criteria and some of the policy implications.

Constructing an Actuarial Balance Sheet and Balancing Assets and Liabilities in NDC Systems

An NDC scheme is a PAYG scheme that deliberately mimics a financial defined contribution (FDC) scheme by paying an income stream whose present value over the person's expected remaining lifetime equals his or her accumulation at retirement.³ The NDC scheme, therefore, has many features of an FDC scheme.

According to Vidal-Meliá, Boado-Penas, and Settergren (2010), a notional account is a virtual account that reflects the individual contributions of each contributor and the notional returns that these contributions generate over the course of the participant's working life. In principle, the contribution rate is fixed. Returns are calculated in line with a notional rate, which may be the growth rate of the gross domestic product (GDP), average wages, aggregate wages, contribution payments, and so forth. When the individual retires, he or she receives a pension that is derived from the value of the accumulated

notional account, the expected mortality of the cohort retiring in that year, and possibly a notional imputed future indexation rate. In this way, the NDC model combines PAYG financing with a pension formula that depends on the amount contributed and the return on that amount.

The account is called *notional* because it exists only on paper. Money is not deposited in any real account. Nevertheless, the amount of the pension is based on the fund accumulated in the notional account. Contributions made to notional accounts are capitalized at a notional rate of return. This hypothetical return is normally linked to some external index set by law. When the individual retires, the notional account—in all the countries that use such accounts—is converted into a life annuity. This conversion is normally done by dividing the value of the notional account by a conversion factor that depends on the individual's life expectancy at the chosen retirement age and on the interest rate.

At first glance, NDC systems appear to be simply an alternative way of calculating the amount of retirement pension, but in fact the notional method goes further than that. The NDC system has a number of positive features:

- The NDC system promises to deal with the effects of an aging population more or less automatically. It meets this promise partly because the annuities are dependent on life expectancy and partly because the internal rate of return reflects growth in productivity along with changing demographic conditions, the most important being declining fertility as propagated through the size of the labor force.
- At least theoretically, the NDC system has stronger immunity against political risk than more traditional DB PAYG systems, because it increases the financial stability of the pension system in the sense that politicians will not have made any promises concerning future pension benefits. However, only time will tell whether the political risk of NDC systems is really much less than traditional DB systems, because some of the system's parameters could always be modified (for political reasons). Of course, no system is politically foolproof, and not even an NDC system is a panacea.
- The NDC approach is a better way of managing and diversifying risk in comparison to all other pension paradigms, because it does not create false expectations about pensions to be received in the future, it makes it difficult for contributors to be tempted to behave opportunistically, and it is not subject to the financial risk of capitalization systems.
- An NDC scheme reduces actuarial hidden redistribution and stimulates the contributors' interest in the pension system by bringing to light any improper redistribution of benefits to privileged groups and by revealing who really benefits from any legislation.⁴
- An NDC scheme avoids arbitrariness of benefit indexation rules, adjustment factors, and so on. Changes in these rules have undermined the credibility of many unfunded DB systems.
- An NDC scheme allows easy portability of pension rights between jobs, occupations, and sectors.

THE ACTUARIAL BALANCE SHEET IN NDC SYSTEMS

Sweden developed the actuarial balance sheet in 2001 and has applied it ever since. Thanks to this innovation, Sweden has endowed its PAYG financed pensions with indicators and information that previously existed only for pensions financed by full funding. The result has been an extraordinary level of transparency, and political risk seems to have fallen. In addition, Sweden has passed legislation to create an automatic balancing mechanism (ABM) for financial imbalances in the pension system.⁵ This mechanism is based on the solvency indicator that emerges from the actuarial balance sheet, known as the *solvency ratio*.

The actuarial balance sheet for the NDC pension system as compiled in Sweden does not fit into any of the classical methods such as aggregate or growth accounting models, microsimulation models, general equilibrium models, or indirect models.⁶ It can be described as a financial statement listing the pension system's obligations to contributors and pensioners at a particular date, with the amounts of the various assets (financial assets and amounts from contributions) that back up these commitments.

As Boado-Penas, Valdés-Prieto, and Vidal-Meliá (2008) have pointed out, the main aim of the actuarial balance sheet is to give a true and fair view of the pension system's assets and liabilities at the beginning and end of the fiscal year and, by comparing these figures, to determine the change in net worth. The actuarial balance sheet also contributes to management and disclosure of information because it is useful not only for the authority governing the system but also for contributors and pensioners in general and for the body that guarantees payment (i.e., the state and the contributors it represents).

For Settergren (2008), the financial reporting of the Swedish pension system resembles the standard income statement and balance sheet of an insurance company. Although in the case of the pension systems, the reporting is on a PAYG plan. The reporting also includes a solvency ratio, which is the ratio of assets to the pension liability. The income statement gives a full explanation of the reasons for changes in the system's solvency.

The main entries on the balance sheet of an NDC system are basically those shown in table 23.1.⁷

As mentioned earlier, producing an actuarial balance sheet is a practice that has been carried out in Sweden since 2001. (Table 23.2 shows the main data for the period 2005–09.) The retirement contingency of the Swedish pension system is mixed, with 86.5 percent of the contributions allocated to the NDC system and the other 13.5 percent allocated to the DC capitalization system. The balance sheet refers only to the PAYG part (notional income, or *inkomstpension*), and to the commitments deriving from the ATP (Allmän tilläggs-pension), the Swedish defined benefit scheme that is being phased out.

The item “financial asset” on the balance sheet is the value of the financial assets owned by the Swedish pension system at the date of the balance sheet. It is valued

TABLE 23.1 **Main entries on the actuarial balance sheet of an NDC system**

Assets	Liabilities
Financial asset	Liability to pensioners
Contribution asset	Liability to contributors
Accumulated deficit	Accumulated surplus
Actuarial losses for the period	Actuarial profits for the period
Total assets	Total liabilities

SOURCE: Authors' compilation, based on Boado-Penas, Valdés-Prieto, and Vidal-Meliá 2008.

TABLE 23.2 **Balance sheet of the Swedish pension system at December 31 of each year for ATP and inkomstpension, 2005–09**

Item	2009	2008	2007	2006	2005
<i>Assets (SKr millions)</i>					
Financial asset (<i>F</i>)	827,069	707,087	898,472	857,937	769,190
Contribution asset (<i>CA</i>)	6,361,925	6,477,351	6,115,970	5,944,638	5,720,678
Accumulated deficit	243,369	n.a.	n.a.	n.a.	n.a.
Actuarial losses	79,329	261,327	81,607	n.a.	n.a.
Total	7,511,692	7,445,765	7,096,049	6,802,575	6,489,868
<i>Liabilities (SKr millions)</i>					
Liabilities to contributors (<i>AD</i>)	5,001,623	5,156,684	4,909,569	4,750,749	4,612,959
Liabilities to pensioners (<i>DD</i>)	2,510,069	2,271,123	2,086,915	1,952,261	1,848,517
Accumulated surplus	n.a.	17,958	99,565	28,392	8,783
Actuarial profits	n.a.	n.a.	n.a.	71,173	19,609
Total	7,511,692	7,445,765	7,096,049	6,802,575	6,489,868
GDP ^a	3,108,002	3,213,659	3,126,018	2,944,480	2,769,375
<i>Funding and solvency indicators</i>					
Solvency ratio ^b	0.9570	0.9672	1.0026	1.0149	1.0044
Smoothed value of financial asset (<i>F</i>)	810,876	821,165	841,866	757,776	664,109
Modified solvency ratio ^c	0.9549	0.9826	0.9945	0.9999	0.9881
Degree of funding (%)	11.01	9.52	12.84	12.80	11.90
Liabilities to contributors/total liabilities (%)	66.58	69.42	70.17	70.87	71.39
Turnover duration (years)	31.76	31.76	31.93	32.05	32.12
Implicit discount rate (1/TD)% PF ^d	3.15	3.15	3.13	3.12	3.11

SOURCE: Authors' compilation, based on Swedish Social Insurance Agency 2006, 2007, 2008, 2009, 2010.

a. Gross domestic product in current prices in millions of Swedish kronor. This figure is introduced to give the reader some idea of the size of the pension system in relation to the size of the Swedish economy.

b. The solvency ratio according to the previous definition (through 2007). It is calculated solely on the basis of the market value of the buffer funds as of December 31 of the respective year.

c. The solvency ratio calculated according to the new definition (2008 onward). It is calculated on the basis of a three-year average of the buffer funds.

d. The contribution asset can be interpreted as the present value of the perpetual future flow of discounted contributions, where the implicit discount rate is the inverse of the turnover duration.

according to internationally accepted principles—that is, based on the financial prices of the securities held. The size of the financial asset is enormous considering that the scheme is a PAYG system, amounting to 26.6 percent of GDP in 2009. Since October 2009, new rules have been used to value the financial assets; to calculate the solvency ratio, the Swedish authorities now use a three-year average of the buffer funds (Sundén 2009a).

The original entry on the PAYG balance sheet is called the *contribution asset*. This asset is derived from linking the pension system's assets and liabilities and is calculated by using a formula that shows the size of both assets and liabilities when the pension system is actuarially balanced and financed by pure PAYG contributions in a simplified scenario. The contribution asset can be interpreted intuitively as the maximum level of liabilities that could be financed by the existing contribution rate, without periodic supplements from the sponsor, if the conditions prevailing at the time of valuation remain constant—in other words, near or close to the steady state (Auerbach and Lee 2009b).

The value of the contribution asset is the product of the turnover duration (TD) and the value of the contributions made in that period. The TD is the time that is expected to pass from when a monetary unit enters the system as a contribution until it leaves in the form of a pension, assuming that economic, demographic, and legal conditions are constant. It is also the sum of the weighted pay-in and pay-out durations of one monetary unit in the system for the year's contributions and is based on population data obtained from a cross-section, not a projection.⁸

In Sweden, to limit fluctuations in the pension system's annual result, the contribution flow used in the calculation of the contribution asset is smoothed. If the population declines (increases), there is a risk that the accounts will slightly overstate (understate) the system's assets in relation to its liabilities because, in such a case, the TD is slightly overestimated (underestimated). However, because the balance sheet is compiled every year according to verifiable events and transactions, it tends to provide a true and fair view. The stationary demographic and economic state is not *ex post facto* true, but because successive changes are included as they are registered in successive balance sheets, the solvency indicator remains reliable (Auerbach and Lee 2009a, 2009b).

Some authors have questioned the validity of the contribution asset or have expressed doubts about it (Andrews 2008; Robalino and Bodor 2009), suggesting that the contribution asset should be replaced by the PAYG asset, which is another name for what Valdés-Prieto (2000, 2005) calls the *hidden asset*: the present expected value of the hidden taxes that the system will apply to its participants in the future, either in the form of excess contributions in relation to the pensions to be provided or in the form of insufficient pensions in relation to the contributions paid. *Hidden taxes* are defined as contributions in excess of those that would be needed by a capitalized system to pay the same benefits. However, Vidal-Meliá and Boado-Penas (forthcoming) found that, despite their very different natures, the hidden asset and the contribution asset may nearly coincide at the limit when the interest rate of the financial market approaches the growth of the covered wage bill from above, but the hidden asset supplies a solvency indicator that is not always consistent with the system's financial health.⁹

In the Swedish model, both the assets and the liabilities are valued on the basis of verifiable cross-section facts; that is, no projections are made. For example, current longevity is used even though it is expected to increase. If and when that expectation materializes in new mortality tables, it will be incorporated into the information on the balance sheet on a year-to-year basis.¹⁰ Because of this assumption, the calculation of the contribution asset does not take into account that contributions will grow in line with real salaries because of expected economic growth. This approach should not be interpreted as assuming that all the basic parameters determining the items on the balance sheet will remain constant in time; instead, it is a result of the policy of using cross-sectional data.

Changes are not included until they happen and can be verified. The Swedish National Social Insurance Board argues that another advantage of using cross-sectional data is that it avoids the manipulations and biases that could affect any projections.

The item “liability to contributors” on the balance sheet is the notional capital accumulated in the contributors’ accounts and the capital that derives from commitments to contributors under the old system. The item “liability to pensioners” is the present value of the amount of all pensions in payment to current pensioners, taking into account current life expectancy and the real technical interest rate applied (1.6 percent) when the amount of the initial pension was calculated, which is subsequently deducted from the yearly indexation of the pension.¹¹ The liability to contributors amounts to 66.6 percent of total liabilities.

As can be seen from the balance sheet (table 23.2), the Swedish system’s degree of capitalization (funding)—calculated as $F/(AD + DD)$ —is remarkable, amounting to 11.0 percent of liabilities in 2009. This level of funding enables any possible yearly imbalances between the system’s income and expenditure to be dealt with by selling financial assets, which would make the need for outside financing unlikely, whether from the state or the financial market.

The accumulated surplus is the accumulated profit or net worth of the pension system, which is owned by the system’s sponsor (in this case the state). As can be seen in table 23.3, the system’s annual profit or loss is the difference between the increase in assets and the increase in liabilities during the period. The loss is also identical to the increase in the accumulated deficit or the reduction in the accumulated surplus, depending on the situation. The results are affected by economic and demographic factors. Usually, the main factor in the short term is growth in employment, whereas in the long term, demographic factors are more important. The principal cause of the year’s losses is the decrease in value of the contribution asset as a result of the current economic crisis. It seems clear that the income statement provides a full description of the reasons for changes in the system’s solvency.

One must not confuse this profit or loss with the annual cash deficit or surplus. In table 23.3, the cash deficit or surplus is the difference between the contributions received and the pensions paid. In 2009, the cash surplus amounted to negative SKr 14,700 million (i.e., SKr 202,712 million – SKr 217,412 million), or approximately –0.5 percent of GDP for that year. The system had losses in 2002, 2004, 2007, 2008, and 2009 and had profits in 2003, 2005, and 2006.

Finally, although this chapter does not focus on the information sent to individuals,¹² a point worth noting is that for individuals to make decisions about retirement and savings, they need information (personal or individual social security statements) about the main features of pensions and should realize that the level of future benefits will depend on a pension system’s ability to meet its obligations. For most workers, social security benefits represent a significant financial asset—in many cases, their principal or sole source of retirement income.

In Sweden, the individual statement is provided by the so-called Orange Envelope,¹³ which was introduced in 1999 in connection with the Swedish pension reform. The Orange Envelope has been the basis for keeping contributors and pensioners informed about the pension system. The envelope is sent annually to all participants as soon as they start to contribute to the system, and it also provides information to retirees about their

TABLE 23.3 **Swedish *inkomstpension* and ATP: Actuarial income statement at December 31, 2009**

<i>Fund assets (changes)</i>		119,982	83,885	<i>Pension liabilities (changes)</i>	
Contributions	202,712			213,510	New pension credit and ATP points ^a
Pension disbursements	-217,412			63,888	Indexation ^b
Return on funded capital	136,412			23,054	Longevity ^c
Deduction for administrative costs	-1,730			1,612	Inheritance gains (distributed – arising) ^d
<i>Contribution asset (changes)</i>		-115,426		-786	Deduction for administrative costs
Contribution revenue	-114,919			-217,393	Pension disbursements
Turnover duration	-507				
<i>Actuarial losses</i>		79,329	0.0	Actuarial profits	
<i>Total</i>		83,885	83,885	Total	

SOURCES: Authors' compilation, based on Swedish Social Insurance Agency 2010 and Settergren 2009a.

NOTE: ATP = Allmän tilläggspension.

a. This amount does not coincide exactly with the contributions made because pension points will continue to be earned in the old DB system (ATP) until 2018. After 2018, the value of contributions will equal the value of pension credits, with only small differences attributable to administrative reasons.

b. This amount is derived basically from changes in the average salary as measured by the income index used for indexing notional accounts and pensions (the latter with the 1.6 percent reduction).

c. This amount is derived from changes in life expectancy, measured annually as a five-year moving average of experienced mortality, included in the so-called economic divisor.

d. The pension balances of deceased persons (inheritance gains arising) are distributed to survivors of the same age. This distribution is made as a percentage increase in pension balances by an inheritance gain factor. Small discrepancies can be seen between inheritance gains arising and inheritance gains distributed because of lags in the recording and distribution of inheritance gains and because, for persons older than 60, statistically measured rather than actually incurred mortality is used. This feature is peculiar to the Swedish system. According to Chłoń-Domińczak et al. (2012), no other country with an NDC system applies a survivorship dividend.

benefits. The Orange Envelope includes account information as well as a projection of benefits that shows how benefits vary with retirement age. Pension benefits for participants under the age of 60 are shown at the earliest age they can be withdrawn (age 61) and at ages 65 and 70. The purpose is to show that working longer will result in higher benefits. The statement for individuals age 60 and older shows benefits for additional ages between 61 and 70, depending on the participant's age.

THE BALANCING OF LIABILITIES IN NDC SYSTEMS

In general terms, one can say that an NDC pension system is reasonably solvent as long as financial assets plus contribution assets are greater than or equal to the liability to pensioners plus the liability to contributors. At the date of the balance sheet, therefore, the participants should have a realistic expectation of receiving the benefits that have been promised, without the system's sponsor (the state) having to make periodic additional contributions or the automatic balancing mechanism being triggered. Solvency is clearly

never completely assured in the long term because neither assets nor liabilities are known in their entirety.

The difference between the concepts of solvency and sustainability is not immediately identifiable. According to Knell, Köhler-Töglhofer, and Prammer (2006), the term *sustainability* has many definitions, though it almost always refers to the fiscal policies of a government, the public sector, or the pension system. One of the most widely accepted definitions of sustainability in relation to pensions is that of not needing to increase the system’s contribution rate in the future. This definition applies to NDC systems as long as the benefit level remains adequate, but not to DB systems.

The main reason for valuing assets and liabilities without taking the future into consideration is that the system’s financial solvency does not depend on the amount of assets and liabilities taken separately, but on the ratio between them as measured by the solvency ratio. The solvency ratio (SR_t) indicator used in table 23.2 emerges from the actuarial balance sheet and, as mentioned earlier in this chapter, does not rely on explicit projections of demographic and economic factors. For Auerbach and Lee (2009b), this indicator is transparent because it is based on current cross-sectional data and is, therefore, less likely to be distorted by political pressures.¹⁴

It is expressed as follows:

$$\begin{aligned}
 SR_t &= \frac{\text{Assets}}{\text{Liabilities}} = \frac{\overbrace{F_t}^{\text{Mean value of financial assets}} + \overbrace{AC_t}^{\text{Contribution asset}}}{\underbrace{AD_t}_{\text{Liabilities to contributors}} + \underbrace{DD_t}_{\text{Liabilities to pensioners}}} \\
 &= \frac{F_t + \left(\overbrace{\bar{C}_t}^{\text{Average contribution revenue}} \times \overbrace{TD_t}^{\text{Median of turnover duration}} \right)}{\left(\underbrace{K_t}_{\text{Sum of the pension balances}} + \underbrace{E_t + ATP_t}_{\text{Liabilities to contributors under the preexisting rules}} \right)}. \tag{23.1}
 \end{aligned}$$

The solvency ratio used in Sweden has a double purpose: (a) to measure whether the system can fulfill its obligations to its contributors and (b) to decide whether the automatic balancing mechanism should be applied. The main flaw in the Swedish mechanism, as Sundén (2006) pointed out, is that its activation does not distinguish between financial imbalances caused by temporary downturns and those caused by more serious economic and demographic developments. Thus, the automatic mechanism can be triggered unnecessarily, which could affect the political stability of the system. According to Barr (2011), another valid criticism of the Swedish mechanism is that it should have taken into account the life cycle. Sharp downward adjustment in indexation may be appropriate for younger workers, but sharp adjustments should be avoided for pensioners and workers close to retirement. This approach may imply a longer period before solvency is restored. The implication is not that pensioners should necessarily be exempt from all risk, but that they should be exposed to less risk than younger participants. The choice of type of ABM is undoubtedly a policy decision with many intra- and intergenerational implications.¹⁵

The actuarial balance sheet of the Swedish pension system shows that the system is not fully solvent given that, at the date of the balance sheet, the pension liabilities cannot reasonably be covered by the flow of income from the contributions and financial assets.

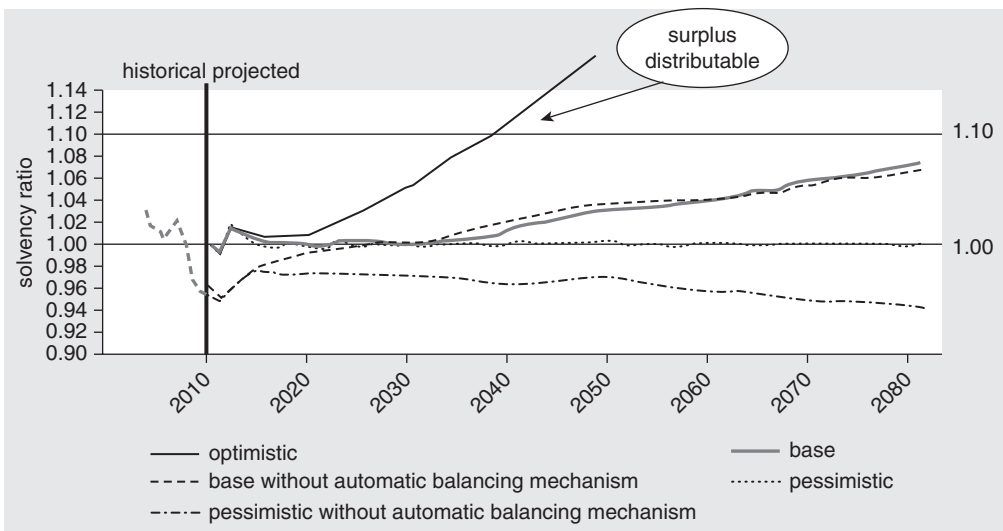
This problem is due to the heavy financial losses caused by the economic crisis in 2008 and the lower rate of increase in the contribution base in 2009 (Settergren 2009a, 2009b; Sundén 2009). Judging from the balance sheet, contributors and pensioners do not have a reasonable basis for believing that they will receive the pensions they had anticipated.

Balancing was activated for the first time in 2010 because the solvency ratio in 2008 was less than 1.0. As a result, disbursements of the inkomstpension and ATP during 2011 were reduced by 4.5 percent in comparison to what they would have been without balancing, although the reduction was partly offset by a higher guaranteed pension.

Projections of the system's possible future evolution are, in fact, made in the Swedish pension system's annual report (known as the *Orange Report*). A projection is made of the balance sheet itself, of the amount in the reserve or buffer fund, and of the cash deficit or surplus on the basis of three possible scenarios—normal (best estimate), pessimistic, and optimistic. These projections provide valuable information. The results of the projections are also reported as calculations of net contributions and average pension levels for new expected pensioners. However, this information is not used in the preparation of the actuarial balance sheet. It would be very difficult to justify a reduction in pension in real terms or an increase in the expected value of contributions made on the basis of a projection (or projected balance sheet) that may or may not be accurate, although—as discussed in the next section—countries such as Canada and Japan do have ABMs that are based on projections of income and expenditure.

As can be seen in figure 23.1, the balance ratio has dropped significantly, from 1.0026 in 2007 to 0.9570 in 2009. This drop is largely, but not solely, due to heavy losses incurred by the buffer funds in 2008 and the lower rate of increase in the contribution base. In the projection (base scenario), the balance ratio will bounce back, but it will stay close to 1.0 until the mid-2030s, partly because of the reduced indexation caused by the balance mechanism. The expected solvency ratio will not reach 1.1 during the projection period, a level that means that the fund has a surplus that is distributable among contributors and

FIGURE 23.1 Historical and projected balance ratio for Sweden, 2009–83



SOURCE: Authors' representation, based on Swedish Social Insurance Agency 2010.

pensioners. In the projections made in 2007, before the financial crisis, the balance ratio level had already reached 1.1 by 2037, indicating the sensitivity of the projections relative to the starting values. In the pessimistic scenario, the balancing mechanism is more or less permanently triggered. With balancing, the system's liabilities accrue interest at the same rate as the growth in the system's assets. As a result, the balance ratio stabilizes at about 1.0. In the optimistic scenario, the balance ratio exceeds 1.0 by 2012 and strengthens after 2015. Beginning in 2039, the expected solvency ratio will exceed 1.1.

ADVANTAGES AND DISADVANTAGES OF THIS APPROACH IN NDC SYSTEMS

The actuarial balance as applied in NDC systems has a high degree of transparency. It needs no complicated projections of economic, financial, or demographic variables, which could easily have a bias effect on the sustainability and solvency indicators. There is no need for projections because the balance is based on verifiable facts and transactions at the date on which it is compiled. Anyone with some knowledge of financial matters can understand the actuarial balance because it expresses the pension system's financial situation in accounting terms that relate the concepts of assets and liabilities to the pension system.

The actuarial balance is easy to compile because it is based on the simple process of calculating both the assets from contributions (by directly relating yearly contributions to the economic and demographic structure of contributors and pensioners) and the liabilities to contributors and pensioners (from the amounts accumulated in the individual notional accounts and the use of the so-called economic divisor).¹⁶

The relationship between this actuarial balance for NDC systems and automatic financial balancing mechanisms comes about naturally because it is assumed that every monetary unit contributed (asset) is converted into pension (liability). When the balance shows in its solvency indicator that this relationship is not correct, the logical step is to apply an ABM to correct the imbalance as soon as possible. As when compiling the balance sheet, one does not need to make projections; hence, the possibly endless debate as to their accuracy is avoided. Applying the necessary adjustment should not give rise to any discussion unless the reasons for applying the ABM are temporary and easily reversed.

The main disadvantage of this approach is that it is not sensitive to economic and demographic uncertainty. Because the actuarial balance sheet is based on verifiable facts and transactions at the date on which it is compiled, no projections are carried out and, therefore, no demographic or economic threats to the system are taken into account. However, this disadvantage can easily be overcome in the same way as is done in Sweden: projections are made of the actuarial balance itself, although these projections are never used to decide whether to activate the ABM.

Finally, using this approach in DB systems is difficult, if not impossible, unless there is a clear separation between contingencies, as will be seen later in this chapter. Even in the case of systems with clearly separated contingencies, a large part of their pension costs would be left out of the actuarial balance. For this approach to be more widely applied to DB systems, a calculation technique would have to be devised to include the contingency for permanent disability, because recipients of disability benefits can be considered early retirees through no fault of their own.

Constructing an Actuarial Balance and Balancing Income from Contributions and Spending on Pensions in DB Systems

In defined benefit PAYG systems, the formulas for calculating benefits explicitly define the amount of pension to be received. This amount is the product of three elements: the replacement rate, which normally depends on the number of years contributed; the pension base, the calculation for which may or may not include the entire lifetime earnings; and a correcting factor that takes into account early or late retirement in relation to normal retirement age. The variable used to index pensions already in payment is also usually known in advance.

Unlike in NDC systems, the contribution rate in DB schemes is variable and has to change from time to time to cope with fluctuations in the system's income and expenditure deriving from economic cycles, the effects of demographic change, and—the most vulnerable aspect—the natural tendency of politicians to increase benefits for purely electoral reasons, known as *populism in pensions*. Therefore, in DB systems, it is possibly even more important for an actuarial balance to be produced at regular intervals because, in principle, the formulas for calculating the pensions do not include automatic adjustments or balancing mechanisms as NDC formulas do. Moreover, having actuarial balances produced on a regular basis would make it very difficult to use the pension system as a weapon during elections.

THE ACTUARIAL BALANCE IN DB SYSTEMS

The main methodology used to compile the actuarial balance in nonfinancial DB systems would best be described as an aggregate accounting projection model of spending on pensions. Basically, the method relies on making a variety of assumptions regarding the economy as a whole, taking into account future trends in demography (fertility rates, migration flows, life expectancy); economic conditions (participation and employment rates, productivity, wages, interest rates); and institutional factors (coverage, pension levels). Although these models are becoming more and more complex as they are made heterogeneous, their main advantages are that they are easy to apply and accurately reproduce the reality of the pension system. Public authorities and organizations frequently also use them. The Ageing Working Group, the technical working group of the European Union's Economic Policy Committee that is responsible for spending forecasts, follows this basically deterministic approach, although not all the countries involved apply it.

This section introduces two actuarial balance models—those used in the United States and Japan. The U.S. model is described as being the benchmark for DB systems, and the Japanese model, despite being a DB system, has some elements in common with the NDC model, including a type of ABM, which means that, in principle, the result of the actuarial balance by definition makes it sustainable.

The U.S. model. The Old-Age, Survivors, and Disability Insurance (OASDI) program in the United States makes available a basic level of monthly income when insured workers become eligible for retirement and in cases of death or disability. The OASDI program consists of two separate parts that pay benefits to workers and their families: old-age and survivors' insurance (OASI) and disability insurance (DI). Under OASI, monthly benefits are paid to retired workers and their families and to survivors of deceased workers; under DI, monthly benefits are paid to workers with disabilities and their families.

The actuarial balance of the OASDI program is aimed at measuring the system’s financial sustainability with a 75-year time horizon. It measures the difference in present value—discounted by the projected yield on trust fund assets—between spending on pensions and income from contributions, expressed as a percentage of the present value of the contribution bases for that time horizon and taking into account that the level of financial reserves (trust fund) at the end of the time horizon reaches a magnitude of one year’s expenditure.

In simplified form, the actuarial balance (*AB*) can be expressed as follows:

$$\begin{aligned}
 AB = & \left[\frac{\overbrace{\widehat{TF}_0}^{\text{Trust fund}} + \overbrace{y_0 \sum_{t=0}^{74} \theta_t N_t \prod_{h=1}^t \frac{(1+g_h)}{(1+r_h)}}^{\text{Present value of contributions}}}{\underbrace{y_0 \sum_{t=0}^{74} N_t \prod_{h=1}^t \frac{(1+g_h)}{(1+r_h)}}_{\text{Present value of payroll}}} \right] - \left[\frac{\overbrace{B_0 \sum_{t=0}^{74} R_t \prod_{h=1}^t \frac{(1+\lambda_h)}{(1+r_h)}}^{\text{Present value of benefits}} + \overbrace{\prod_{h=1}^{74} \frac{(TF_{74})}{(1+r_h)}}^{\text{Trust fund}}}{\underbrace{y_0 \sum_{t=0}^{74} N_t \prod_{h=1}^t \frac{(1+g_h)}{(1+r_h)}}_{\text{Present value of payroll}}} \right] \approx 0. \quad (23.2)
 \end{aligned}$$

Summarized income rate
Summarized cost rate

In a situation of financial equilibrium for the valuation period, *AB* should give a zero value, where \widehat{TF}_0 is the value of assets at the beginning of the valuation period; θ_t is the payroll tax (contribution) rate in year t ; y_0 is the average contribution base in year 0; N_t is the number of contributors in year t ; g is the annual real wage growth rate; r is the projected yield on trust fund assets; B_0 is the average pension (benefit) in year 0; R_t is the number of pensioners in year t ; λ is the annual real benefit growth rate; and TF_{74} is the value of assets at the end of the valuation period.

The value of equation 23.2 summarizes the system’s financial deficit or surplus for the 75-year horizon and only for that horizon, and it therefore allows for a sharp jump in the contribution rate or in the benefit level at the end of the 75-year period and for the winding up of the trust fund on that date. In fact, the 75-year time horizon moves ahead every year, and the deficit will be noticed well before the time horizon ends or the sharp jump materializes. If, despite recognition of the deficit, nothing is done with the program, the trust fund will be depleted well before the end of the 75-year time horizon, and a sharp rise in the contribution rate or a steep decline in benefit levels will take place on the fund depletion date.

If the balance is negative, the figure can be interpreted as the increase that would need to be applied to the contribution rate—immediately from that moment—to finance predicted benefits until the end of the 75-year period. The balance can also be expressed as the decrease in pensions, to be applied immediately, that would be needed for the contribution rate not to change within the next 75 years.

The report from which this actuarial balance is compiled is actually much more detailed. It contains a complete analysis of the assumptions used, the underlying methods, and the long-term sensitivity of the main assumptions. A stochastic actuarial balance is drawn up too.

According to the U.S. actuarial balance at December 31, 2009, under intermediate assumptions (the “best-estimate” assumption; see table 23.4), the system could regain financial solvency in 75 years if a 1.92 percent increase in the contribution rate were to be implemented immediately, applied to taxable earnings.¹⁷ The actuarial balance is the

TABLE 23.4 Elements of the 75-year actuarial balance in the United States under intermediate assumptions, 2010–84

Item		OASDI
1	Payroll tax revenue (US\$ billions)	37,689
2	Taxation of benefits revenue (US\$ billions)	2,430
3 = 1 + 2	Tax income (US\$ billions)	40,119
4	Cost (US\$ billions)	48,065
5 = -4 + 3	Initial deficit (US\$ billions)	-7,946
6	Trust fund assets at start of period (US\$ billions) ^a	2,540
7 = 5 + 6	Open group unfunded obligation (US\$ billions) ^b	-5,406
8	Ending target trust fund (US\$ billions) ^c	441
9 = 7 - 8	Results for the period (US\$ billions) ^d	-5,847
10	Taxable payroll (US\$ billions)	304,530
11 = (3 + 6)/(10)%	Summarized income rate (%)	14.01
12 = (4 + 8)/(10)%	Summarized cost rate (%)	15.93
13 = (9/10)%	Deterministic actuarial balance (%)	-1.92
Details in data source	Deterministic actuarial balance ($TH \infty$) (%)	-3.34
	Stochastic actuarial balance, 50th percentile (TH 75 years) ^e	-2.01

SOURCE: Authors, based on Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds 2010.

NOTE: Amounts are in the present value as of January 1, 2010. According to standard actuarial terminology, the “best-estimate” scenario is that obtained under best-estimate assumptions. These assumptions reflect the best judgment of the experts as to future demographic and economic conditions that will probably affect the long-term financial viability of the system.

a. This amount represents 17.92 percent of projected GDP in 2010.

b. This amount is the present value of the debt that would have to be incurred to fund the payments that have been promised, wiping out all the financial assets. This item should not be confused with the implicit debt of the system at a particular date.

c. The calculation of the actuarial balance includes the cost of accumulating a target trust fund balance equal to 100 percent of annual cost by the end of the period.

d. This item represents 41.25 percent of GDP in 2010 (US\$14,175 billion), or 0.70 percent of the present value of the GDPs for the period 2010 to 2084 (US\$838.2 trillion).

e. The outcomes from stochastic methodology should be interpreted with prudence and with a full understanding of the inherent limitations. Results are very sensitive to equation specifications, degrees of interdependence among variables, and the historical periods used for the estimates.

difference between the summarized income rate and the summarized cost rate over a given valuation period. The adjusted summarized income rate (14.01 percent) equals the ratio of (a) the sum of the trust fund balance at the beginning of the period plus the present value of the total income from taxes during the period to (b) the present value of the taxable payroll for the years in the period. The adjusted summarized cost rate (15.93 percent) is equal to the ratio of (a) the sum of the present value of the cost during the period plus the present value of the targeted ending trust fund level to (b) the present value of the taxable payroll during the projection period.

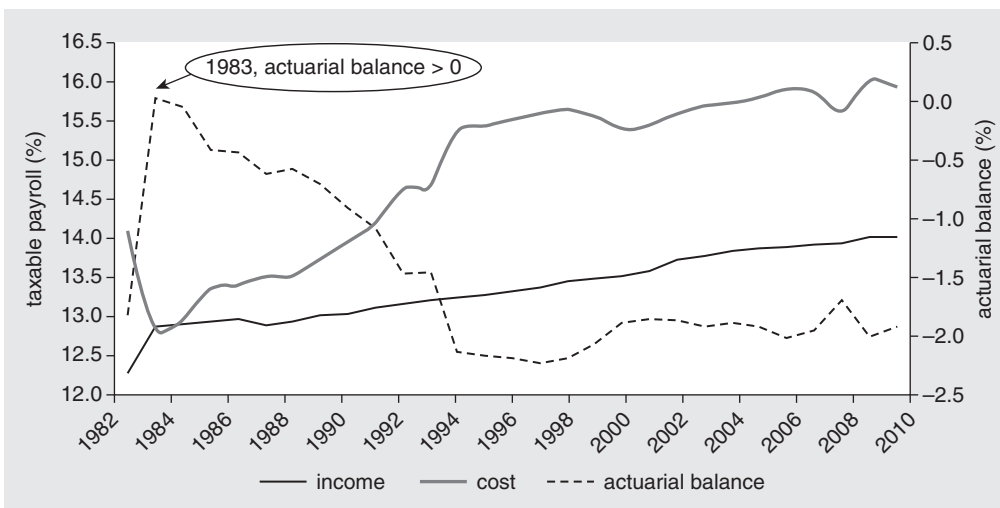
Similarly, all expected payments could be made up to 2084 if an across-the-board cut of 12 percent were imposed on benefits¹⁸ or an allocation of US\$5.4 trillion were made to the trust fund. Naturally, a combination of both these measures could be made instead. In terms of annual deficit or surplus, a cash deficit is forecast to appear in 2010 and 2011; it will be less than tax revenues in 2012 through 2014 and then will exceed tax revenues in 2015 and remain higher throughout the remainder of the long-range period. The reserve fund is expected to be exhausted in 2037.

The result of the actuarial balance for a perpetual time horizon is -3.34 percent, and the unfunded liabilities are estimated at US\$16.1 trillion. Significant uncertainty surrounds the projections under best-estimate assumptions, particularly for a period as long as 75 years. Stochastic methodology estimates a probability distribution of future results of the actuarial balance. The actuarial balance estimated using stochastic methodology for a 75-year time horizon gives a result of -2.01 percent for the 50th percentile and unfunded liabilities that total US\$5.7 trillion; the reserve fund is forecast to be exhausted in 2037. Thus, everything is similar to the result of the deterministic actuarial balance in the case of the best-estimate scenario. The confidence interval of 95 percent indicates that the value of the actuarial balance swings between -3.75 percent and -0.51 percent, and this range is smaller than would be the case for the best and worst assumptions for the system (-5.26 percent and 0.59 percent).

For some researchers—Howe and Jackson (1998) and especially Jackson (2004)—this type of actuarial balance, based on cash flow statements, highlights the system's annual surpluses and reserves, and it undermines efforts to address social security reform proposals by locating the timing of scheme crisis far in the future, in 2037, when the trust fund is expected to be exhausted.

Figure 23.2 shows the historical evolution of OASDI actuarial balance estimates. The left vertical axis shows the summarized income rate and the summarized cost rate;

FIGURE 23.2 Historical evolution of OASDI actuarial balance estimates, 1982–2010: Intermediate assumption



SOURCE: Authors' representation, based on Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds 2010.

the right vertical axis shows the evolution of the actuarial balance (the difference between the summarized income rate and the summarized cost rate) from 1982 to 2010. Although the value of the balance for 2008 (which corresponds to December 31, 2007) was the best in 15 years, comparisons between values are not fully homogeneous. Practically every year, methodological improvements are incorporated that prevent direct comparison, although details of the changes and their year-on-year effects are supplied in the report on which the actuarial balance is based. Even so, the chart gives an effective summary of each year's expectations as to the evolution of the system's financial health over the following 75 years. One can see that only the balance for 1983 supplies a value greater than zero.

Table 23.5 shows the past figures and forecast evolution for the intermediate assumption of some of the key elements that have an effect on determining the actuarial balance. As can be seen in table 23.5 and figure 23.3, an annual deficit will arise in 2010 and 2011 as a result of the economic recession and an expected downward adjustment to 2010 income that corrects for excess payroll tax revenue credited to the trust funds in earlier

TABLE 23.5 Past figures and forecast evolution (intermediate assumption) of some of the basic U.S. OASDI indicators, 1990–2080

Year	Income rate (%) ^a	Cost rate (%) ^b	Annual balance (%) ^c	Contributors/beneficiaries ratio	Trust fund ratio (years) ^d
1990	12.66	10.74	1.92	3.4	0.78
1995	12.51	11.67	0.84	3.3	1.39
2000	12.62	10.40	2.22	3.4	2.23
2005	12.79	11.16	1.63	3.3	3.4
2008	12.73	11.55	1.18	3.2	3.92
2009	13.07	13.00	0.07	3.0	3.9
2010	12.33	13.09	-0.76	2.9	3.55
2020	13.05	14.15	-1.10	2.5	2.99
2030	13.19	16.41	-3.22	2.2	1.54
2040	13.23	16.64	-3.41	2.1	—
2050	13.23	16.33	-3.10	2.1	—
2060	13.24	16.48	-3.24	2.1	—
2070	13.27	16.21	-2.94	2.0	—
2080	13.30	17.25	-3.95	2.0	—

SOURCE: Authors' compilation, based on Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds 2010.

NOTE: — = not available.

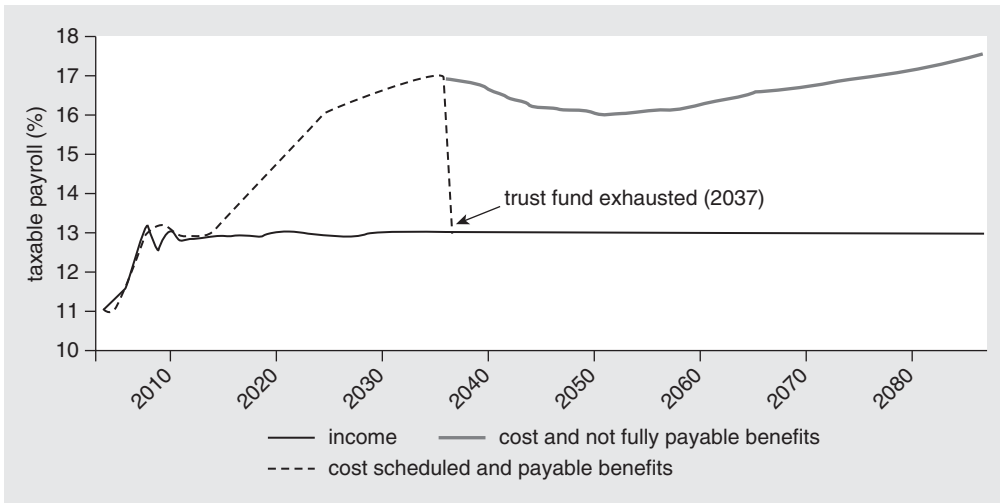
a. The income rate is the ratio between the income from tax revenues on a liability basis (payroll tax contributions and income from the taxation of scheduled benefits) and the OASDI taxable payroll for the year.

b. The cost rate for a year is the ratio between the cost of the program and the taxable payroll for the year.

c. The annual balance is the difference between the income rate and the cost rate in a given year.

d. The trust fund ratio represents the proportion of a year's cost that could be paid with the funds available at the beginning of a year.

FIGURE 23.3 OASDI income and cost rates under intermediate assumptions as a percentage of taxable payroll, 2000–90



SOURCE: Authors' representation, based on Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds 2010, figure II.D2.

NOTE: Payable benefits as a percentage of scheduled benefits are 100 percent for 2010–36, 78 percent for 2037, and 75 percent for 2084.

years. A cash surplus is projected in 2012 through 2014, and then deficit again from 2015 onward. The annual balance worsens considerably insofar as the ratio of contributors to beneficiaries decreases because of the retirement of the large baby-boom generation between about 2011 and 2030. After 2030, increases in life expectancy and the relatively low fertility rates since the baby boom will cause the level of the accumulated financial reserves to fall noticeably, until they become exhausted, as shown in the value of the trust fund ratio, which is defined as the assets at the beginning of a year, including advance tax transfers, if any, expressed as a percentage of the cost during the year.

If no action were taken until the combined trust funds were exhausted in 2037, the effects of changes would be more concentrated in fewer years and fewer cohorts. For example, payroll taxes could be raised to fully finance scheduled benefits in every year starting in 2037. In that case, the payroll tax would increase to 16.01 percent at the point of trust fund exhaustion in 2037 and continue rising to 16.70 percent in 2084. Similarly, benefits could be reduced to the level that is payable with scheduled tax rates in each year beginning in 2037. Under that scenario, benefits would be reduced by 22 percent at the point of trust fund exhaustion in 2037, with reductions reaching 25 percent in 2084. Either of these examples would eliminate the shortfall for the 75-year period as a whole by specifically eliminating annual deficits after trust fund exhaustion. Consequently, ensuring the system's sustainability beyond 2084 would probably require further changes beyond those expected to be needed for 2085. These scenarios are illustrated in figure 23.3, where the vertical axis shows the expected OASDI income and cost rates under intermediate assumptions as a percentage of taxable payrolls for the period 2010–84.

As in the Swedish case, every year the U.S. Social Security Administration (SSA) sends social security statements to all eligible workers over the age of 25 (Jackson 2005).¹⁹

The statements have two basic purposes: (a) to help people plan for their retirement and explain how contributors (and their families) could be affected by disability or death and (b) to check whether the information held by the SSA concerning recorded contributions is accurate and complete. Benefits paid by the SSA are directly conditional on recorded contributions, with the best 35 years taken into consideration; therefore, the reliability of the estimates depends on this information being as complete as possible. The statement contains a section that gives a future outlook warning of the possible financial difficulties facing the social security system and the need to solve them by reforming the system to make it viable. It is this aspect that is the main link between general (the system's actuarial balance) and individual information, as Regúlez-Castillo and Vidal-Meliá (2012) have pointed out. The connection between the two types of information is obvious. If the solvency or sustainability indicators deriving from the general information show an uncertain financial position, this sign should indicate to contributors that either they will have to increase their contributions in size or over time or the benefits will decrease to maintain the system's sustainability.

Three papers have recently been published that try to value U.S. social security obligations in a different, innovative way on the basis of the estimated market value of social security, but the results reached are quite surprising and contradictory. Blocker, Kotlikoff, and Ross (2008) show how asset pricing can be used to value social security commitments, taking into account their risk properties. This approach treats social security benefit obligations and tax claims as nontraded financial assets and applies standard asset-pricing techniques (arbitrage pricing theory and its associated risk-neutral, derivative pricing, and process-free pricing theories) to their valuation. The methodology considers future social security payments and incomes as securities whose returns include two components: a market component, which is spanned by traded securities, and an idiosyncratic component, which can be fully diversified. This method is applied to value the SSA's net retirement benefit liability with the aim of determining how much the U.S. government would have to pay private parties to assume the liability.

The key conclusion is that the SSA valuation method for 2005 appears to understate the market value of the net liability to working-age Americans by approximately US\$2 trillion or 23.1 percent. The key source of this undervaluation involves the valuation of benefits. SSA-based valuation amounts to US\$13.7 trillion, whereas arbitrage pricing theory valuation puts the figure at US\$15.8 trillion. In contrast, the difference between the SSA and arbitrage pricing theory values of taxes owed by working-age Americans is only US\$1 trillion. The main reason for this disparity is that Blocker, Kotlikoff, and Ross (2008) use risk adjustments that are based on the correlation between (a) wage growth and returns on traded assets and (b) the inflation insurance provided by consumer price indexed benefits. They assume a risk-free rate of between 1.5 percent and 2.0 percent, whereas the SSA projections assume a rate of 2.9 percent for nearly the entire horizon.

Geanakoplos and Zeldes (2009) aim to answer the following question: What payment would financial markets require for taking on the responsibility of paying social security retirement benefits? With this question in mind, they use a model to estimate what the market price for SSA commitments would be if they were traded on financial markets. The model treats aggregate social security payments as dividends on a risky asset, and it considers that wages and stock prices are linked in the long run (the correlation is large and positive), thus linking social security benefits to stock market performance.

Market valuation includes a risk premium that reflects the market risk of the cash flows being discounted. Consequently, the market valuation of social security benefits will differ from the traditional actuarial approach used by the SSA. Contrary to findings of Blocker, Kotlikoff, and Ross (2008), Geanakoplos and Zeldes (2009) find that the market value of accrued social security retirement benefits is substantially less than the actuarial value, and that the difference is particularly large for younger cohorts. Taken as a whole, the market value of accrued benefits is only 81 percent of that implied by the actuarial approach. The main reason for the difference between these results and those reached by Blocker, Kotlikoff, and Ross (2008) is that Geanakoplos and Zeldes (2009) consider that the long-run correlation of wages and stocks is large and positive, which implies that risk adjustment should be large and should decrease the current market value of a claim on future economywide wages.

Geanakoplos and Zeldes (2008) extend the use of derivative pricing methods to consider other measures of the financial status of the U.S. social security system, concluding that the market value of the open group unfunded obligations of the 75-year actuarial balance is between 25 and 50 percent lower than the traditional actuarial approach.

Finally, Geanakoplos and Zeldes (2008) note that a common criticism of their methodology of deriving the estimated market value of social security is that it does not take into account the general equilibrium effects of selling or trading a huge quantity of assets. Bringing all social security liabilities to the market at once could possibly change how the market values those assets.

The Japanese model. Japan implemented a two-tier mandatory pension system in 1986. All residents between the ages of 20 and 59 are compulsorily covered by the first-tier National Pension (NP) plan, which provides flat-rate benefits. In the second tier, employees in the private sector join a compulsory scheme called the Employees' Pension Insurance (EPI) scheme. This scheme provides earnings-related pension benefits that are based on the average salary. Civil servants are covered by different schemes called Mutual Aid Association schemes, though they are also covered by the NP scheme for flat-rate benefits in the same way as private employees. In addition to those social security pension schemes, corporate pension funds and private savings plans are available on a voluntary basis.²⁰

In Japan, the actuarial balance or report is compiled at least every five years with a 95-year time horizon by the Actuarial Affairs Division (AAD 2005b, 2009). Although the report resembles the statement issued by the U.S. SSA, it includes some important differences. The latest report on the actuarial valuation in Japan was published in February 2009. According to Actuarial Affairs Division, under the report's intermediate assumptions, the replacement rate is projected to always be above 50 percent for the next 95 years (AAD 2009). This projection is based on certain assumptions. Although fertility and mortality rates are assumed at more pessimistic levels than those of the 2004 valuation, long-term economic factors are assumed to be more optimistic than those of the 2004 valuation, reflecting the better long-term perspective of the economy than that prevailing at the beginning of the century. Recent good news is that the fertility rate was slightly higher in 2006 to 2008 than had been assumed.

Japan applies what is known as the *limited balance* or *closed period balancing* method.²¹ Its public pension schemes (NP, EPI, and other public pension plans) have adopted the limited balance method when balancing expenditure with revenue. The limited balance

method defines the balancing period, stipulated by law, as 95 years. The period was chosen because most people who were already born at the valuation date will be dead by the close, and during that period, expenditure needs to be balanced with revenue. In the last fiscal year of the period of financial equilibrium (2105 in the case of the 2009 actuarial valuation; see table 23.6), as in the case of United States, the reserve fund for payment must be equivalent to one year of disbursements.

The simplified expression of the Japanese actuarial balance, using the terminology of the U.S. model, is

$$\underbrace{\overbrace{TF_0}^{\text{Trust fund}} + y_0 \sum_{t=0}^{94} \theta_t N_t \prod_{h=1}^t \frac{(1+g_h)}{(1+r_h)}}_{\text{Present value of incomes, 2010-2105}} + \underbrace{\sum_{t=0}^{94} S_t \prod_{h=1}^t \frac{1}{(1+r_h)}}_{\text{Present value of subsidies}} = \underbrace{B_0 \sum_{t=0}^{94} R_t \prod_{h=1}^t \frac{(1+\lambda_h)}{(1+r_h)}}_{\text{Present value of expenses, 2010-2105}} + \underbrace{\prod_{h=1}^{94} \frac{(TF_{94})}{(1+r_h)}}_{\text{Trust fund}}. \quad (23.3)$$

In the equation, S_t is the amount by which the state subsidizes the pension system in year t . From its inception in 1961, the NP plan has been financed from contributions as well as subsidies (general revenue). The 2004 pension reform stipulated that the subsidies should be raised from just over 33 percent of benefit payouts to 50 percent by 2009.

Table 23.6 shows the actuarial valuation of EPI, the most important public pension scheme in Japan. The column of total income includes contributions, projected investment returns, and the national subsidy, whereas the column of total expenditure contains the transfers to the basic pension. EPI is anticipated to be in deficit for the first five years and then have a surplus through 2060. After that, it is projected to be in deficit again and will need to use the reserve fund to compensate. The amount of the trust fund at the end of 2009 represents approximately 28 percent of the projected GDP for that year.²² As in the case of Sweden and the United States, EPI is enormous considering that it is a PAYG system. At the end of the period of financial equilibrium, the size of the reserve fund is projected to be equal to one year's expenditure, although this calculation cannot be directly obtained from table 23.6 because the trust fund ratio is calculated as the ratio between the expenditure of each fiscal year and the reserve fund at the end of the preceding fiscal year. Information very similar to that shown for EPI in table 23.6 is also published for the NP system.

THE BALANCING OF LIABILITIES (INCOME AND EXPENDITURE) IN DB SYSTEMS

The first important point regarding the two actuarial balance models described in the previous section is that they have no specific reference to the concepts of assets and liabilities, as expressly defined for the Swedish NDC actuarial balance sheet. Rather than assets and liabilities for the time horizon considered by the actuarial balance (75 years for the United States and 95 years for Japan), reference is made to the pension system's projected income and expenditure, but liabilities to contributors are not taken into account until they become liabilities to pensioners and generate an obligation to pay or an actual financial payment.

The United States. The actuarial balance for the U.S. model, unlike the NDC model, includes no automatic mechanism that works to recover the system's sustainability, and in this sense, much work needs to be done. However, various researchers have claimed

TABLE 23.6 **Financial projection of Japan's EPI (intermediate assumption), 2009–2105**

Years	Contribution rate (%) ^a	Total income (¥ trillions)	Total expenditure (¥ trillions)	Annual balance (¥ trillions)	Trust fund at the end of fiscal year (¥ trillions)	Trust fund ratio (years)
2009	15.7	34.9	35.8	-0.9	144.4	4.1
2010	16.1	35.0	36.7	-1.7	142.6	3.9
2011	16.4	36.7	37.8	-1.1	141.6	3.8
2012	16.8	38.5	39.2	-0.7	140.9	3.6
2013	17.1	40.4	40.4	-0.1	140.8	3.5
2014	17.5	42.5	41.3	1.2	142.0	3.4
2015	17.8	44.8	42.6	2.2	144.2	3.3
2020	18.3	53.3	45.7	7.6	172.5	3.6
2025	18.3	59.5	48.6	10.9	219.9	4.3
2030	18.3	66.1	52.3	13.8	284.2	5.2
2040	18.3	78.5	67.3	11.2	417.1	6.0
2050	18.3	90.4	82.9	7.5	507.7	6.0
2060	18.3	101.2	97.6	3.6	562.5	5.7
2070	18.3	109.6	112.8	-3.2	561.3	5.0
2080	18.3	116.7	124.2	-7.5	502.5	4.1
2090	18.3	123.9	135.6	-11.7	406.4	3.1
2100	18.3	129.9	149.8	-19.9	247.2	1.8
2105	18.3	132.4	157.5	-25.1	132.4	1.0

SOURCE: Authors' compilation, based on AAD 2009.

NOTE: This is the basic scenario for the EPI plan—that is, the intermediate fertility, mortality, and economic scenario.

a. The pension reform of 2004 established that the contribution rate would increase from 14.29 percent in 2005 to 18.30 percent in 2017. The numbers shown in the table have been rounded up or down to the nearest decimal point.

that some kind of automatic balancing mechanism should be included in the U.S. public social security system (see Palley 2000; Diamond 2004; Capretta 2006; Furman 2007; Penner and Steuerle 2007; Turner 2008). According to Turner (2008), for example, the Congressional Budget Office in 2005 estimated the effect of a U.S. reform that involves only life expectancy indexing of initial social security benefits, similar to the life expectancy coefficient legislated in Finland and Portugal. This one change, if put into effect in 2012, would eliminate 43 percent of the 75-year deficit and extend the insolvency date—when the trust fund runs out of money—by seven years, resulting in an insolvency date more than 50 years in the future.

Japan. The actuarial balance for the Japanese model includes explicit measures for making the system sustainable in the sense that projected benefit payments for the time period

covered by the actuarial balance—95 years—cannot exceed the total revenue from contributions and subsidies for that period plus the accumulated funds existing at the beginning of the valuation period.

Financial balancing is carried out by the so-called fixed-contribution program method and modified indexation (Sakamoto 2005, 2008). Contributors will receive benefits at levels that are automatically adjusted according to the rate by which the number of active participants in the social security pension schemes decreases and the rate by which longevity at age 65 improves until financial equilibrium is attained under the program. However, because benefit levels may be lowered too much if pensions are subject to modified indexation with the contribution program, the pension scheme defines the lower limit of benefit levels and stipulates that the contribution-benefit regime of the scheme should be drastically reviewed when the benefit level threatens to fall below predefined levels by the next actuarial valuation.

According to the 2009 actuarial valuation, the replacement rate specifically defined for monitoring the benefit level is forecast to decrease from 62.3 percent in 2009 to 50.1 percent in 2038. To prevent the benefit level from becoming too low, the law stipulates the provision of a minimum benefit level: if the replacement rate threatens to fall below 50 percent before implementation of the next actuarial review, modified indexation will cease, and the scheme will undergo a drastic review.

Finally, of note is that the Japanese authorities considered the possibility of implementing a Swedish-type actuarial balance, but, as Sakamoto (2005) points out, introducing this type of actuarial balance sheet depends on the socioeconomic conditions of the country concerned. For example, Japan is aging much faster than Sweden, and an ABM as applied in Sweden would probably be continuously activated if it were applied to Japanese social security pension schemes. Furthermore, the adjustment degree on each balancing might be too small to restore long-term financial equilibrium, and it would take a long time for this equilibrium to be restored. Another problem with Japan is the benefit design. As mentioned earlier in this chapter, it is composed of a flat-rate (basic pension) part and an earnings-related part with a redistributive function.²³ Under such a design, defining the turnover duration would be difficult or even impossible. For those reasons, Japan did not adopt an actuarial balance sheet and ABM like that used in Sweden. As a result, the Japanese ABM was constructed in a different way, which is, by coincidence, quite similar to the German method, which is also based on a sustainability factor, though the approach is quite different. The pension reforms in Germany and Japan also took place in the same year, 2004.

SOME EXAMPLES FROM OTHER COUNTRIES

This subsection looks briefly at the actuarial balances; automatic and semiautomatic balancing mechanisms; and the most recent results in Canada, Finland, Germany, and the United Kingdom, all of which have pension systems offering what are mainly defined benefits. The actuarial balance is still the main aggregate accounting methodology, but the way in which the main results are presented may vary.

Canada. A pension reform was carried out in Canada in 1997 in which a sustainability clause and other changes were included in the Canada Pension Plan (CPP), converting it into a partially funded system. The CPP today is a partially funded PAYG system integrated within the wide-ranging Canadian social security system, which combines various pillars of protection.

As mentioned earlier, the Canadian actuarial balance has been drawn up every three years since 1966 (Office of the Chief Actuary 2007, 2008) and involves projecting revenue and expenditure over a long period of time with the aim of accurately assessing the future effects of historical and projected trends in demography and economic factors.

According to Brown (2008), if any of the actuarial projections—which have a time horizon of 75 years—concludes that the plan is not financially sustainable, a mechanism will be triggered to keep the actuarial deficit in check by increasing the contribution rate by the amount necessary to cover 50 percent of the deficit. At the same time, the remainder will be covered by adjusting the pensions payable; that is, the amount of pensions in payment will be frozen for three years until a new actuarial study is carried out. However, the semiautomatic adjustment occurs only if the Canadian parliament cannot first decide on an adjustment, which is considered unlikely.

An important point regarding the scheme is that it is considered unsustainable if the projected contribution rate in a stationary state for the next 75 years needs to be greater than that established by law (currently 9.9 percent). The steady-state contribution rate is defined as the lowest-level contribution rate applicable after the end of the review period, which results in the assets-to-expenditures ratio being the same in the 10th and 60th year following the end of that review period.

According to the Office of the Superintendent of Financial Institutions Canada, the minimum contribution rate, which is the lowest rate sufficient to sustain the CPP without further increase, is 9.8 percent of contributory earnings for 2010 and thereafter (Office of the Chief Actuary 2008). Consequently, the semiautomatic mechanism will not be triggered. With the legislated contribution rate of 9.9 percent, contributions are more than sufficient to cover expenditure from 2007 to 2019. Thereafter, a proportion of investment earnings will be required to make up the difference between contributions and expenditure. In 2050, 31 percent of investment earnings will be required to pay for benefits.

Finland. Following Hietaniemi and Ritola (2007) and Lassila and Valkonen (2007), the most important changes in the extensive Finnish pension reform of 2005 were (a) the move to consider earnings during the whole of working life as pensionable earnings, (b) the introduction of a flexible retirement age for the old-age pension between ages 63 and 68, (c) the raising of the age limits for preretirement pensions, (d) the total abolition of unemployment and individual early retirement pensions, and (e) the inclusion of increased longevity in the pension amount through a life expectancy coefficient. This life expectancy coefficient automatically adjusts the amount of pensions being paid as longevity increases (or decreases). In the formula, to be enforced in 2010, the value of new pensions will depend on life expectancy as of 2010 compared with that of 2009. In addition, the calculation rules of Finland's different pension acts were further harmonized.

Every two years, the Finnish Centre for Pensions compiles a type of actuarial balance that is based on an aggregate accounting model projecting pension spending. The Finnish statement is similar to the statements in Canada and the United States but reflects the characteristics of the pension system in Finland (Elo et al. 2010). The balance values the earnings-related pension scheme, which is a DB scheme outlined in several pension acts, which together cover the different sectors of the economy. In practice, all work performed by people between the ages of 18 and 67, whether employees or self-employed, is insured under one of the pension acts. The national pension guarantees a minimum pension if the earnings-related pension is small.

According to the latest actuarial balance, in 2025, the value of the life expectancy coefficient is forecast to be 0.90, and in 2075, it will be 0.75, which means that the average pension in comparison to the average wage will go down from its current level of 50 percent to 40 percent by the end of the projection horizon in 2075. However, this decline will not be enough to maintain financial balance throughout that period. In 2008, pension spending was 18.1 percent of total wages, and by 2030, this percentage is expected to increase by 11 percentage points. Therefore, the level of the contribution rate starting in 2010 needs to be 25.4 percent (4.4 percentage points higher than the current level) to ensure the long-term financial stability of the scheme.

Germany. The pension system in Germany relates the amount of retirement pension to the number of years contributed and the pensionable income for each of those years. This points system has undergone a series of reforms over the past 15 years that have transformed it into a multipillar system that brings to mind the Swedish system. The most important changes of the pension reform were (a) the introduction of the so-called sustainability factor, which maintains the contribution rate below 20 percent until 2020 and below 22 percent until 2030; (b) an increase in the normal retirement age from 65 to 67, which should become fully operational in 2029; and (c) the stipulation that the government could adopt new measures if the replacement rate fell below 67 percent of average net earnings (Börsch-Supan 2006, 2007).

Rather than draw up an actuarial balance at regular intervals in Germany, the European Union's Ageing Working Group makes a projection of pension spending using a time horizon of 53 years (Economic Policy Committee 2007). The pension projections performed for the working group cover the statutory pension scheme as well as the pension scheme for civil servants. These two schemes cover almost 90 percent of the employed population. It seems that the Economic Policy Committee calculations are better suited to the intra-European peer review process than to use in Germany.

The projections consist basically of two submodels: first, a cohort model for projecting the demographic effect on pension spending, and, second, a partial equilibrium model for calculating dynamic financial development regarding pension adjustment and contribution rates. According to the Economic Policy Committee (2009), old-age and early pensions are projected to increase by 2.4 percent of GDP between 2007 and 2060 in Germany, mainly as a result of the projected aging of the population.

Despite not conducting an official actuarial balance at regular intervals, the negative results of the various projections mean that the formula for revaluing pensions in payment in Germany also includes a sustainability factor—a permanently triggered ABM—that takes into account the system's rate of dependence. This factor reflects the way in which the ratio between the number of contributors and the number of pensioners evolves—that is, the system's dependency rate—which is the main determinant for the long-term funding of the pension system and which will reduce the amount of annual pensions if that ratio should become smaller. Incorporation of this sustainability factor links increases to pensions being paid to increases in productivity and the contribution base.

The United Kingdom. According to the Economic Policy Committee (2009), the United Kingdom's public pension system provides in the first instance a flat-rate pension, which can be supplemented by an earnings-related public pension scheme (i.e., the state second pension, known as the State Earnings-Related Pension Scheme, or SERPS) or a private

occupational pension plan. Occupational pension plans should provide benefits at least as generous as SERPS.

The British Government Actuary's Department (GAD) is required to review the operation of the National Insurance Scheme of Great Britain at least every five years with a projection horizon of 62 years (GAD 2010). The main benefits paid by the National Insurance Fund are for retirement, incapacity, bereavement, unemployment, maternity and paternity, and sickness. It is funded by national insurance contributions from employees, employers, and the self-employed. The object of the GAD's review is "to determine the extent to which the level at which the National Insurance Fund stands from year to year may be expected in the longer term to bear a proper relation to demands in respect of payments of benefit" (GAD 2010, 6).

According to GAD (2010), the National Insurance Fund's expenditure is projected to increase from about 5 percent of GDP in 2008/09 to about 8 percent in 2070/71, mainly because of population aging. The national insurance contribution rate required to balance fund expenditure is projected to decrease from about 21 percent of relevant earnings in 2008/09 to about 19 percent in 2020/21 and then to increase steadily to about 26 or 27 percent in 2070/71.

Even though an official actuarial balance is compiled at five-year intervals in the United Kingdom, so far no kind of ABM has been incorporated to correct financial imbalances.

ADVANTAGES AND DISADVANTAGES OF THE ACTUARIAL BALANCE FOR NONFINANCIAL DB SCHEMES

A number of advantages are gained from using an actuarial balance approach with DB systems. To begin with, the actuarial balance reduces the traditional difference between the planning horizon of politicians, which is usually no more than four years, and that of the system itself. In this way, it helps to overcome one of the main weaknesses of DB systems: the ease with which politicians approve benefit increases on no actuarial basis solely for electoral reasons.

Actuarial balance systems can include all the contingencies covered by the system—retirement, invalidity, survivor, and other benefits. This ability is an advantage because DB systems often have no clear separation between contribution rates by contingency, and even if they do, large-scale redistribution often occurs under these systems that makes it difficult for the various contingencies to be dealt with separately.

The actuarial balance also makes it easy to include the expected effects of aging and predicted trends in the main economic variables (i.e., productivity, employment, and rate of activity). Furthermore, by using scenario-generating techniques, the effects of changes in the variables for expected behavior can be quantified.

Finally, the actuarial balance enables the intergenerational effects of any proposed reforms to the system to be studied and quantified. This approach presents the best way of dealing with hypothetical situations of structural financial imbalance. It avoids the usual tendency to put off the worst of the changes for future generations to deal with, which, as Blake and Mayhew (2006) have pointed out, is extremely important: credible pension policies have to be time consistent, and time-consistent policies cannot pass the challenge to future generations.

However, there are also a number of disadvantages to using actuarial balances. Individual actuarial equilibrium based on the ratio between contributions made and benefits accrued is not clearly shown in this balance, because only financial costs to pensioners are considered, and the increase in liabilities that comes about in the system per contribution unit is not measured. Paradoxically, some authors call this balance model actuarial, although in fact it is not very actuarial at all. For Jackson (2004), in this type of actuarial balance system, which is mainly based on statements of annual cash flows, a substantial temporal disconnect is apparent between commitments and payments.

The balance is certainly not easy to compile. It calls for complex projections, given the extremely long time horizon under consideration. The result is very sensitive to hypotheses regarding the evolution of the main economic, demographic, and financial variables, and, therefore, complementary sensitivity analyses and the formulation of alternative scenarios are needed.

The relationship with automatic financial balancing mechanisms does not come about naturally. Those affected by possible measures can argue that the adjustments should not be based on projections, which may or may not be right. Nevertheless, as shown in the cases of Canada and Japan, the adjustments can still be applied.

Comparing the Methods Using Some Important Criteria

The main differences and similarities between the Japanese, Swedish, and U.S. actuarial balances are the following:

- *Objectives.* The U.S. actuarial balance has a different mission from the Swedish one. Its aim is not to provide for automatic piloting but rather to provide information to the interested public and legislators, on which the latter may or may not act. The Japanese actuarial report includes elements that can also be found in the other two models: it highlights future challenges to the system (mainly aging and the forecast increase in longevity) through projections, but it incorporates automatic measures (so-called modified indexation under the fixed contribution program) to deal with the projected future imbalance between the system's costs and revenue. These measures can be adapted every five years in line with the projections contained in the new actuarial report.
- *Information.* The information provided by the two types of actuarial balance is also different. The double-entry bookkeeping method of the Swedish NDC system provides information on changes in the pension plan's solvency position (the net income of the accounting period) that occurred during the accounting period, and it quantifies the sources of that change in the income statement. The future (i.e., any time after the last day of the accounting period) does not affect the analysis. The traditional actuarial projection of the U.S. defined benefit system is largely concerned with the future. The result of the U.S. analysis is condensed into a single number—the actuarial balance—and the sources of the change in the actuarial balance are not as easily quantified as in the Swedish case. Nevertheless, such quantification of the sources of change is provided in the U.S. case, but it does not follow from an accounting identity.

- *Structure.* The Swedish NDC balance sheet follows the traditional structure of an accounting balance sheet that derives from principles of double-entry bookkeeping and has a very strong actuarial profile because it includes its commitments to both pensioners and contributors as liabilities. The U.S. (as well as the Japanese) balance sheet has a more financial profile because its commitments to contributors are not quantified until those contributors become pensioners.
- *Projections.* Projections of demographic, economic, and financial variables are made for a 75-year period in the United States with no changes in legislation, whereas in Japan the period is 95 years, and the changes in the benefit level necessary to achieve financial equilibrium are incorporated into the projection, as stipulated by law. In Sweden, a valuation system based on verifiable facts and transactions at the effective date of the balance sheet is used, although the value of the liability of the old DB system (the ATP) for active workers is carried out by means of an actuarial projection.
- *Valuation of assets and revenues.* In Sweden, the contribution asset is quantified on the basis of the conditions prevailing at the time of valuation and assumes those conditions remain constant, whereas in Japan and the United States, revenues are estimated for the next 95 years and 75 years, respectively.
- *Discount rate.* The actuarial balance in Japan and the United States depends on the projected yield on trust fund assets, whereas the Swedish NDC balance sheet, being independent, does not. The Swedish NDC balance sheet considers the inverse of the turnover duration to be the implicit discount rate for contributions, whereas for the liability to pensioners, a predetermined technical interest rate within the so-called economic divisor is used.
- *Effects on contributors and pensioners.* Every year the information deriving from the Swedish NDC balance sheet has an effect on the indexation of the contributions registered in the notional accounts and on the rate of variation of pensions in payment. By comparison, the U.S. DB actuarial balance has no immediate effect but serves as an element to provoke thought and analysis for possible legislative reform of the pension system. In this respect, the Japanese model resembles the Swedish model rather than the U.S. model because it introduces mechanisms for adjusting spending in line with income over the entire period considered (95 years). Therefore, the Japanese actuarial report—even though it uses projections that may or may not be accurate—does have an immediate effect on present and future pensioners in that whether their indexation should be modified depends on the result of the actuarial valuation.
- *Individual information sent to contributors and pensioners.* Both the Swedish Social Insurance Agency and the U.S. Social Security Administration send annual information to contributors and pensioners. The personal statement basically deals with account information as well as a projection of benefits that shows how benefits would fluctuate with retirement age. The personal statement is even more important in NDC systems than in DB systems, because NDC systems put more of the responsibility and risk to plan for retirement on individuals. That difference is mainly due to the difficulty in converting the account balance of the NDC

to a monthly benefit, because the benefits vary with the choice of retirement age. Life expectancy is also a key factor.

- *Solvency and sustainability indicators.* The solvency and sustainability indicators for the system emerging from the Swedish and U.S. balances can be complementary in some cases, although they are conceived and composed in clearly different ways. The U.S. sustainability indicator is no more than the sum in present value of the projected cash deficits or surpluses for the time period considered, to which are added the value of the financial assets at the beginning of the valuation period. The Swedish indicator concentrates more on evaluating the commitments it has with both pensioners and contributors. In the Japanese model, the indicator is the projected sum of the deficits, which by definition is zero if reality corresponds to the assumptions, because it incorporates measures for balancing the system in the horizon considered. The obligation to compile an actuarial balance every year—or at least periodically as in Canada, Finland, Japan, and the United Kingdom—makes people more interested in how the system develops; hence, introducing ABMs into the system to guide it firmly onto the road to long-term financial solvency and sustainability may be easier. If this obligation did not exist, it would be practically impossible to introduce ABMs.
- *Transparency.* The really important thing about the actuarial balance is what it represents (or should represent) for good pension system management: the fact that it has to be compiled every year—or at least every five years as in Japan—and exceeds the traditional planning horizon of the politicians. Compiling actuarial balances—which in the cases described are also audited and have the support of experts on the subject—should oblige politicians to be much more careful about what they say and should minimize the use of populism in pensions (political risk). In addition, actuarial balances give contributors and pensioners a reliable idea of the extent to which promises made to them regarding the payment of their pensions will be kept. It undoubtedly also makes them more involved in the way their payment evolves, because it gives them greater knowledge of both the system and their individual rights and obligations.
- *Applicability.* As a model, the Swedish actuarial balance sheet seems more appropriate for an NDC system, especially if measures that immediately affect current pensioners and contributors can be derived from the solvency indicator. Such measures would be more difficult to justify if they were based on projections that require explicit assumptions of future developments because such assumptions are easy to criticize. Nothing prevents the Swedish actuarial balance sheet from being applied to other DB PAYG systems, particularly if the separation between the retirement contingency and the other contingencies is clear.

Concluding Remarks, Policy Recommendations, and Future Research

This chapter has shown the advisability of drawing up an actuarial balance in DC and DB PAYG pension systems to improve their transparency, credibility, and solvency. It has

also shed some light on the two main methods used by government social security departments to draw up the actuarial balance in DC and DB PAYG pension systems, focusing especially on their results, methodology, and actuarial issues. Given the arguments looked at and the research referred to in this chapter, some specific policy recommendations can be made that would be of interest to public finance economists, social security actuaries, and policy makers. Moreover, some questions arise regarding the actuarial balance that need to be investigated more comprehensively.

The main conclusion is that the actuarial balance is becoming an essential instrument for the correct running of PAYG pension systems because it tends to minimize the traditional difference between the planning horizons of whichever authority is in charge of the system and the system itself. The advantages to society of having an actuarial balance are extremely important:

- Contributors and pensioners have a good idea of the extent to which promises or commitments regarding their pensions are being kept, because the actuarial balance shows the (true) financial and solvency status of the pension system.
- Use of the actuarial balance strengthens public interest in how the system is developing, thereby making introducing ABMs easier because the system would already have an accepted objective information base showing sustainability and solvency indicators.
- The actuarial balance obliges politicians to be much more careful about what they say about the system, thereby reducing populism in pensions and enabling the effects of proposed reforms to be assessed with greater reliability and, where appropriate, to be accepted with greater support.

Several policy recommendations derive from these advantages. First, countries that do not regularly compile an official actuarial balance—the vast majority—should very seriously consider doing so as soon as possible. Even more important is for countries with DB systems to have an official actuarial balance produced at regular intervals, because, in principle, the formulas for calculating the pension include no elements for adjusting or automatically balancing as in NDC systems. If these elements are included, as in the case of Finland, Germany, and Japan, they are based only on certain important aspects and others are left out, which means that—unlike the actuarial balance—the full perspective is not taken into account.

Second, the best model to follow would depend basically on whether the PAYG system is DB or NDC, whether the different contingencies are clearly separate, and what the system's implicit degree of redistribution is.

Those countries that already regularly compile some sort of official actuarial balance—a minority—should continue along the following paths:

- *Increase the frequency of the reports.* Although it is a notable achievement that the balances are drawn up periodically—every two years in Finland, every three years in Canada, and every five years in Japan and the United Kingdom, for example—publishing them annually would be better because the value of financial assets and the economic situation may change drastically and have a great effect on the results. For example, the change in the solvency of the Swedish system in 2008 was attributable to heavy financial losses caused by the economic crisis. Clearly,

if the frequency of the Swedish actuarial balance was lower, policy makers might not have noticed this change in solvency.

- *Have a panel of independent, recognized experts decide on the economic, demographic, and financial assumptions on which the projections underpinning the actuarial balance are based.* Such a panel could be similar to the Social Security Technical Panel on Assumptions and Methods in the United States. Some researchers—and many politicians—argue that long-term forecasts are unsound, which means that a high level of consensus is necessary regarding the a priori reliability of the assumptions.
- *Make use of new methodologies to compile the actuarial balance.* In this regard, the efforts made by the U.S. Social Security Administration in the United States and the Swedish Social Insurance Agency are examples to follow.
- *Ensure that the two basic focuses of the actuarial balance complement each other to the extent possible.* As mentioned earlier, one focus is largely concerned with the future and covers the threats posed to the system by demography and lower productivity (U.S. model); the other deals more precisely with the actuarial design problems of the system (actuarial balance sheet).

Hence, the last recommendation, though no less important than the others, relates to international organizations, such as the International Social Security Association, the World Bank, and the Organisation for Economic Co-operation and Development, that are interested or involved in pension system reform. These organizations could support the development and enforcement of international accounting and actuarial valuation standards for PAYG pension systems.

Finally, three important issues regarding the actuarial balance—though addressed to a certain extent in this chapter—need to be investigated more thoroughly:

1. Researchers should study whether a survivorship dividend should be included as part of the return on the notional rate on the NDC accounts. The survivorship dividend at a particular age quantifies that part of the contributor's notional capital corresponding to the sharing-out of the notional capital of the original group members who have died. Of those countries that currently have an NDC system, only Sweden applies what is known as *inheritance gains* or the *survivorship dividend*. Given that the report issued by the Swedish authorities does not explain the foundation on which the dividend is applied (and a search of the literature has not discovered that foundation), it would be a good idea to investigate whether an actuarial basis actually exists and the effect it has on the equilibrium of the NDC system's actuarial balance (Swedish Social Insurance Agency 2010).
2. The actuarial balance as used in NDC systems is difficult to transfer to DB systems unless those systems' various contingencies are clearly separate. Therefore, researchers need to develop a theoretical method for applying the actuarial balance jointly to the retirement and disability contingencies in DB systems. Specifically, new expressions need to be defined for the turnover duration and the contribution asset, thus enabling a greater percentage of spending on contributory pensions to be included on the actuarial balance.

3. The DB actuarial balance model and market valuation need further study. As shown in the papers by Blocker, Kotlikoff, and Ross (2008) and Geanakoplos and Zeldes (2008, 2009), the use of techniques based on asset pricing and derivative pricing methods leads to actuarial balance values that differ significantly from those obtained by the U.S. Social Security Administration, which uses traditional methods. Other questions to investigate in the case of the market-based models are the following: Would they bring instability in the results of the actuarial balance? Are the approaches too complex for plan members to understand? Would the general equilibrium effects of selling or trading a huge quantity of assets have a significant effect on the results obtained using these methods?

Notes

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1. The most commonly used methodologies for making projections of spending on pensions or analyzing the sustainability of pension systems are aggregate or growth accounting models, microsimulation models, general equilibrium models, and indirect models. On this aspect, see the papers by Lefebvre (2007) and EPC (2007).
2. In the case of Japan, Takayama (2004) uses the actuarial balance sheet as an element to analyze proposals for reforming the pension system, although the list he presents of the items it comprises is not very developed. In the case of Spain, Boado-Penas, Valdés-Prieto, and Vidal-Meliá (2008) compile an actuarial balance sheet to assess the solvency of the Spanish system and compare it to the Swedish system. They also develop the concepts of the contribution asset and the average turnover duration for defined benefit PAYG systems. Vidal-Meliá, Boado-Penas, and Settergren (2009) apply the balance sheet of the Spanish system to support the introduction of an automatic balancing mechanism.
3. For more information, see other chapters in this volume and, among other works on this topic, Williamson (2004); Börsch-Supan (2006); Holzmann and Palmer (2006); Marin (2006); Vidal-Meliá et al. (2006); Chłoń-Domińczak, Franco, and Palmer (2012); and Vidal-Meliá, Boado-Penas, and Settergren (2010).
4. Because of the way the uniform actuarial factor is built, the so-called actuarial hidden redistribution is still very high. Just like traditional DB systems—as well as most DC systems—NDC systems have in practice established a uniform actuarial factor where there is expected income redistribution from contributors with a shorter-than-average life expectancy to those with a longer-than-average life expectancy. According to Brown and McDaid (2003), to minimize actuarial hidden redistribution, at least 10 important factors, apart from gender, should be

taken into account: race, level of education, wealth, employment, marital status, religion, lifestyle, weight, smoking habits, and drinking habits.

5. An ABM is a set of predetermined measures established by law to be applied immediately as required according to the solvency indicator (Vidal-Meliá, Boado-Penas, and Settergren 2010). Its purpose, through successive application, is to provide what could be called *automatic financial stability*, which can be defined as the capacity of a pension system to adapt to financial turbulence without legislative intervention. Turbulence can be caused by economic or demographic shocks that have an effect on the system's solvency or financial equilibrium. In other words, an ABM is used to depoliticize the management of the PAYG system by adopting measures with a long-term planning horizon. Some European countries that have fairly recently reformed their pension systems have introduced a sustainability factor or other reduction coefficients into the specification that determines the amount of pension benefit at retirement (EPC 2009). This approach introduces a component that changes the size of the pension benefit, depending on expected demographic changes such as life expectancy at the time of retirement.
6. For more information about the Swedish pension system, see Palmer (2002), Sundén (2006), and Chłoń-Domińczak et al. (2012).
7. As shown in Boado-Penas, Valdés-Prieto, and Vidal-Meliá (2008); Vidal-Meliá, Boado-Penas, and Settergren (2009); and Vidal-Meliá and Boado-Penas (2010), this balance sheet structure is perfectly valid for DB systems in which the contribution rates for different contingencies are clearly separated.
8. The theoretical foundations of the TD and its solvency implications through the contribution asset are currently being researched. See Vidal-Meliá and Boado-Penas (forthcoming) and chapter 19 of this volume.
9. Vidal-Meliá and Boado-Penas (2010, forthcoming) developed a model, based on models first put forward by Settergren and Mikula (2005) and Boado-Penas, Valdés-Prieto, and Vidal-Meliá (2008), to obtain the analytical properties of the contribution asset and to confirm its soundness as a measure of the assets of a PAYG scheme. Their model also enables them to explore whether, and to what extent, the hidden asset can be considered a second alternative measure of the assets for PAYG schemes.
10. This method is consistent with actuarial valuation basics. An actuarial valuation of a retirement plan (system) is an estimate of the plan's financial position at a specific point in time, and actuarial assumptions are primarily based on past experience or standard tables. During the valuation, the actuary takes a "snapshot" of the plan (or the PAYG public pension system in the case of Sweden) at a given date to determine the plan's liabilities and *funded* (solvency) status.
11. For calculating the liability using current pensioners, the initial pension of each cohort is multiplied by the economic divisor (ED), which corresponds to an actuarial discount factor weighted by the number of pensioners with their respective pensions. The ED is consistent with the definition of the TD, in which the ages of the working and retired affiliates are weighted by their economic amounts (contributions and pensions). The ED supplies a slightly different value to that of the classic actuarial discount factor. The ED should not be confused with the demographic divisor (DD) used to calculate the initial benefit, where the notional capital accumulated in the contributors' accounts is divided by the demographic divisor. The DD is the present value of a life annuity due of 1, constant, in installments, with a technical interest rate of 1.6 percent. See Vidal-Meliá, Boado-Penas, and Settergren (2010) for the actuarial differences between ED and DD, and Swedish Social Insurance Agency (2010), appendix B, section 4, for full technical details on calculating the ED.
12. According to Regúlez-Castillo and Vidal-Meliá (2012), individual pension information can be defined as all the necessary details that the participant, contributor, or pensioner needs

to receive from the system or plan with which they are currently affiliated. The details they receive include contributions made, projected benefits, replacement rate, retirement choices, accrued or consolidated rights, and so on. This information enables them to adequately plan their retirement period and cover the risks mainly associated with disability and death. See chapter 17 in this volume for more about the information sent to individuals.

13. For more information about the Orange Envelope, see Larsson, Sundén, and Settergren (2008); Sundén (2009); and Larsson and Paulsson (2010).
14. See Swedish Social Insurance Agency (2009) and Vidal-Meliá, Boado-Penas, and Settergren (2010) for full actuarial details on calculating the solvency ratio.
15. On this aspect, see Turner (2008); Vidal-Meliá, Boado-Penas, and Settergren (2009); Barr and Diamond (2009, 2011); and Barr (2011).
16. See note 11 for more about the economic divisor.
17. The increase in the contribution rate would be 1.84 percent without considering the final target fund reserve, and the necessary contribution rate is increased on the assumption that any change in tax rates would affect the proportion of employee compensation that is paid in wages.
18. This figure cannot be directly obtained from table 23.4. See details of the calculation in Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds (2010).
19. Regúlez-Castillo and Vidal-Meliá (2012) give a detailed description of the statements in Sweden and the United States and Sweden. In particular, they look at how the statements are structured, aspects that could be improved, and limitations of the statements.
20. The history of social security pension schemes in Japan and the current roles of public pension schemes and corporate pension plans can be seen in Takayama (2003); Lu, Mitchell, and Piggott (2008); and Sakamoto (2009).
21. Under the closed period balancing method, the period of financial equilibrium is finite, whereas the whole future balancing method considers that the period of financial equilibrium is for a perpetual time horizon. The former method was applied in Japan for the actuarial valuation in 1999. The latter method was ruled out mainly because if the share of elderly population became very high, as was the case in Japan, the public pension system would have to manage enormous financial assets to be able to make use of the investment profit in the future.
22. According to Takayama (2003), the EPI system was intended to be a fully capitalized DB system, and during the long period of Japanese growth from the 1960s through the 1980s, large pension reserves were accumulated. However, between 1965 and 1973, the replacement rate was boosted sharply from 40 percent to 60 percent of gross wages, rendering reserves insufficient and transforming it into a PAYG system.
23. For Lu, Mitchell, and Piggott (2008), the current system is far from actuarially neutral. Specifically, the NP scheme subsidizes single NP contributors relative to EPI workers, whereas the EPI system subsidizes married couples relative to singles. It also provides disability and survivor benefits.

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CHAPTER 23

COMMENT

Robert Gillingham

The interesting and well-crafted chapter by María del Carmen Boado-Penas and Carlos Vidal-Meliá addresses a number of important issues and does so in a very informative fashion. It provides a wealth of information on how a number of countries address the need for actuarial analyses for their (partially) pay-as-you-go (PAYG) public pension schemes. Moreover, it emphasizes the need for a mechanism that will allow a country to react when a pension system becomes financially unsustainable. My main concern is that the chapter does not go far enough in addressing the complexities of achieving the potentially conflicting goals of fairness and affordability. The chapter focuses on the overall cash balance of pension systems, with appropriate focus on the long run. In my opinion, however, it would be useful to merge concerns about the financial balance of the system with concerns about how that system meets the needs of participants. I will expand on this point by discussing some of the concepts that are central to the chapter.

Information

The chapter emphasizes the value of information and the role that actuarial analysis can play in providing information. However, the authors focus on the overall balance of the system, rather than on the effects of the system on individual participants. As the chapter rightly points out, an actuarial analysis is a necessary input into understanding what I will call the *macrobalance* of a pension system. However, an actuarial analysis entails much more. Just as important as the macrobalance are the projections that an actuarial analysis will produce for the individual participants in the system. The macrobalance is simply an aggregation of the micro-cash flows that pertain to each of the participants. The micro-analysis provides information on winners and losers. How does the rate of return on contributions vary across participants, and how does it compare with alternative investments?

As an example, if the nonfinancial (notional) defined contribution (NDC) system in Sweden were simply an individual retirement account, the analysis would be much less complex, though still daunting. One goal would be to determine whether the expected rate of return on the NDC would be greater or less than the rate that would elicit voluntary participation in the system. The difference would be a subsidy or tax. Certainly, the amount of tax or subsidy could vary across participants—depending on a wide range of factors—although one could argue that the variation in this paradigm would be relatively small. However, the NDC is much more. It appends forced annuitization on the individual account balance, creating a more complex set of intracohort cross-subsidies, for instance, from men to women or lower-income to higher-income, that are systematic

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rather than stochastic and similar to those in defined-benefit schemes. As I will discuss, the choice of rate of return and balancing in the Swedish pension system also has significant implications for intercohort cross-subsidies.

Transparency

Comprehensive information is a necessary condition for transparency. The chapter appears concerned only with transparency about the financial status of the system rather than the benefits that the system is likely to deliver to participants. The Swedish actuarial balance calculation does not appear to provide any information or transparency on the latter, but the Swedish system does provide annual reports to participants on the balances in their individual accounts and the facility to estimate benefits based on either generic or their own assumptions. This type of transparency seems at least as important to me. As another example, the U.S. Social Security Administration provides participants with an annual statement on what they have contributed to the system and the level of benefits that they can expect to get out of the system. The latter is, of course, speculative, especially for younger participants, but it provides a benchmark that can be continually reassessed with each additional year of participation. Just such a projection is implicit in the Swedish actuarial analysis.

Transparency would also require that participants understand their property rights in the pension system. The similarities and differences between the U.S. and Swedish systems are again informative. Abstracting from the buffer fund and automatic balancing mechanism, the Swedish system appears to promise (a) a retirement account that depends on the contribution history of the participant and a rate of return on contributions that depends on the growth in the nominal per capita wage, which is adjusted if the system solvency indicator falls below unity, as determined by the financial balance exercise, and (b) an annuity that depends on the balance in the retirement account, group-average life expectancy, and the same rate of return. The U.S. system appears to promise a defined benefit that depends on the wage—rather than contribution—history of the participant, the rate of growth of economywide average wages, and the relative wage level of the participant. Both systems, however, carefully hedge these promises.

The threshold question is whether a participant has a *right* to a pension defined in these ways. Under Swedish law, workers have a legal right to pensions defined in this way. The United States, however, has explicitly denied the right of participants to particular benefits.¹ Both approaches provide for a reduction in net benefits in response to macroeconomic realities. However, whether large reductions would actually take place is fundamentally a political question. Clarity on property rights can facilitate a more reasoned political discourse, however.

Automatic Balancing

Boado-Penas and Carlos Vidal-Meliá applaud the value of the Swedish automatic balancing system. From the point of view of the public treasury, the mechanism has obvious benefits. However, it is not clear what the incidence of the balancing mechanism is. Who loses and who wins when the mechanism is invoked? Would another mechanism achieve the same financial sustainability but with a different incidence? A quick reading of

Settergren (2001)—and I would not claim to have internalized all that is in this article—indicates that the balancing mechanism is meant to address situations in which the pension system strays from a steady-state environment. Such a situation might be considered a risk facing the system, or it might be considered a certainty. In either case, the rules of the system must be adjusted. I assume that the choice of the balancing mechanism—as with the choice of the system to begin with—is a normative policy decision. It seems strange to ignore all of the information contained in the Swedish projections of the future evolution of the system in determining how to address a possible imbalance. For instance, suppose we “know” (or at least project with confidence) that the labor force will shrink over the next 30 with a concomitant effect on the balancing index over the same time period. In this case, balancing will last for 30 years as well, and the drop in the internal rate of return on NDCs will be far higher for younger workers than for older beneficiaries. Conversely, the opposite will occur if there is a once and for all increase in the average rate of growth in productivity. In this case, younger workers will receive a higher internal rate of return on their contributions than older beneficiaries. These outcomes are not wrong, but they reflect a policy choice. Again, a comparison of the Swedish and U.S. rules is interesting. The U.S. rule allows for an across-the-board reduction in benefits on current and future beneficiaries if the trust/buffer fund is exhausted. The two rules have very different implications for intercohort distribution.

Actuarial Fairness

The chapter supports the concept of actuarial fairness, as well as the need for a true and fair view of the system. From my perspective, actuarial fairness is a non sequitur. According to the website American Academy of Actuaries,²

Actuaries put a price tag on risk. They are the leading professionals in finding ways to manage risk, and are experts in:

- Evaluating the likelihood of future events.
- Reducing the impact of undesirable events.
- Designing creative ways to reduce the likelihood of undesirable events.

According to this definition, actuaries are not concerned with fairness per se. What events are “undesirable” presumably is determined not by the actuary, but rather by the sponsor that uses the actuarial analysis. The Swedish actuarial balance does not seem to address risk and uncertainty, but rather provides a financial balance conditional on maintained hypotheses about the future evolution of key determinants. The longer-term analyses for Sweden and the United States do deal with uncertainty, so they seem more like actuarial analyses to me. However, the actuaries are not supposed to make value judgments. Rather, they provide positive analysis.

The use of the term *actuarially fair* can be particularly pernicious in certain circumstances. For example, people often discuss the need for an actuarially fair adjustment of benefits when workers retire at different ages. It is possible to talk about an actuarially neutral adjustment for a particular individual, because everything else can be held constant. To apply an adjustment to a group invites adverse selection, with individuals choosing the option that is most likely to benefit them, assuming the adjustment cannot be conditioned on every variable about which the individual has information (for instance,

individual life expectancy). The reduction of benefits in the U.S. social security system when the trust funds are exhausted can be viewed as actuarially neutral. Whether it is fair is another issue.

NDC Pension System

Even the concept of an NDC system is somewhat nebulous. Although the Swedish pension system is categorized as an NDC system and the U.S. system is categorized as a PAYG one, the approaches are more similar than they appear. The Swedish system records and cumulates contributions, indexing the contributions by an internal rate of return that depends on the rate of growth of the contribution base and age-related wage and mortality patterns. The U.S. system cumulates wages, indexing the wages by the rate of growth of the economywide average wage. If we hold the contribution rate constant, the two are conceptually equivalent but use a different rate of return. The U.S. average indexed monthly earnings (AIME) can be rewritten as a notional account multiplied by a constant factor:

$$AIME = \sum_{i=1}^{35} W_i \prod_{j=1}^{35} (1 + r_j) = \frac{1}{35c} \sum_{i=1}^{35} c_i \prod_{i=1}^{35} (1 + r_j) = \frac{1}{35c} NDC,$$

where W_i and C_i are the wage and contributions in period i , r_j is the wage indexation factor in period j , c is the constant contribution rate, and wages are averaged over the highest 35 years.

The Swedish system gives participants explicit information on account balances and the U.S. system gives participants information on the benefits their balances should yield. Neither, however, gives participants control over access to the accounts they have accumulated. The Swedish system multiplies the value of the notional account by an annuity factor to get an initial benefit, and the U.S. system multiplies the AIME by a wage-based replacement rate (equivalent to multiplying the implicit NDC by an annuity factor equal to the replacement rate divided by $35c$). Both systems redistribute from high-mortality to low-mortality participants. The progressive replacement rate schedule in the U.S. system also redistributes from high-wage to low-wage participants. Each superimposes a mechanism to control benefits when financial sustainability is either threatened (Sweden) or breached (the United States). The point of this comparison is to suggest that any system that imposes a close tie between contributions and benefits is implicitly an NDC system. The Swedish system differs most significantly from the U.S. system in its automatic balancing mechanism, which does not rely on a cataclysmic event. The key question is whether an NDC system will face severe political hurdles if and when the internal rate of return in a particular country falls significantly below the rate of return in financial markets or if the replacement rates from NDC accounts fall so far below the replacement rates prior to the introduction of an NDC system.

One option to address this problem is to gradually increase the degree of funding, either within the NDC system (both Sweden and the United States have significant buffer funds) or through supplemental saving. The trend in many countries has been to shift a fixed share of pension contributions into funded accounts. From my perspective, this approach does not solve the NDC problem, because the share of funded saving does not

automatically increase. An alternative would be either to impose a cap on contributions that grows more slowly than average wages or to slow the growth of the existing cap. This step could be combined with mandatory individual accounts funded from wages above the cap. In that way, the burden of the unfunded system would gradually fall as a share of gross domestic product and asymptotically disappear.

Notes

1. First, current law provides for full benefit payments only to the extent that there are sufficient balances in the social insurance trust funds. If the trust funds run out, benefits must be delayed until the trust funds can be replenished. Second, the law states—and the U.S. Supreme Court has verified—that program participants have no accrued property right to benefits.
2. The website of the American Academy of Actuaries is <http://www.actuary.org>.

Reference

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PART VI

Closing Panel

Reflections on Aspects of NDC Schemes

NDC versus FDC: Pros, Cons, and Replication

David Blake

Given that the Swedish nonfinancial (notional) defined contribution (NDC) pension scheme has had about a decade to bed down since its launch in 1999, now is an ideal opportunity to examine its advantages and disadvantages relative to financial defined contribution (FDC) pension plans. It also provides an opportunity to investigate whether an NDC outcome can be replicated in an FDC framework.

In conducting this analysis, one should keep in mind the three main characteristics of the pension benefits in a “good” pension plan:

- They are related to final salary. In line with the life-cycle model of Ando and Modigliani (1957) and Modigliani and Ando (1963), consumers value consumption smoothing over their lifetimes and dislike sharp falls in income and, hence, consumption between one year and the next.
- They are uprated with inflation once payment has begun to maintain the standard of living in retirement.
- They hedge longevity risk by providing an income for life. A pension is a stream of payments that starts when someone retires and continues in payment until that person dies. In other words, a pension provides lifetime income security in retirement for however long the retiree lives (Bodie 1990). Unless a plan provides this protection, it can be considered a wealth management plan but not a pension plan.

One also needs to distinguish between the accumulation phase and the decumulation phase of funded pension plans.

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NDC: PROS AND CONS

Before examining the pros and cons of NDC, briefly reviewing its design, using the original Swedish model for illustration, is worthwhile. During the accumulation phase, each plan member has a notional fund that grows with new contributions at a rate of return that equals the average wage growth rate in the economy plus an adjustment arising from an automatic balancing mechanism. Defining A/L as the ratio of assets to liabilities in the plan, the adjustment will be negative if $A/L < 1.0$. It will be positive if following a negative adjustment, and this adjustment will be maintained until the scheme has returned to the same path of indexation that would have been followed had the negative adjustment not occurred. No positive adjustment takes place in other circumstances, however, so in principle, the scheme could build up a surplus that is never distributed.

In the NDC decumulation phase, the life annuity at retirement that each plan member receives will equal the individual's accumulated account value divided by an annuity factor that depends on cohort life expectancy at retirement. The initial real growth rate in the annuity was set at 1.6 percent per year, adjusted (upward or downward) to maintain scheme's financial balance. The annuity can be claimed in part or whole from age 61. The worker does not need to leave the labor force to claim it, and as long as he or she continues to work, contributions will be paid on earnings. Also, there is no maximum age at which the pension must be drawn. The Swedish plan has a minimum pension guarantee, financed through general tax revenues, allowing an element of redistribution in favor of poorer retirees. Additional redistribution occurs through noncontributory rights, such as child-care rights granted during the first four years after a child is born, also paid through external contributions from the general budget.

NDC plans have a number of advantages:

- They are compulsory, so the plan designer can choose and enforce the parameters of the system. For example, the designer can choose an appropriately high contribution rate, one intended to achieve a desirable replacement ratio in retirement: the Swedish system has a 16 percent mandatory contribution rate in its NDC component and a 2.5 percent mandatory contribution rate in its FDC component. As another example, the designer can specify the minimum guaranteed pension level.
- They involve risk sharing within each generation, thereby avoiding the *intergenerational* inequities of other systems—including the previous Swedish system—that pass deficits down to the next generation. Given demographic changes such as increasing life expectancy and declining fertility, these deficit transfers were seen as unaffordable going forward.
- They overcome the *intragenerational* inequities of defined benefit (DB) pensions, which leave companies bearing longevity risk and are unfair to early leavers, who experience portability losses when they change jobs, and to low fliers, who do not gain from the back-loading of benefits in DB plans.
- In addition, the Swedish FDC plan, which supplements the NDC plan with a free choice of investment portfolios from a set of registered funds, is characterized by several advantages. Its cost of operation is low. Economies of scale are maximized because the state (through the tax authorities) collects contributions,

and it has a central clearinghouse, through the Premium Pension Authority (Premiepensionsmyndigheten, or PPM).¹ The long-run target costs (e.g., Palmer 2008) of around 0.20 percent of PPM assets—comprising about 0.04 percent for PPM overhead costs, 0.15 percent for fund management fees of FDC assets, and 0.01 percent for contribution collection—are very low compared with typical FDC costs.

- Access to information is good. The clearinghouse provides information on returns, costs, and risk measures for all funds in the FDC component.

NDC plans also have a number of disadvantages:

- They require the whole country to participate; hence, a high degree of social solidarity is required.
- The assets are very poorly diversified internationally. In effect, the Swedish NDC system invests in a single stock called “Sweden.” Thus Swedish pensions—in the NDC component at least—are wholly dependent on Swedish economic growth rates and Swedish demographic trends. Countries can become insolvent. What happens then to NDC pension entitlements?
- NDC plans cannot deal well with international labor mobility.²
- The pension assets are not portable in the way that the assets in FDC plans are.
- The state is a monopoly supplier of services and products (e.g., annuities). Can it be trusted to provide these services efficiently and at fair prices? Can it be trusted not to change contract terms in the long run?
- Because the annuity factor depends on cohort life expectancy at retirement, the NDC pension is unfair to people with impaired lives, unless supplemented with noncontributory rights for these persons.

In short, NDC pensions are really just pay-as-you-go (PAYG) pensions with a bit more equity, although NDC is arguably more efficacious than other forms of PAYG, because members get what they pay for with their contributions.

FDC plans, too, have a number of advantages:

- A separate fund accumulates for each individual, giving a sense of ownership and security. The fund allows greater portability: workers can move between jobs and between countries more easily, taking their pension pot with them.
- FDC plans are transparent. The value of the assets held in each pension pot can easily be determined at any time, as can the size of the annuity that can be bought with the assets.³
- FDC plans allow for the diversification of investments internationally. They can invest in the world’s fastest-growing companies in the world’s fastest-growing economies.
- Aaron (1966) showed the condition under which funded pension plans are superior to unfunded plans: it requires the real rate of return on assets in funded plans to exceed the real growth rate in the wage bill, which equals the “rate of return” in a PAYG plan, such as an NDC plan. This condition holds in practice, not least because

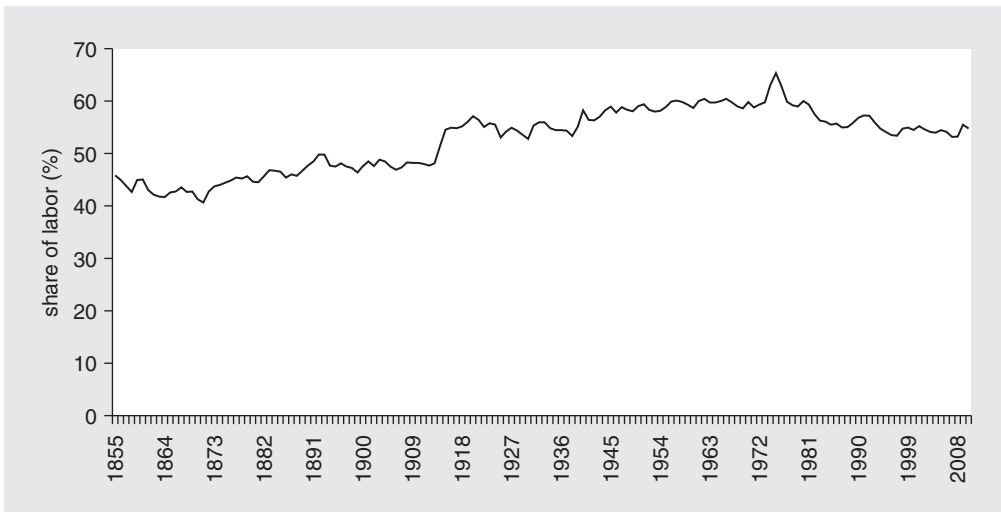
pension funds are able to generate higher returns by investing in the fastest-growing economies of the world, rather than in the domestic economy. The condition must also hold in theory because of the dynamic efficiency of the economy (see, e.g., Blake 2000). Dynamic efficiency requires that the average return on financial assets exceed the growth rate in the wage bill, which, in turn, equals the growth rate in national income if the share of wages in national income is constant. Saving through a pension fund helps the process of capital accumulation, which, in turn, improves the productivity of workers. However, so much capital can be accumulated that the rate of return on capital assets falls below the growth rate in national income and the economy becomes dynamically inefficient: people could be made better off by saving less and consuming more. Dynamically inefficient economies are unlikely to be sustainable in the long run, because the owners of capital are likely to transfer their capital to economies offering higher returns. Thus, in long-run equilibrium, funded plans, such as FDC plans, will be superior—in the sense of generating higher overall returns—to unfunded plans, such as NDC plans.

FDC plans also have a number of disadvantages:

- The contribution rates might be insufficient to generate an adequate pension in retirement, unless the FDC plan has mandatory minimum contributions.
- The individual funding of pension arrangements might not be feasible for the low paid.
- State-run PAYG systems permit minimum welfare standards to be established through income redistribution in a way that private sector-funded plans do not.
- Funded pension arrangements can give an illusion of security that disregards the political risks associated with the visible presence of a large pool of financial assets. Cash-strapped finance ministers can change the rules of the game: for example, U.K. finance ministers removed the right of pension funds to recover tax paid on dividends in U.K. companies (in 1997) and put a cap on the level of contributions eligible for tax relief (in 2011).
- Individually funded pension arrangements are subject to the following types of risks:
 - Contribution risk caused by unemployment, ill health, disability, or death in service
 - Asset return risk
 - Inflation risk
 - Interest rate risk
 - Longevity risk (the risk related to the provision of pension annuities when lifetimes are uncertain)

These risks are either expensive or impossible to hedge using private insurance markets⁴: individuals are unable to transfer risks efficiently to the insurance companies operating in these markets.

How one compares the pros and cons of the two types of pension plans is largely a matter of personal preference, but, for me, the Aaron condition and the condition for dynamic efficiency provide a powerful argument favoring FDC over NDC.

FIGURE 24.1 **Share of labor in U.K. national income (GDP), 1855–2010**

SOURCES: Feinstein 1972; Office for National Statistics, various years.

NOTE: GDP = gross domestic product.

CAN NDC BE REPLICATED IN AN FDC FRAMEWORK?

The answer is “yes”⁵ if the government introduces two new types of bonds, one designed for the accumulation phase and the other for the decumulation phase.⁶

Because benefits in an NDC plan grow with earnings, a perfect matching asset for the accumulation phase would be either (zero-coupon) wage-indexed bonds or—since the long-run shares of factors of production in national income are relatively stable over time, as figure 24.1 demonstrates for the United Kingdom—bonds that are gross domestic product (GDP) indexed. If pension contributions were invested in these bonds, they would accrue returns precisely as they would in an NDC plan. Note that coupons are not needed prior to retirement; hence, the bonds should be zero coupon. The government is a natural issuer of these bonds because it has a natural hedge in its balance sheet. If wages or GDP increase, the payments on the bond increase, but so do the tax revenues to pay for these extra payments. The risk premium that the government would need to charge on these bonds would therefore be negligible.

Because pensions in payment need to provide an income for life and need to protect against postretirement inflation, the best way for members of defined contribution pension plans to hedge their (idiosyncratic) longevity risk and inflation risk after retirement is to purchase an index-linked lifetime annuity at retirement. The best way for annuity providers to hedge the (aggregate or systematic) longevity risk they face is to buy index-linked longevity bonds issued by the government.^{7,8}

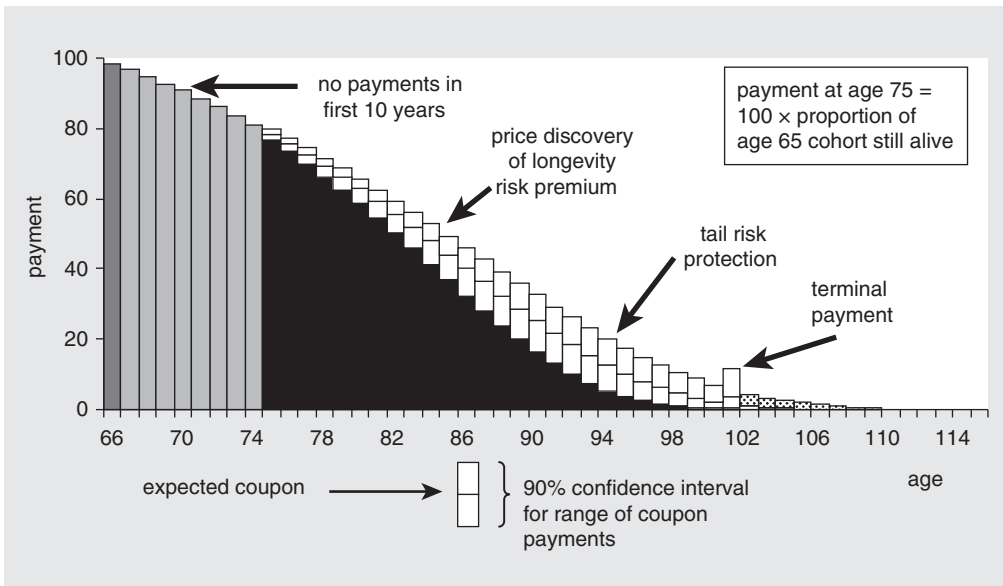
A longevity bond with the following characteristics can help annuity providers hedge aggregate longevity risk:

- The bond pays coupons that decline over time in line with the actual mortality experience of a cohort of the population. Consider, for example, 65-year-old males from the national population: the coupons payable at age 75 will depend on the proportion of 65-year-old males who survive to age 75.⁹

- Coupon payments are not made for ages for which longevity risk is low. Thus, for example, the first coupon might not be paid until the cohort reaches age 75 (such a bond would be denoted as a *deferred longevity bond*).
- The coupon payments continue until the maturity date of the bond, which might, for example, be 35 years after the issue date, when the cohort of males reaches age 100.
- The final coupon incorporates a terminal payment equal to the discounted value of the sum of the post-100 survivor rates to account for those who survive beyond age 100. The terminal payment is calculated on the maturity date of the bond and will depend on the numbers of the cohort still alive at that time and projections of their remaining survivorship. It is intended to prevent the payment of trivial sums at very high ages.
- The bond pays coupons only and has no principal repayment. In financial engineering terms, it is equivalent to an annuity bond plus a longevity swap.

Figure 24.2 shows the likely range of coupon payments on a deferred longevity bond, purchased by an annuity provider with the proceeds from selling an index-linked annuity to a 65-year-old retiree. Little aggregate longevity risk exists in the first 10 years after retirement, so the annuity provider has no need to seek aggregate longevity risk protection for annuitants between 65 and 75 years of age. After age 75, longevity risk increases and reaches a peak around age 90. After 90, longevity risk begins to tail off, but a long tail of

FIGURE 24.2 Longevity bond for a cohort, age 65, payable from age 75 with terminal payment at 100 to cover post-100 longevity risk



SOURCE: Blake, Boardman, and Cairns. 2010.

NOTE: The 90 percent confidence interval for cash flows was produced using the Cairns-Blake-Dowd stochastic mortality model (Cairns, Blake, and Dowd 2006), using mortality data for the national population of England and Wales for the period 1961–2003.

annuitants—even if small in number—survive to ages above 110. The best estimate of the coupons on the longevity bond is shown by the central bar in the middle of the 90 percent confidence band for coupon payments in figure 24.2. If population survivorship is higher at each age than was expected, the bond pays out higher coupons. This result is what the annuity providers need to help match the higher-than-expected annuity payments they need to make. If, in contrast, survivorship is lower at each age than was expected, the bond pays out lower coupons. But annuity providers are not likely to mind this outcome, because their annuity payments are also likely to be lower.

Different from the case of wage- or GDP-indexed bonds, the government is not a natural issuer of longevity bonds. It has an existing large net exposure to longevity risk through the social security pension system and the pension plans of public sector workers. The government would therefore need to charge a longevity risk premium to issue longevity bonds. However, annuity providers would be willing to pay a fair longevity risk premium to hedge a risk that cannot be hedged with existing instruments. So a potentially important advantage of traded longevity bonds would be to help establish a market price for longevity risk.¹⁰ As well as earning the longevity risk premium, the government can also hedge the longevity risk that it would be assuming from issuing longevity bonds by indexing the state pension age to increases in life expectancy. Such indexing would provide an alternative to the automatic balancing mechanism adjustment.

CONCLUSION

An NDC pension plan is a PAYG pension plan with greater inter- and intragenerational equity than a standard PAYG plan. The rate of return to plan members is linked to the wage growth of the economy in which the plan resides over the accumulation phase and to the realized postretirement lifetimes of each cohort of members. NDC plans cannot be considered as offering a well-diversified investment. Furthermore, given the long-run dynamic efficiency of economies, NDC plans fail the Aaron test and so will generate lower average pensions than are available from FDC plans.

NDC outcomes could be replicated using an FDC framework if the government

- Issued wage-indexed or GDP-indexed bonds for the accumulation phase
- Issued indexed-linked longevity bonds for the decumulation phase

However, although these bonds would help deal with the poor international portability of NDC plans, they would not address the issue of poor international diversification of investment risks or the failure of NDC plans to pass the Aaron test.

NOTES

The author is grateful for helpful comments from Edward Palmer and for some useful references provided by Salvador Valdés-Prieto.

1. In 2010, the PPM became part of the Swedish Pensions Agency, which administers the entire public pension system.
2. A similar weakness holds for DB plans.
3. The same is true of NDC plans, unlike other PAYG plans: the exact accounting values in NDC either are always known or can be readily computed for all participants.
4. For example, attempts to provide guaranteed minimum returns within FDC plans tend to reduce total returns.

5. Valdés-Prieto (2000, 2004) provides the formal conditions under which an FDC plan can replicate a mature NDC plan: (a) the FDC plan is taxed to equalize returns, (b) the NDC plan is heavily guaranteed by the state, and (c) the FDC plan is fully invested in long-term public debt. The two plans will, however, differ during a transition arising from changes in the population growth rate.
6. These bonds can be issued by private sector organizations but with greater credit risk attached.
7. Annuity providers do not face idiosyncratic longevity risk if the annuity pool is sufficiently large. They do face basis risk, which arises from the difference between the realized mortality experience of the national population on which the bond's coupon payments are based and the realized mortality experience of their annuity pool. However, basis risk can be hedged effectively (see Coughlan et al. 2011).
8. Interestingly, Palmer (2011 and chapter 19 of this volume) shows that a longevity bond—which he calls an *NDC bond*—is needed to close an NDC pension system and establish a unique value for the NDC assets. In other words, an NDC pension system is an incomplete system without a longevity bond.
9. The coupons will, however, increase in line with an inflation index.
10. Palmer (2011 and chapter 19 of this volume) argues that the NDC longevity bond required to complete the NDC pension system does not need to be sold on the financial markets and can be issued without a longevity risk premium accruing to the government. “[I]t is clear that there would be no marginal gain in marketing the NDC bond. Selling the NDC bond on the market would lead to marginal costs in the form of transaction costs and a risk premium to compensate the holder for holding the bond. This would, however, create no welfare gain for the participants—this only shifts individuals’ money from one pocket to the other; the taxpayers are in principle the same individuals as the workers and pensioners . . . [T]here is no reason for the government to attach a risk premium to this debt component and by not doing this the cost to the taxpayers is exactly on par with the value of the commitment behind the bond” (Palmer 2011, 23–24). The same arguments could be made for standard longevity bonds as originally proposed by Blake and Burrows (2001) if everyone in the economy were covered by an FDC or DB pension plan. Otherwise, redistributive effects—associated with all taxpayers providing the longevity insurance but only some taxpayers benefiting from it—would arise, which can be (at least partially) overcome by the government earning a longevity risk premium from selling longevity bonds on the open market. Furthermore, the trading in market-issued bonds establishes a market price for longevity risk. The absence of such a market price is at present a key weakness in the life market—the newly emerging global market that trades longevity-linked assets and liabilities. The NDC bond proposed by Palmer will not provide a price of longevity risk.

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NDC Schemes: Strengths and Weaknesses

Lans Bovenberg

The main merit of nonfinancial (notional) defined contribution (NDC) schemes is that they focus on the objective of consumption smoothing across time and various contingencies by helping the middle class to maintain its standard of living after retirement. Other objectives, such as intragenerational redistribution, macroeconomic stabilization, and insurance of idiosyncratic shocks in human capital, are the responsibility of other government programs. The separation of tasks contributes to transparency and allows each of the programs to focus on a single objective and attain that objective in the most efficient way. At the same time, however, one should be aware that the NDC scheme itself can be so efficient because it has shifted the responsibility for other objectives to other programs. To judge the efficiency of the social protection pension system as a whole, one should take into account the costs of these other programs as well. These comments, therefore, consider NDC schemes in the context of the social protection systems as a whole and compare NDC schemes with alternative mandatory pension schemes for the middle class. I will argue that NDC schemes feature important strengths, but that most of these strengths can be reaped also by alternative pension designs, such as mandatory funded pension schemes supplemented by a public pension scheme aimed at the poor.

RETIREMENT DECISION MORE ACTUARIALLY FAIR

The first strength of NDC schemes is a large upward adjustment in annual pension benefits when people decide to retire later. In this way, pension systems impose fewer distortions on the labor supply of elderly workers. In many European countries, retirement systems used to be far from actuarially neutral. The reason was that countries used their pension systems in the 1980s to induce agents to leave the labor force so that their jobs could be given to younger, unemployed workers. This flawed thinking, which was based on the so-called lump-of-labor fallacy, gave rise to major distortions in labor markets. NDC schemes have helped to reduce these distortions. At the same time, three qualifications on the merits of NDC schemes can be made.

NDC not necessary. First, proper actuarial adjustments to retirement benefits have also been implemented in defined benefit (DB) schemes or so-called point schemes. Most European countries (including those without NDC schemes) have substantially improved the incentives for later retirement.

Actuarial adjustment relatively small in NDC. In fact, adjustments for early and late retirement are often larger in funded schemes because these adjustments are based on higher discount rates reflecting the higher returns in funded schemes. In particular, not to distort the retirement system, benefits for people retiring early should be reduced by 7 or 8 percent for people retiring at age 64 rather than age 65.¹ In NDC schemes, these actuarial adjustments are typically smaller so that early retirement is still encouraged. Intuitively, by retiring early, workers can avoid the implicit tax required to service the implicit debt in pay-as-you-go (PAYG) systems that is the result of the initial PAYG gift to older generations (see Sinn 2000).

Early retirement induced by intragenerational redistribution and risk sharing. Another qualification to the merits of NDC schemes is that countries with these schemes do not escape the fundamental trade-off between equity and efficiency that is the result of substantial heterogeneity at the end of the working life. In particular, NDC schemes must be supplemented with special provisions for low-income groups to prevent old-age poverty. Helping groups with low human capital escape old-age poverty inevitably harms the incentives to accumulate, maintain, and use human capital. For example, the means-tested guaranteed pension in Sweden imposes a marginal tax rate on retiring later for those who benefit from this guaranteed pension. Moreover, disability and unemployment insurance programs inevitably give rise to moral hazard as a result of human capital insurance.

Indeed, compared to high-skilled workers, low-skilled workers typically face substantially smaller incentives to delay retirement for at least two reasons. First, various means-tested programs discourage low-skilled workers from continuing to work because additional labor income is taxed away in the form of lower means-tested benefits. Second, actuarial adjustments of NDC benefits are based on average mortality rates, whereas low-skilled workers generally feature higher mortality rates and lower life expectancy. Low-skilled workers are thus not compensated adequately for later retirement and, hence, face incentives to start receiving retirement benefits as early as possible.

LINKING OF RETIREMENT BENEFITS TO LIFETIME EARNINGS

Another strength of NDC schemes is that they determine individual pension rights on the basis of individual contributions throughout the entire working life. Thus, they provide

incentives to workers to contribute to the pension scheme because additional contributions provide additional retirement benefits. Also here, however, some qualifications are in order.

NDC not necessary. First, other pension schemes can enhance incentives for labor supply during the accumulation phase. In Dutch DB pension schemes, for example, schemes based on final pay have been replaced by schemes based on career average pay; thus, pension rights are based on earnings during the entire life cycle. At the same time, contribution rates are increasingly fixed so that contributions are a fixed share of earnings. Hence, linking retirement benefits to earnings becomes equivalent to linking benefits to contributions.

Implicit taxes in NDC to service legacy costs. Second, in NDC schemes, incentives to contribute to the pension scheme are weaker than in funded schemes because NDC contributions include an implicit tax to service the implicit debt in PAYG systems. Indeed, financial sustainability of NDC schemes must be distinguished from the absence of intergenerational transfers from workers to older generations. Whereas NDC schemes are typically fiscally sustainable (because pension benefits absorb demographic and other risks), they involve transfers from young to old agents (as a result of the legacy of the initial gifts to the generations alive when the PAYG system was started up and expanded) and thus impose taxes on the work effort of workers.

The implicit PAYG tax is related to the positive gap between the returns on funded and PAYG systems. It is especially large for young workers because this gap in accumulated returns grows with the time that elapses between when the contribution is made and when the pension benefits are received. This duration is largest for young workers. Another reason the implicit tax on younger workers is large is the wage-related nature of the acquired pension claims. The discount rate that younger agents use to value the acquired wage-linked claims exceeds that of older agents because the young already bear a lot of wage risk through their human capital. Moreover, in the long run, wage risks are closely related with stock market risk (see Benzoni, Collin-Dufresne, and Goldstein 2007).

Implicit taxes in mandatory pension systems. Third, the mandatory character of NDC scheme suggests an implicit tax on workers if these workers are short sighted. In that case, workers discount the value of the additional retirements that are being accumulated. Forced saving helps address saving distortions as a result of free-riding behavior, but at the same time it leads to labor supply distortions. Mandatory saving schemes that address short sightedness are thus not without costs. These costs are again likely to be largest for young workers, who are the furthest from the time when they will enjoy their retirement benefits and thus are likely to be the most short sighted. These costs, however, apply to any welfare system that seeks to address moral hazard and short sightedness by forcing people to make their own provisions for old age.

Harm to labor supply induced by intragenerational redistribution and risk sharing. Fourth, the redistributive programs that supplement NDC schemes tend to hurt labor market incentives. Means-tested retirement benefits harm the incentives of those who are in the phase-out range. Moreover, the contribution rates that finance flat retirement benefits provided solely on the basis of age and residence (so-called demogrant programs) harm labor supply because the contributions are distortionary.

MACROLONGEVITY RISK ABSORBED IN BENEFITS DURING THE ACCUMULATION STAGE

The macrolongevity risk is absorbed by the age cohorts themselves during the preretirement period in NDC schemes. At retirement, annuity payments are based on life tables at that time. Hence, if remaining life expectancy at retirement has increased, annuity payments are reduced accordingly. This feature of NDC schemes is desirable because it contributes to the financial stability of the pension scheme. In particular, costs of the pension scheme do not rise as longevity increases. Another merit of this longevity adjustment is that the pension scheme is transparent *ex ante* about how macrolongevity risk will be dealt with. Political risk is reduced as a result of this more complete risk contract. Moreover, workers can anticipate a longer working life and are therefore encouraged to invest more in their human capital.

A number of qualifying remarks can be made here, however.

NDC not necessary. First, risk-sharing devices that shift preretirement systematic longevity risk to the individual participants can be implemented in other retirement programs (e.g., DB schemes or funded schemes). In Dutch funded schemes, cohorts bear their own longevity risk during the accumulation phase.

Longevity adjustments in other programs required. Second, many NDC programs are complemented by DB programs aimed at old-age poverty alleviation. These schemes should ideally be adjusted if longevity increases. Similarly, the earliest age at which a worker can get retirement benefits should rise with longevity. This principle holds true for the maximum age at which one is eligible for other social insurance, such as disability and unemployment insurance. In Sweden, however, these retirement ages do not vary with longevity. For example, the age at which people become eligible for the guaranteed pension is fixed at 65.

Desired magnitude dependent on longevity and morbidity of the low skilled. A serious complication in setting a longevity adjustment for the entire population is that mortality and morbidity tend to fall faster for high-skilled workers than for low-skilled workers. From an equity point of view, it thus would make sense to impose a larger longevity adjustment on workers with higher incomes than on those earning lower incomes. These latter workers rely more heavily on the guaranteed pension. Hence, the government may want to raise the eligibility age for guaranteed pensions more slowly than the longevity adjustment in the NDC scheme.

Credibility longevity adjustment and fiscal sustainability. A related problem is the credibility of the NDC scheme in an environment in which the human capital of older workers is not maintained adequately and the labor market for older workers does not function well. Because of the longevity adjustments in the provided annuities, NDC countries project substantial declines in the replacement rates at the fixed age of 65 over the coming decades. These declines help ensure fiscal sustainability in the face of an aging population. However, these cuts in replacement rates seem credible only if older workers remain more productive and are able to continue to find work beyond current effective retirement ages.

If these labor market conditions are not met, governments will face political pressures to raise replacement rates so that the living standard of the older population does not

decline too far below that of the rest of the population. Alternatively, the public finances will be burdened by higher costs of other social insurance programs, such as disability insurance, unemployment insurance, or means-tested guaranteed pensions. In NDC countries, therefore, fiscal sustainability depends on whether the human capital of older citizens can be protected and used better. Only if lower mortality goes together with lower morbidity and more durable earning power are stable contribution rates credible in the face of increased longevity.

Another important challenge in this respect is whether countries succeed in addressing the labor market challenges of low-skilled and high-skilled workers alike. The less countries succeed in raising the earning power of low-skilled workers in line with that of high-skilled workers, the more they will be forced to have additional means-tested DB social programs for low-skilled workers whose human capital depreciates earlier in life. These programs typically harm incentives to maintain human capital so that a vicious circle is likely in which human capital does not become more durable. Accordingly, the main challenge for aging economies in which longevity increases is to address the weak labor market position of elderly workers in general and that of older, low-skilled workers in particular.

Similar issues arise for women. The more countries succeed in strengthening the labor market position of women, the less they have to rely on social programs that protect women (e.g., partner pensions) but at the same time harm labor market incentives faced by women. Indeed, young parents should be able to invest in the human capital of their children without having to depreciate their own human capital. Reasonable levels of fertility are a necessary condition for the credibility and legitimacy of NDC schemes. At very low fertility levels, replacement levels of NDC schemes may become too low to be socially sustainable.

Human capital and the labor market at the center. Increasing the durability of human capital across the board is thus a challenge for all countries—irrespective of whether they have defined contribution or DB pension schemes. NDC schemes are legitimate and credible only if countries address the labor market problems facing older workers and enhance the possibilities for combining of family and work. This situation clearly raises issues that go beyond the pension system.

WAGE-LINKED RETIREMENT BENEFITS AND INTERGENERATIONAL RISK SHARING

One of the main merits of NDC schemes is that these schemes provide wage-linked benefits to retirees. These wage-linked benefits have at least two advantages. First, they help the retirees hedge standard-of-living risk. Second, the wage-linked benefits allow workers to shed some of their wage risks. By issuing wage-linked benefits backed by payroll taxation, the government, in fact, makes human capital tradable. Through its power to tax, the government can fight moral hazard and adverse selection by mobilizing the human capital of workers. Accordingly, human capital risks can be shared with the retired generations that have depreciated their human capital.

No optimal intergenerational risk sharing. The NDC scheme, however, does not efficiently distribute wage risks across generations. The reason is that it distributes human capital risk uniformly over the pension claims of various age categories. In an optimal retirement system, in contrast, young agents who still have substantial human capital

should take on most of the financial market risks, while older retired agents take on human capital risk in their retirement accounts.

The NDC scheme can be seen as a transitional arrangement on the way to better pension arrangements that optimally distribute financial market and human capital risks across generations. Such an optimal pension system would integrate NDC and FDC schemes so that agents can implement optimal life-cycle investment. In particular, the government would provide wage-linked retirement benefits to older generations so that wage risks are shifted from younger to older generations. At the same time, the younger agents would absorb financial market risk by holding equity in their own retirement accounts. Moreover, the government can take on financial market risks on behalf of younger generations. In particular, if the government taxes pensions on a cash flow basis, it participates in the financial market risks taken on by the pension system and can shift these risks to younger and future generations through its tax and public debt policies.

This model in effect integrates PAYG financing and funding through financial markets. On the one hand, the government provides wage-linked bonds to the elderly, and on the other hand, it taxes the elderly on the financial returns that they have enjoyed throughout their life cycle on their pension savings. Hence, the government can ensure optimal intergenerational risk sharing without engaging in intergenerational redistribution.

By buying bonds from different European Union countries, private pension providers can better diversify credit risks (of government defaults), thereby enhancing financial stability in the European Union. In fact, governments may replace part of their earnings-related PAYG pensions by issuing tradable wage-linked securities to their citizens. Indeed, one can view current earnings-related PAYG schemes as governments forcing their citizens to buy bonds from their own national governments. This practice distorts a free European capital market. Replacing PAYG schemes with tradable wage-indexed debt imposes more fiscal discipline on governments because capital markets must willingly absorb these securities. This additional market discipline contributes to long-run financial stability in Europe.

In the context of optimal risk sharing, macrolongevity risk is important. The main macroeconomic risk is the tail risk (i.e., the survival probabilities at very advanced ages). This tail risk should be absorbed by generations younger than the cohorts concerned. This approach in effect amounts to a DB aspect within a defined contribution scheme: younger generations insure the macrolongevity risk of the oldest generations. One way to implement this practice is for the government to issue longevity bonds for these tail risks. An alternative is to spread these risks over all the participants in the NDC scheme.

No optimal intertemporal consumption smoothing. In addition to intergenerational risk sharing, intertemporal consumption smoothing is a problematic aspect of NDC schemes. By fixing contribution levels and thus absorbing shocks only in pension benefits, the pension scheme fails to smooth consumption over the active and inactive phases of the life cycle. For example, after an adverse shock in the reserve fund, workers should ideally spread the shock over not only the decumulation phase but also the accumulation phase of the life cycle by raising contributions. By using the contribution rate as an instrument for absorbing shocks, the pension system can shift more risks to the active population. In this way, optimal consumption smoothing and optimal intergenerational risk sharing are closely related.

LOW TRANSACTION COSTS

NDC schemes feature low transaction costs and help short-sighted people save for retirement. Depending on the exact design, funded schemes in countries with well-functioning financial markets and government institutions can feature low transaction costs, especially if participants are not given much choice in setting their own saving, investment, and payout choices. A drawback of the collective nature of such schemes is that they do not offer much room for solutions that are tailored to the idiosyncratic needs of individuals. Pension systems face a fundamental trade-off between low transaction costs and tailoring pension provisions to individual circumstances.

TRANSPARENCY

Transparency is another potential strength of NDC schemes.

Separation of objectives. Separation of objectives is potentially helpful, but it could also result in a lack of transparency. NDC schemes focus on the objective of consumption smoothing across time and various contingencies. Other objectives, such as intragenerational redistribution, macroeconomic stabilization, and insurance of idiosyncratic shocks in human capital, are the responsibility of other government programs. The clear separation of tasks contributes to transparency and allows each of the programs to focus on a single objective and attain that objective in the most efficient way.

At the same time, however, one should be aware that the NDC scheme by itself can be quite efficient because it has shifted other objectives to other programs. To judge the efficiency of the social protection pension system as a whole, one should account for the costs of these other programs. Moreover, depending on their exact design, NDC systems may lack transparency with respect to certain elements.

Front-loading and actual replacement rates. NDC schemes may overstate the actual replacement rates by front-loading the benefits. By setting the annuities on the basis of high discount rates, NDC schemes pay out more benefits at the beginning of the retirement period, whereas benefits decline compared to wages during the retirement period. The advantage of front-loading may be that individuals have relatively more spending needs at the beginning of their retirement period— especially if they have long-term care insurance, which reduces spending needs at the end of life, when care needs typically are substantial. Front-loading also leads to high replacement rates at the time of retirement.

An important disadvantage of front-loading is that the very elderly may become impoverished compared to the rest of the population. As a result of front-loading, elderly poor people may have to draw on means-tested benefits at the end of their lives, thereby putting pressure on the public finances. In Sweden, for example, those relying on publicly provided care pay income-dependent contributions to the municipalities providing long-term care. Front-loading of benefits thus taxes the finances of these municipalities.

Retirement age and longevity. Another part of an NDC scheme that potentially lacks transparency is the retirement age. Most NDC schemes adjust only the annuity factor for longevity but keep fixed the retirement age (i.e., the age at which one no longer has to work for welfare benefits, the age from which one can draw on guaranteed pensions without the obligation to work, the age at which one no longer can draw on regular social

insurance such as unemployment insurance and disability insurance, and the age at which employment protection ends). Raising the retirement age in line with longevity would give a stronger signal to the population that one must invest more in human capital so that one can work longer if longevity increases.

Implicit debt and implicit taxes. NDC schemes also tend to hide the tax component of the contribution paid. The tax component of the contribution helps service the PAYG debt, which is implicit rather than explicit. Whereas the NDC scheme is financially sustainable if the government can, in the future, continue to tax the human capital of the active population, it still levies an implicit tax on participants to service the initial debt that was accumulated at the time the scheme was started up and expanded. Several NDC systems suggest that for each euro that participants contribute to the scheme, participants should get pension rights of the same value back in return. In reality, however, NDC schemes do not do so, because part of the contributed euro is used to service the PAYG debt in the system.

Transparency can be enhanced with regard to intergenerational risk sharing and the associated balancing mechanisms, which determine how benefits are adjusted to ensure the credibility of future benefits promised on the basis of a constant contribution rate.

CONCLUSIONS

NDC schemes exhibit a number of important strengths. In particular, they improve labor market incentives by making the retirement decision more actuarially fair and by linking the accumulation of new pension rights to contributions over the entire life cycle. Moreover, automatic longevity adjustment of annuities contributes to the financial stability of the pension scheme. Finally, the provision of wage-related pension benefits helps to share wage risk between generations.

All of these benefits, however, can in principle be reaped in other pension schemes. Moreover, NDC schemes do not address all of the problems associated with PAYG schemes. There is also room for better designs in terms of intergenerational risk sharing and intertemporal consumption smoothing. Indeed, the NDC scheme can be seen as a transitional arrangement on the way to better pension arrangements that optimally distribute financial market and human capital risks across generations in countries with advanced financial markets and well-functioning private and public institutions.

NOTE

1. See Queisser and Whitehouse (2006). These numbers are based on average mortality rates in the Organisation for Economic Co-operation and Development (OECD) countries. Mortality rates in Sweden are lower than the OECD average. Hence, the actuarial adjustments for retiring later are lower than in most other OECD countries.

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NDC Reserve Funds: The Swedish Reserve Funds after 10 Years

Harry Flam

The main purpose of the Swedish nonfinancial (notional) defined contribution (NDC) reserve is to absorb imbalances between contributions and payments—in particular, a forecast deficit in 2010 to 2040 caused by birth cohort effects. When the new Swedish public pension fund scheme began to operate in 2001, it was constructed with not one but four reserve funds. The reserve funds currently make up about 12 percent of the pension system's total assets, the remaining 88 percent being the present value of future contributions. Their assets consist of 54 percent in listed equities, 34 percent in interest-bearing assets, and 12 percent in private equity and real estate, with some variation across funds.

It is time to take stock of how the institutional setup with several reserve funds instead of one has worked so far.¹ I will limit the discussion to four different issues: the funds' given objectives for asset management, the perceived trade-off between competition and economies of scale that motivated setting up four and not one reserve fund, asset management strategy, and independence from political interference.

GIVEN OBJECTIVES FOR ASSET MANAGEMENT

The given objectives can be found in a specific law governing the reserve funds and in the government's proposition to parliament to enact the law. All the law has to say is that the funds should be managed for the good of the pension system. The government's proposition to parliament is more detailed and contains several objectives: (a) obtaining a high rate of increase in pensions, (b) ensuring neutrality between different generations, and (c) avoiding a situation in which the value of assets becomes lower than the value of liabilities such that pensions are consequently made to increase at a lower rate than average income.

The objective written into law is too general to be of much practical use and is open to interpretation. The three objectives stated by the government are, unfortunately, not consistent. The third objective places a greater weight on the present generation of retirees than on future generations and calls for a relatively low risk and, consequently, low return of the portfolio, which is inconsistent with the first objective, a high rate of return, and the second objective, neutrality between generations. All reserve funds have been considerably influenced by the third objective in trading off return against risk.

THE PERCEIVED TRADE-OFF BETWEEN THE BENEFITS OF COMPETITION AND ECONOMIES OF SCALE

No other NDC pension scheme has opted to have more than one reserve fund. The stated reason for having four funds in the Swedish system was to have the benefits of competition

between several funds, in the form of lower costs and higher returns, and to avoid the costs of too large actors in the Swedish equity and fixed income markets, in the form of illiquidity and high transaction costs. The new Swedish pension system was negotiated among five political parties. An additional reason for having several funds instead of a single fund was that the nonsocialist parties wanted to make it harder for a socialist government to use the reserve funds for other purposes, such as to fund regional or industrial policies and even to nationalize industry.

The calculations about market shares of the four reserve funds have proven to be wrong, for at least two reasons. First, the Swedish equity and fixed-income markets have grown much more than was expected when the system was conceived in the 1990s, and, second, the reserve funds allocated much smaller shares than expected to domestic assets. A consolidated Swedish reserve fund would rank as 20th in size internationally and be much smaller than, for example, Norwegian, Dutch, or Californian public pension funds. The idea that several reserve funds would add competitive pressure for each fund was erroneous from the start. All asset managers are evaluated against clear and precise benchmarks. The benchmarks provide sufficient competitive pressure. The existence of other funds of the same starting size and mandate are unlikely to have contributed to the performance of each fund.

It is self-evident that asset management is subject to very substantial returns to scale. Many costs are more or less fixed, such as for information technology infrastructure and systems, and size gives asset managers access to more and better investment opportunities. According to evidence reported by Björkmo (2009), scale effects for a large number of pension funds somewhat surprisingly appear much stronger for revenues than for costs. Translating the evidence to the Swedish reserve funds means that consolidating the four funds into a single fund would increase returns by 23 basis points: 6 points from cost savings and 17 points from higher revenues. The cost savings can be compared with the present 14 basis points in costs relative to assets for the funds as a whole. Thus, costs could be decreased from 14 to 8 basis points.

ASSET MANAGEMENT

The main issue facing an asset manager is whether the assets should be managed passively or actively. Active management seeks to achieve the highest return possible for a given level of risk. Passive management seeks to achieve the same return as the average for the asset in question, such as Swedish equities. Active management is motivated if the return is higher than for passive management net of the extra costs for active management.

The Swedish reserve funds have mostly been actively managed. The record for the period from 2001 to 2010, the funds' first 10 years of operation, is not very convincing for active management. The accumulated active return—the return relative to benchmarks—was a positive 7.5 basis points on average. However, one needs to deduct the extra cost of active management rather than passive management to be able to judge whether active management pays. The cost of passive management would presumably be no greater than 5 basis points—that is, about 10 basis points less than for (mostly) active management. In other words, the net return to active management of the reserve funds has been slightly negative over the first 10 years of the funds' existence.

Other contentious issues faced by the funds concern ethics and corporate governance. The reserve funds have adopted a policy not to invest in companies that break

international agreements concerning human rights, the environment, health, and the like, but breaches of this policy become a topic in mass media from time to time. Of course, the dilemma in pursuing this sort of policy is that the same company may breach the policy on some point while still being a leader in another field. The funds have also adopted an activist stance concerning corporate governance in Swedish firms, trying to make the firms follow voluntary rules on governance.

FUND INDEPENDENCE

The law stipulates that the funds should be totally independent and should not be used for purposes other than those of the pension system, such as to pursue regional or industrial policies. Nevertheless, in numerous instances, cabinet members have expressed opinions about what the funds should invest in. Examples include buying shares in Volvo, Saab, or Skandia (an insurance company) to keep those companies in Swedish hands or to ensure that their operations are not closed down in Sweden. So far, no evidence indicates the funds have listened to such advice.

Perhaps the most serious infringements on the funds' independence have been attempts by first a social democratic government and then the nonsocialist coalition government to prevent the use of bonuses for managers of Swedish companies. In fact, the present government has, through public statements, effectively instructed the funds to use their ownership influence to this end. According to newspaper reports, the government has threatened to replace the board of one of the funds unless it pursued such a policy. The practice of the government to appoint board members for one-year terms, instead of the intended three years, can be interpreted as an attempt to put pressure on board members.

Several measures can be taken to secure the independence of the reserve funds. One would be to require passive management of Swedish assets. Another would be to prohibit investment in Swedish equities in the same way that the Norwegian public pension fund is prohibited from investing in Norwegian assets. Both measures would reduce or completely eliminate the risk of the funds' use for interests other than those of present and future pensioners.

LESSONS FROM THE SWEDISH RESERVE FUND SYSTEM

One obvious lesson from the Swedish system is to have one reserve fund and not several. The official reasons appeared right at the time: to stimulate competition and thereby promote efficiency and to avoid the high transaction costs that result from being a large actor in a small market. Subsequent developments have proved those reasons to be wrong: Swedish financial markets have grown much more than anticipated and are part of the international market. However, one must understand that historical and political reasons were behind the creation of several funds instead of one fund. The reserve funds of the previous pension system also had several funds, but with very different mandates, and Sweden had lived through two decades of bitter political controversy over the creation of so-called wage earners' funds. These funds were originally proposed by Sweden's largest labor union confederation, the confederation of unions for blue-collar workers, which openly supports the Social Democratic Party; they were then instituted by a social democratic government, with the aim of socializing Swedish industry. When the new NDC

scheme was to be introduced, the nonsocialist parties demanded a system with several reserve funds to reduce the risk of “socialization through the back door.”

At the time of this writing, the four nonsocialist and the social democratic parties have agreed to discuss consolidating the reserve funds into one fund. The nonsocialist parties are seemingly no longer afraid of socialization, and cost savings in fund management have become paramount.

Another lesson that may be taken from the Swedish system after a decade of operation is that active asset management is not necessarily better than passive management for relatively large funds. Also, one should ensure independence of the reserve funds, so that they are managed solely with the pensioners’ interest in mind and cannot be exploited by politicians for other ends.

Finally, managing the funds according to the highest professional standards is important. Among other things, the rules should be clear and unambiguous, and board members should be selected according to a process that ensures professionalism and integrity. The present Swedish system is not set up this way. Instead, some seats on the boards for representatives are designated for representatives of business and labor unions, the so-called social partners, who need not have professional experience and skills in asset management. The idea is, ostensibly, to secure the support of the social partners, an idea that can be relevant in an occupational scheme but has little relevance in a national NDC scheme.

NOTE

1. Two critical reviews of the reserve fund system have been published in Swedish, by Flam (2007) and Björkmo (2009). The government evaluates the performance of the reserve funds annually. The latest evaluation, in Swedish, covers the period from 2001 to 2010 summarily and 2010 in detail (see McKinsey & Company 2011).

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Reflections on Introducing NDC in the Arab Republic of Egypt and Other Emerging Economies

Mohamed Ahmed Maait

The world of pension and social insurance has been witnessing in recent years significant and critical changes in both its literature and its practical applications under the name of reform. One such significant change in the functioning of a pension scheme is associated with the shift from a defined benefit (DB) scheme to a defined contribution (DC) scheme, which is the main reason the literature differentiates *systemic* from simple *parametric* reforms. Nonfinancial (notional) defined contribution (NDC) schemes are considered to be adequate mechanisms that address the problems related to financial

insolvency, nontransparent redistribution, and weak incentives that pervade traditional defined benefit pay-as-you-go (PAYG) pension systems. In addition, the transition to a new system usually requires some financing mechanism that is typically more transparent in the case of an NDC scheme. NDC schemes remain financed on a PAYG basis, but the benefit formula is modified to establish a transparent and actuarially fair link between contributions and benefits.

These prime qualities of an NDC scheme—solvency, transparency, and incentive compatibility—were behind the decision of the Egyptian government to give this new reform option a close look and thorough review, including an examination of the analytical basis and the pilots in Italy, Latvia, Sweden, and Poland. The outcome of these considerations and internal deliberations was the adoption of the basic NDC concept with two important additions: (a) a DB component to address poverty issues in the country and (b) an financial defined contribution (FDC) component to improve consumption smoothing through better risk diversification and to contribute, as far as possible, to financial market development.

The experience of other countries that shifted their pension schemes decades ago from DB to DC, such as Chile, has shown that complementing a DC purely contribution-based scheme with a DB universal basic pension is very important. The DB component serves the main objective of preventing the risk of poverty and is highly redistributive. For this reason, the Arab Republic of Egypt decided to incorporate such a zero-pillar element that is mainly financed by general revenues from the treasury. The basic pension is equivalent to 18 percent of the net national average salaries. It includes a clawback mechanism that provides an additional proportional benefit to members who made partial contributions toward their old-age social insurance during their active life.

Although some countries adopting DC schemes select either an FDC or NDC framework, Egypt combines the two as part of the mandatory scheme. The DC component is structured as a combination of financial and notional defined contribution (FDC + NDC). Egypt followed the criterion that a mix of NDC and FDC is an adequate solution to (partially) combine the advantages of both schemes, although it may add complexity to the system. The new Egyptian system structure will benefit from a mix of philosophies of prefunding and PAYG schemes.

The new comprehensive three-pillar mandatory social insurance system is expected to be able to address the demographic, financial, and institutional challenges by putting in place diversified mechanisms to achieve an optimal risk-return combination adapted to the specificities of the Egyptian labor market and economy. By reflecting a close relationship between contributions and pensions, DC pensions are also expected to entice individual savings and help discourage evasion. The new system includes a minimum guaranteed rate of return on the total balances of the NDC and FDC accounts at the time of retirement, which is the arithmetic average of the inflation rates over the whole contributory period. The new system also ensures the elements of social solidarity and redistribution within the structure of the system.

The Egyptian deliberation, decision, and implementation processes around the NDC pension reform provide important lessons for other emerging economies. The Egyptian experience shows that an NDC plus FDC approach as the core of the mandated consumption smoothing pillars not only is feasible but also offers particular advantages for emerging economies if the enabling conditions are met. First, the DC approach promises

much better labor market incentives than the DB alternative, and integrating large numbers of informal workers into the formal economy is critical for all emerging economies for economic, social, and political reasons. Second, if properly designed and implemented, both NDC and FDC schemes promise more convincingly than the nonfinancial defined benefit (NDB) and financial defined benefit (FDB) alternatives to ensure sustainability of the pension system under challenging economic and demographic circumstances. Third, the alternatives, NDB and FDB, are not transparent. Distribution is obscure in NDB and FDB schemes, whereas in the chosen design for Egypt, a distributional DB guarantee complements the DC scheme, ensuring everyone of a sufficient minimum income in old age while enabling Egypt to profit from the advantages of DC schemes. The transparent nature of this design is hoped to enable greater trust in government, which is a very important spin-off effect.

Although Egypt, like other emerging economies, still has a young population, the aging process has set in; hence, a lengthening of the working life will be necessary for the social insurance scheme to remain financially sustainable in the coming decades. In fact, Egypt has seen financial sustainability as a critical element for the development process of the country's social protection system. The crises emanating from overextension and accompanying sovereign debt provide a lesson for economically developing as well as economically developed countries. Last but not least, adding an FDC component is suggested as a critical element from the point of view of risk diversification for all economies. For emerging economies, the funded component has a special addition: it is a marker for possible future extensions, and it has the potential to contribute to the development of the internal financial market. Egypt, with a long tradition in financial markets and a parallel financial market development project, is in a good initial position to use the FDC component to push national economy growth and financial market development forward.

The deliberation and consultation process of the reform has had to face the challenge of reaching out to the population and soliciting the support of key groups. This process has been important because it has presented to these groups the unsustainability of the unreformed system, but such efforts will not be sufficient. Convincing the population and key stakeholders in the population of the merits of the reform was definitely a challenge in Egypt before the Arab Spring. After this opening, many more voices, beyond the parliamentary majority, need to be heard. This circumstance presents a challenge but also an opportunity to present the logic of the reform to the population and gain popular support for it.

Last is the issue of implementation of the reform, which is still in front of us. With the reform legislation in June 2010, a major step was achieved, but only a first step. Although we recognized that enacting the legislation was only the beginning, we may have underestimated the challenge of implementation and what it implies. The task of capacity building in the administration, the development of information technology support, the need for institutional improvements for regulation and supervision, and the need to reach out to the people of Egypt with the necessary basic information to develop a general understanding of the principles and working of the reform all present final challenges. The message from Egypt's ongoing process for other emerging economies is to have patience. Do not underestimate the importance of starting up the implementation process at an early stage in the work on the reform. Give the process of implementation the time it needs, and be prepared for delays. Perhaps one of the most important international lessons

we have internalized in our process is to implement only when you are ready. By not heeding this lesson you may risk the reputation of the reform project for reasons that have little or nothing to do with its conceptual qualities of the reform, but with glitches created through poorly conceived and executed implementation.

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Nonfinancial defined contribution (NDC) schemes are now in their teens. The new pension concept was born in the early 1990s; implemented from the mid-1990s in Italy, Latvia, Poland and Sweden; legislated most recently in Norway and the Arab Republic of Egypt; and serves as inspiration for other countries. This innovative, unfunded individual account scheme provides a promising option at a time when the world seems locked into a stalemate between piecemeal reform of ailing traditional defined benefit plans or their replacement with prefunded financial account schemes. The current financial crisis, with its focus on sovereign debt, has enhanced the attraction of NDC as a pension scheme that aims for intra- and intergenerational fairness, offers a transparent framework to distribute economic and demographic risks, and, if well designed, promises long-term financial stability. Supplemented with a basic minimum pension guarantee, explicit noncontributory rights, and a funded pillar, the NDC approach provides an efficient framework for addressing poverty and risk diversification concerns.

This new anthology, published in two volumes, examines NDC in its adolescence, with the aim of contributing to its successful adulthood. Volume 1, *Lessons, Issues, and Implementation*, reviews and draws policy lessons from experience with NDC schemes in the original pilot countries and in subsequent adopters and examines the potential of NDCs in other countries, including Chile, Greece, and China. Volume 2, *Gender, Politics, and Financial Stability*, contains new and deeper analyses of issues that received little or no attention in an earlier (2006) publication. The 24 chapters in the two volumes offer new insights and strong guidance for pension reformers around the world, independent of the reform model envisaged. The NDC approach pinpoints the pension issues that any main public scheme must confront, making it well suited to serve as a benchmark for discussion of reforms.

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