Kant vs Nash:
Solving the Global Commons Goods Problem

by

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CICP & CEFAGE & Assistant Professor of Economics, DE-ECS, University of Évora , Portugal.
IPSA RC 35, Toronto & SASE, Paris.
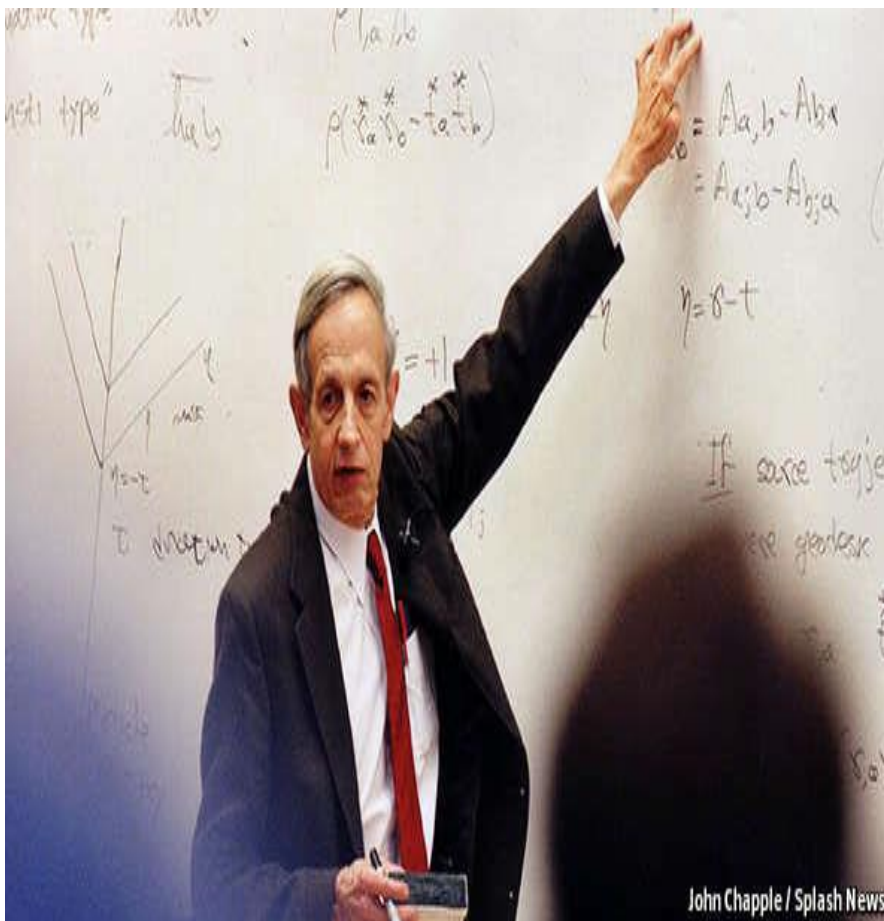Ordem dos Economistas & SEDES, PT.

Vanessa Duarte
CEFAGE, University of Évora, PT &
IPSA RC 35, Toronto.

IPSA World Congress,

**17-07-2023 09:00 UTC-3
(1 hour 45 minutes) A**

ROOM SJ2 233
Buenos Aires, Argentina
Universidade Catolica Argentina

Kant vs Nash:
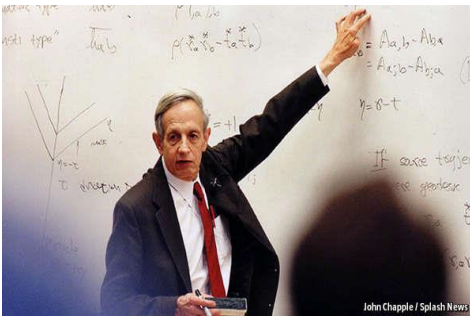# Solving the Global Commons Goods Problem

by

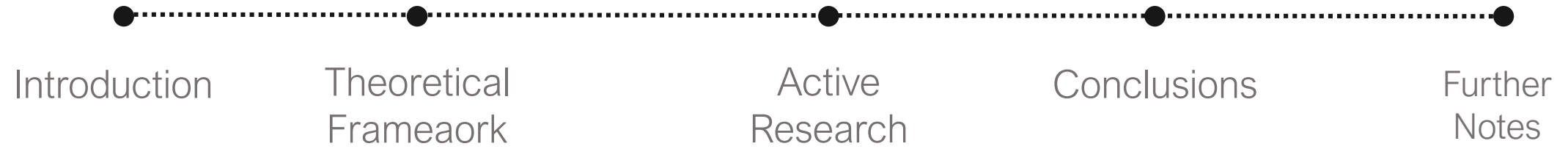**Miguel Rocha de Sousa (mrsousa@uevora.pt) & Vanessa Duarte**

Abstract: We provide the notion of Kantian equilibrium versus Nash equilibrium, and try to recover the efficiency of Pareto allocations within public goods (global commons) and external effects (like pollution). Nash (1950a,b) provided the first solution to a non zero-sum non-cooperative game through a fixed point theorem. Nevertheless, market efficiency is not recovered when there are either externalities (like pollution, or the global common problems), or common public goods. Ostrom (1989) provided a solution in small numbers through cooperation in small lake ponds and lobsters aquaculture production and local water provision. Roemer (1992) studied theories of distributive justice and came forth with a solution to global commons problem of environment and pollution (Roemer, 2019). Nevertheless, Roemer's solution, while solving the global commons incentive problem, by thinking out of the box, and providing a new framework provides a too much collective solution. We provide instead a communitarian solution, inspired by Christian ethics, namely Economics of Francis, Laudatio si, which also recovers the global incentive problem, but provides a different politico-economic perspective.

Key-words: Nash vs Kantian equilibria, Roemer, Laudatio si, Economics of Francis, Collective versus communitarian equilibria, private versus public provision, Global common goods, green house gas emissions, pollution, Peace versus war, Ethics versus Positive thought

JEL Codes: C70; C71; C72; D64; D70; D71; D72; O13; O19

July, 2023

Introduction

Theoretical
Frameaork

Active
Research

Conclusions

Further
Notes

Introduction   Theoretical
Framework   Active
Research   Conclusions   Furhther
Notes

Introduction

Motto | Research Question | Literature review | Climate Change | Game Theory

Introduction   **Theoretical Framework**   Active Research   Conclusions   Further Notes

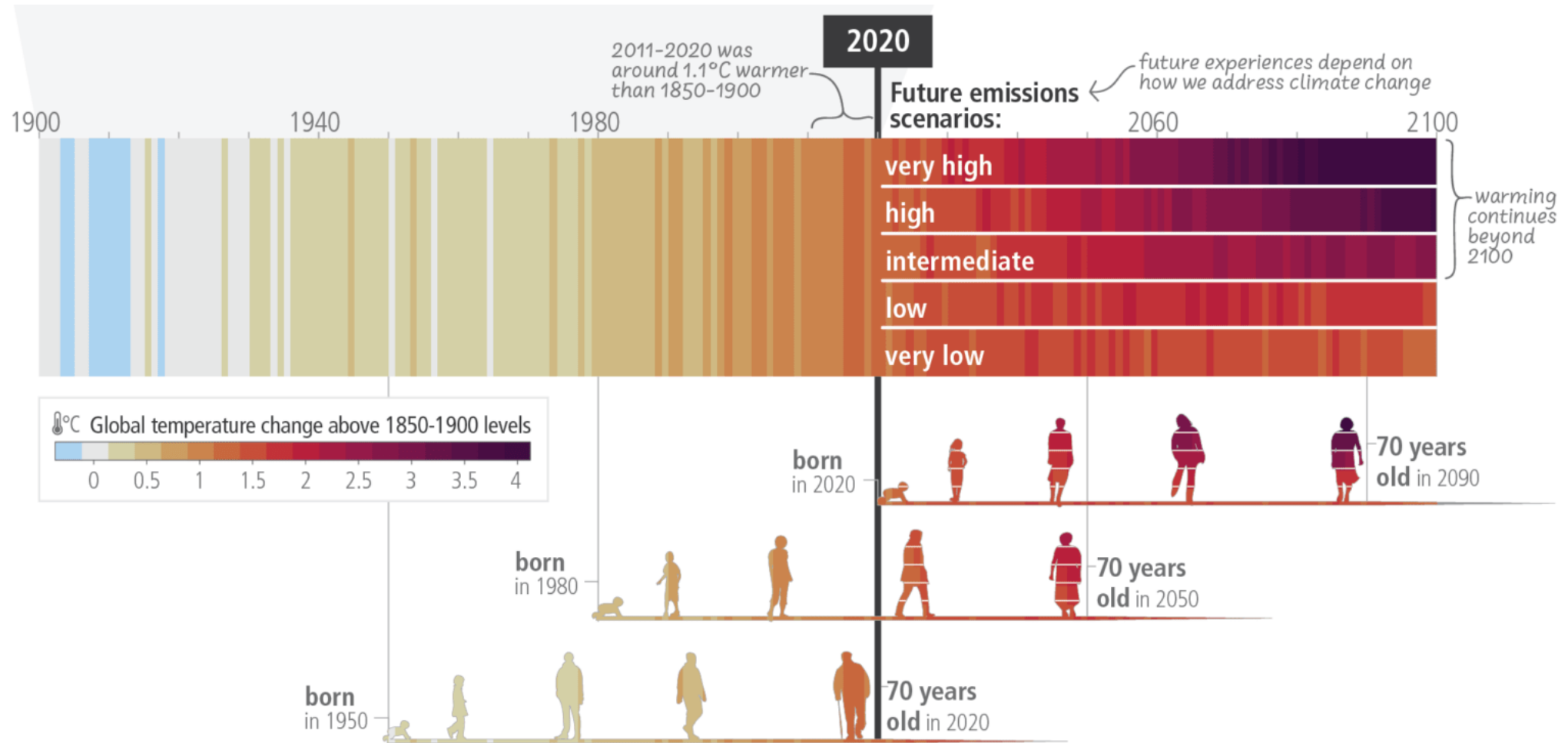# Theoretical Framework – Climate Change

Figura 1
Observed (1900–2020) and projected (2021–2100) changes in global surface temperature (relative to 1850–1900)
Source: (IPCC, 2023)

Nicholas Stern

Arthur Pigou

William Nordhaus

Nicholas Stern

Arthur Pigou

William Nordhaus

Nicholas Stern

Arthur Pigou

William Nordhaus

Nicholas Stern
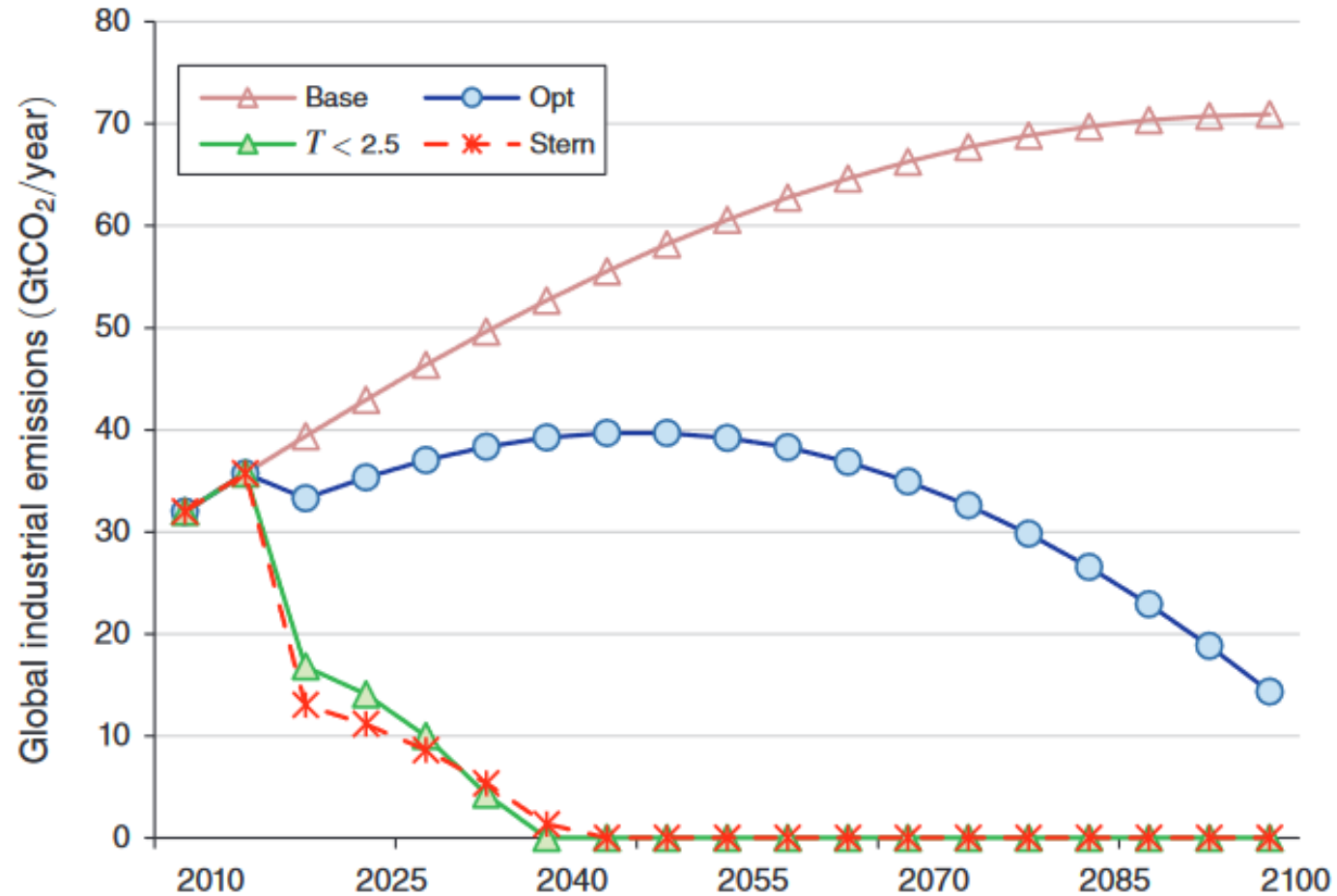
Arthur Pigou

William Nordhaus

Figura 2
Global industrial greenhouse gas
(GHG) emissions

Source (Nordhaus, 2018, p. 347)

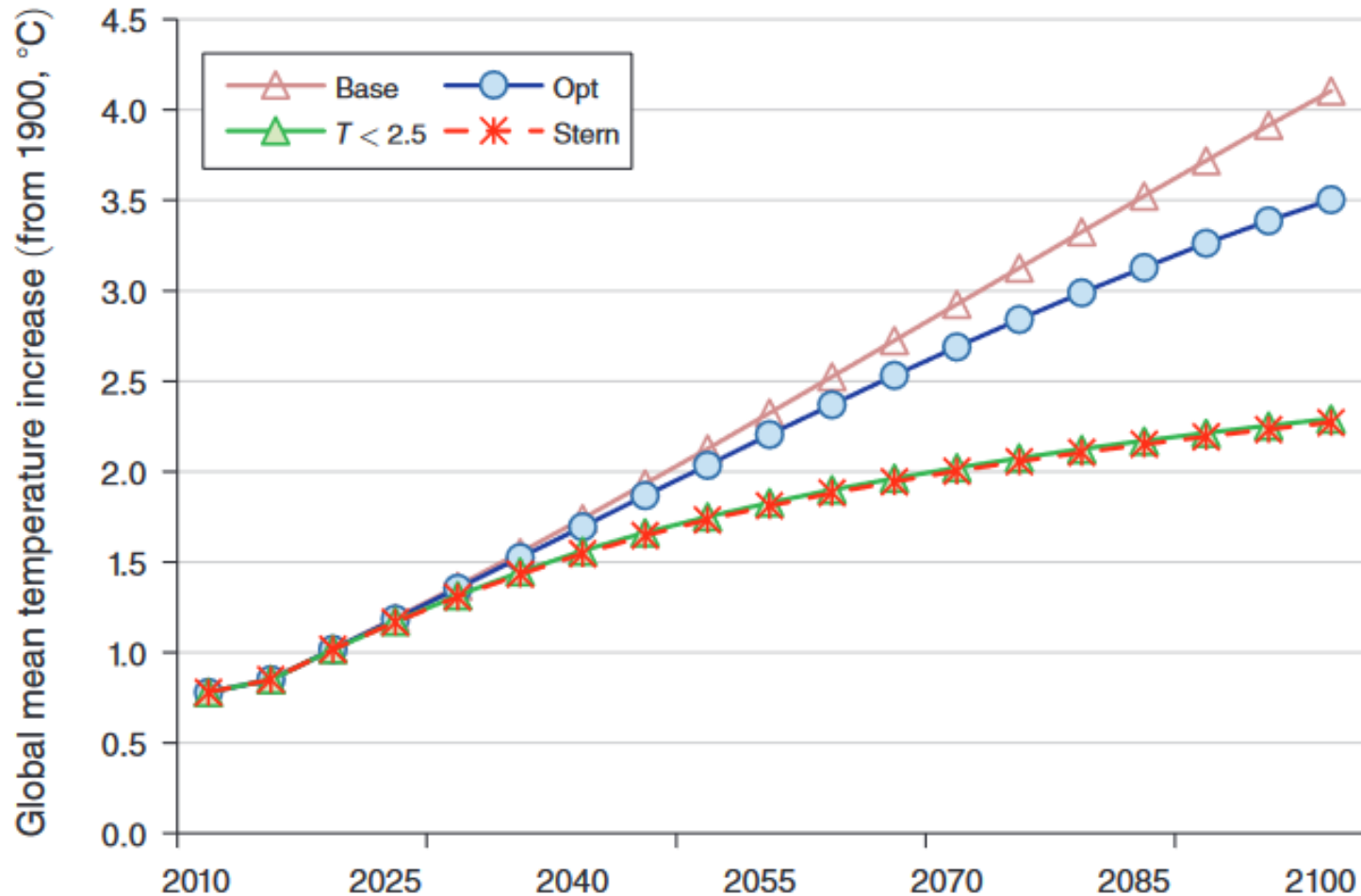# Theoretical framework – Economics and Environment

Figura 3
Average temperature rise
under different scenarios (since 1900,
ºC)Source: (Nordhaus, 2018, p. 348)

John von Neumann and Oskar Morgenstern

John Nash

Fudenberg e Tirole

John von Neumann and **Oskar Morgenstern**

John Nash

Fudenberg and Tirole

John von Neumann e Oskar Morgenstern
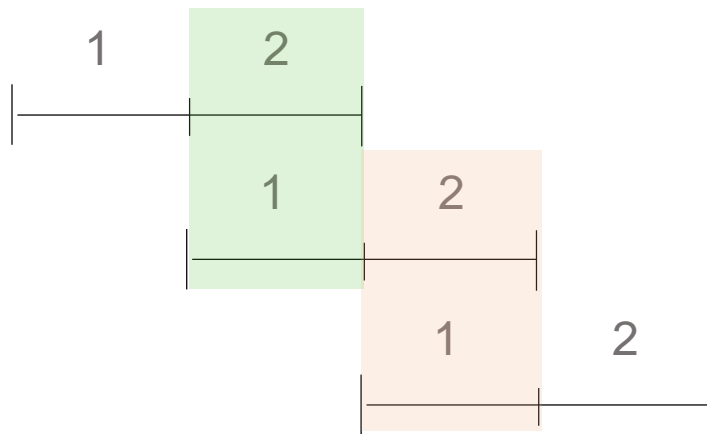
John Nash

Fudenberg and Tirole

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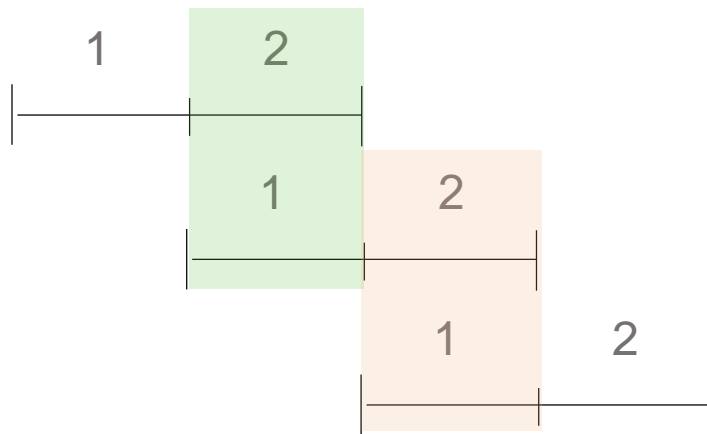
John Nash

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Allais, Samuelson and Diamond

John and Pecchenino

Vladimir Udalov

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Allais, **Samuelson** and **Diamond**

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Allais, Samuelson and Diamond

John and **Pecchenino**
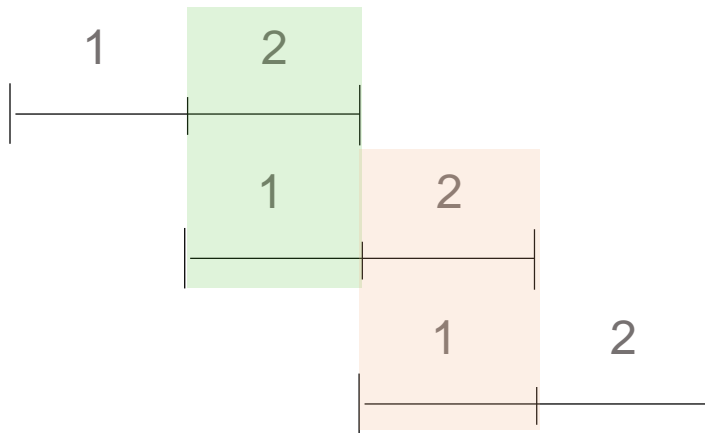
Vladimir Udalov

Allais, Samuelson and Diamond
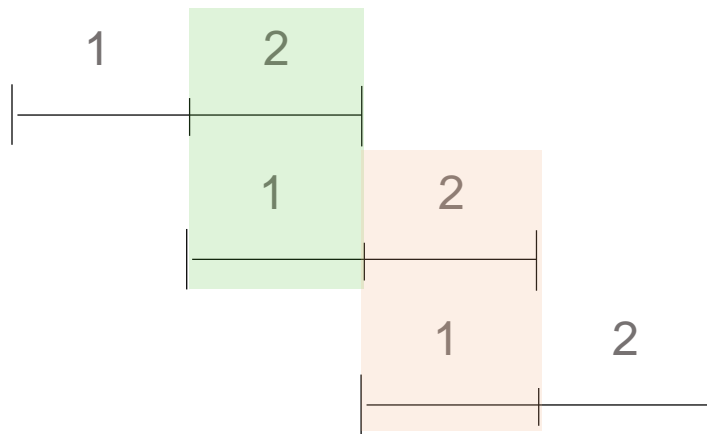
John and Pecchenino

Vladimir Udalov

The clock is ticking and we need to ACT!

Introduction   Theoretical Framework   **Active Research**   Conclusions   Further Scores

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Enviormental Quality
At Present day

Consumption
Next Period

Environmental Quality
Next Period

$$U_t = \ln c_t^1 + \ln Env_t + \frac{1}{1+\delta}\left(\ln c_{t+1}^2 + \eta \ln Env_{t+1}\right)$$

Current
Consumption

Intertemporal
Discount rate

Intergenerational
Concern

Interest rate

Environmental
Degradation

$$\left[\frac{\bar{c}}{\overline{Env}}\right]^{young} = \left(\frac{\bar{r}-\delta}{1+\delta}\right)\frac{\omega}{\eta} + \mu^1$$

Base value
Assigned to
Consumption

$$c_t^1 = c_{t+1}^2 = \bar{c}$$

$$Env_t = Env_{t+1} = \overline{Env}$$

$$r_{t+1} = \bar{r}$$

Evolução do consumo por qualidade ambiental
(parametrizado em $\bar{r}$, δ, $\eta=0{,}1$, $\omega=1$ e $\mu^1=1$)
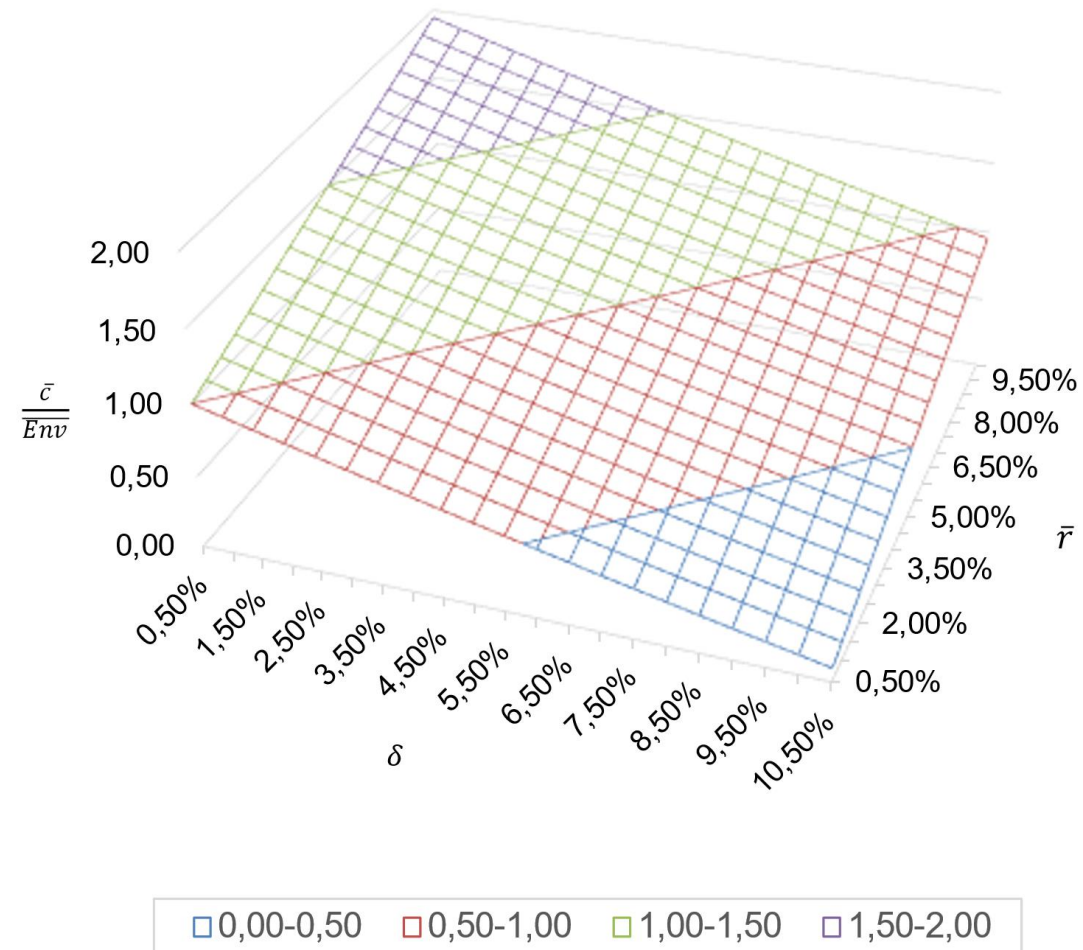
Figure 4
Evolution of consumption by environmental quality
Pica and De Sousa, 2023

Legend: 0,00-0,50 | 0,50-1,00 | 1,00-1,50 | 1,50-2,00

Without Intergenerational concern

$$V_t^{old} = \ln c_t^2 + \ln Env_t$$

With Intergenerational concern

$$U_t^{old} = \ln c_t^2 + \ln Env_t + \frac{\eta}{1+\delta} \ln Env_{t+1}$$

$$\left[\dfrac{\overline{c}}{\overline{Env}}\right]^{old} = -\dfrac{1}{\omega} + \mu^2$$

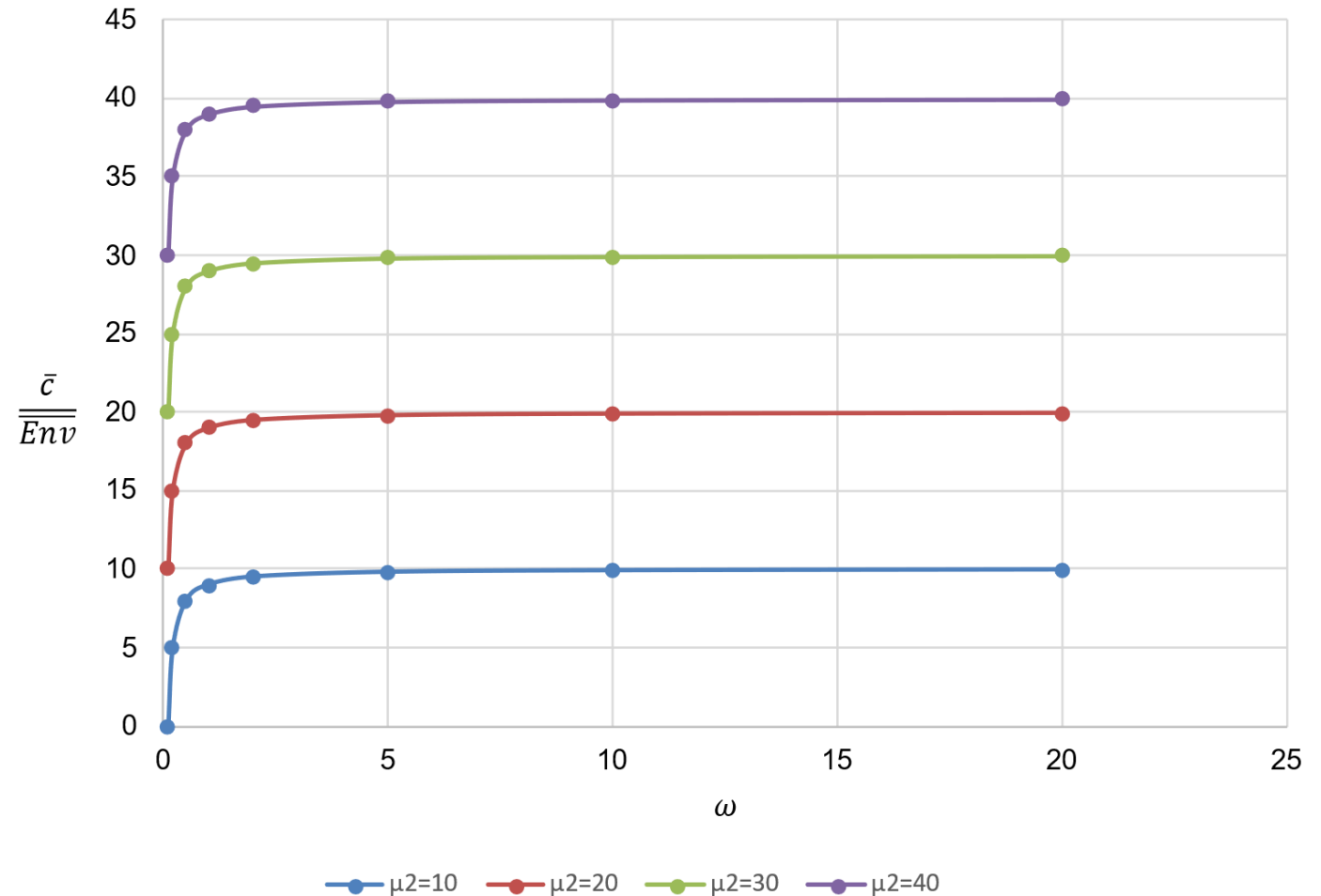Evolução do consumo por qualidade ambiental
(parametrizado em ω e μ^2)

Figure 6
Evolution of consumption by environmental quality
Pica and De Sousa, 2023

$$\eta = \left(-\omega + \mu^*\right)\frac{\omega\left(\bar{r} - \delta\right)}{\left(1 + \delta\right)}$$

$$\mu^2 - \mu^1 = \mu^*$$

Superfície de EN da Preocupação Intergeracional
(parametrizada em $\bar{r}$, δ, ω=0,5 e μ^*=-10)

Fronteira de EN

☐ -0,60--0,40 ☐ -0,40--0,20 ☐ -0,20-0,00 ☐ 0,00-0,20 ☐ 0,20-0,40 ☐ 0,40-0,60
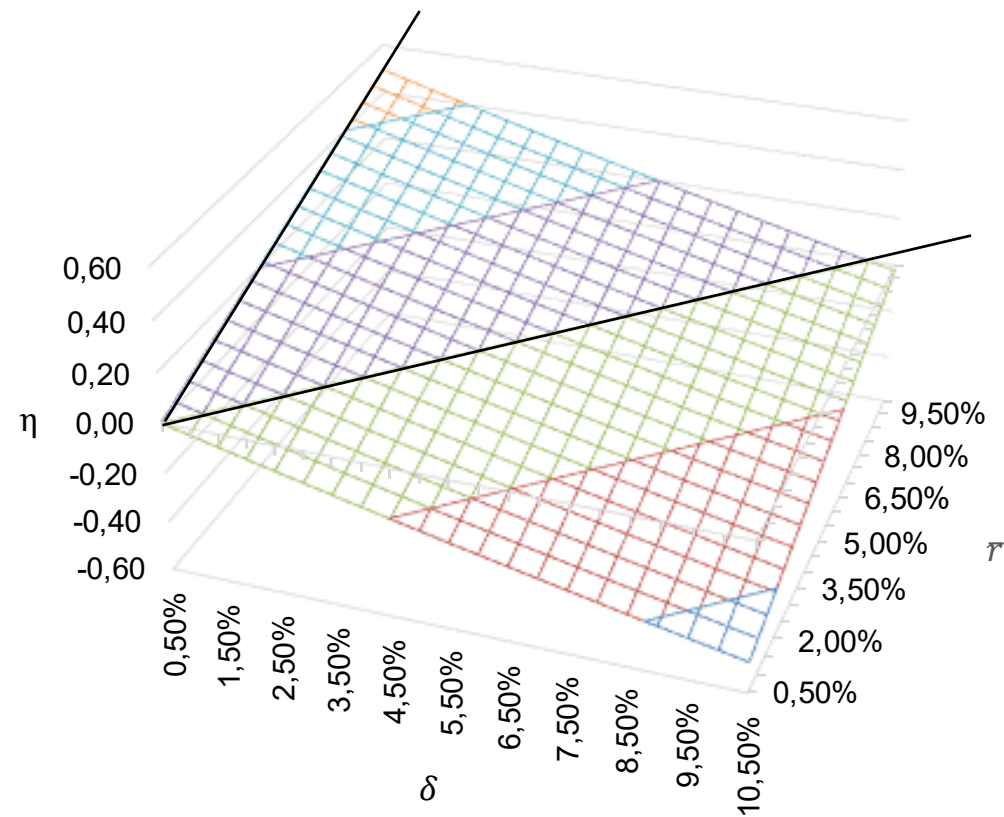
Figure 7
NE Surface of Intergenerational Concern
Pica and De Sousa, 2023

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youngsters

Intergenerational Concern ↗ ⟶ Consumption ↘

η
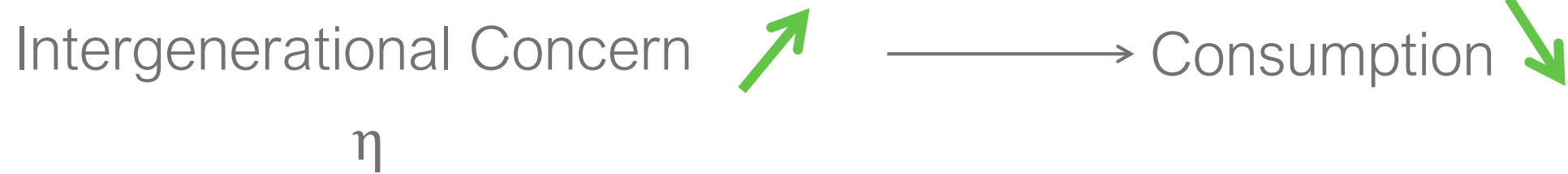
Elderly

Consumption Evolution $\longrightarrow$ μ^2

(consumption base value)
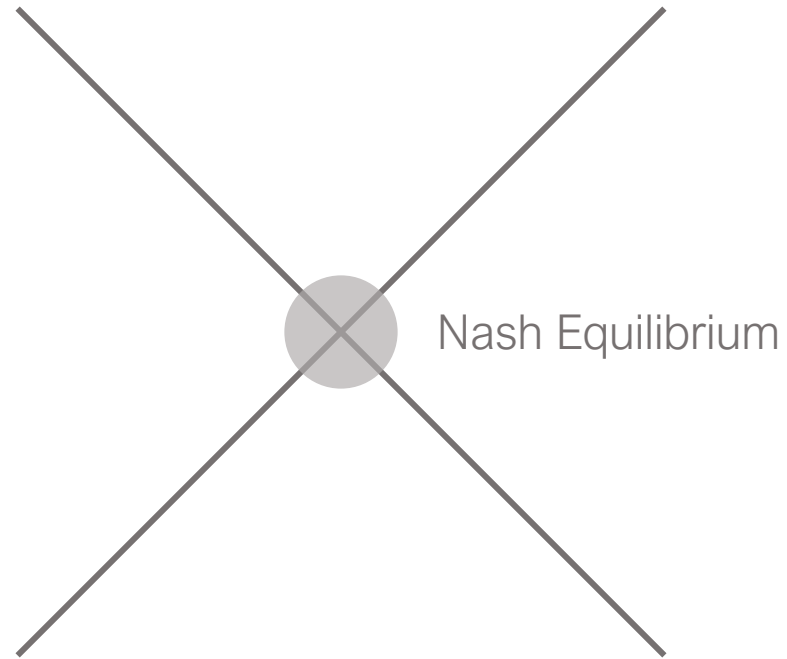
Strategic Interaction

$\mu^1 > \mu^2$

$\mu^2 = \mu^1$

$\mu^2 > \mu^1$

Nash Equilibrium

Environmental degradation

Intergenerational concern

Strategic Interaction

$\mu^1 > \mu^2$

$\mu^2 = \mu^1$

$\mu^2 > \mu^1$

Nash Equilibrium

The Kantian equilibrium is not just a new objective function, is really a new problem.
A new parametrization, a new approach.

The **Nash equilibrium** is just an individual egoistical function, is really an old problem.

Environmental degradation

Intergenerational concern

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Strategic Interaction

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Kantian Additive equilibria Simple Kantian Equilibrium

Definition 1.1. [Roemer, 2019, p.13]:

"In a **symmetric game,** the strategy that each **would all** play is a simple Kantian equilibrium (SKE)."

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Monotonocity and Pareto efficiency:[Roemer, 2019,p.23]
A game V, with n players, with pay-offs:
V_i : Sn → R for i = 1, 2, ..., n as per defined, is (strictly) monotone increasing if, for each i, V_i is (strictly) increasing on the strategies of other players j≠ i.

Common diagonal, definition (Roemer, 2019,p.23):
"If the pay-offs functions of all players coincide on the diagonal (p, p, .., p) ∈ Sn|S ∈ S".

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Example 2 -person-game[Roemer, 2019,p.23]
This condition of common diagonal is weaker than perfect symmetry.
For a 2-person-game, symmetry means p, q ∈ S,
$V_1(p, q) = V_2(q, p)$ It is immediate,
that this game has a common-diagonal, and thus a SKE.

Proposition 2.1.[Roemer, 2019, p.23]
a) If a game V possesses a common-diagonal, then a SKE exists.
b) In a strictly monotone game, any SKE is Pareto efficient. (Demo: Roemer, 2019, p.23-24.)

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Example 2 –prisioner's dilemma[Roemer, 2019,p.23]

Example 2-person Symmetric Games

Table 2.1. The prisioner's dilemma with $0 < b < c$.

	Cooperate	Defect
Cooperate	(0,0)	(-c,1)
Defect	(1,-c)	(-b,-b)

The expected value of the row-player in the PDs problem is:

$V^pD(p, q) = -p(1 - q)c + (1 - p)q - b(1 - p)(1 - q)$

with $p(q) \rightarrow$ probability of the row (column) player cooperates.
Pareto efficiency is defined in terms of expected utility EU, and thus:

$$\frac{\delta V^{PD}}{\delta q} = pc + (1 - p)(1 + b) > 0.$$

The mixed strategy prisioner's dilemma is strictly monotone increasing.
Thus, from proposition 2.1. the SKE of the mixed strategy prisioner's dilemma (PD) is Pareto efficient.

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Proposition 2.2.[Roemer, 2019, p.25]

a. The SKE of the PDs is Pareto efficient.

b. If $1 \leq c \leq 1 + b$, the SKE of the PDs game is $(p*, p*) = (1, 1)$.

c. If $c < 1$, the SKE of the PDs is $p* = 2b−p+1−c$ $2(1+b−c)$ and $0 < p* < 1$.

d. If $1 + b < c$, the SKE of the PD game is $p* = 1$.

(Demo: Roemer, 2019, p.25.)

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Example 2 –stag hunt game[Roemer, 2019,p.23]

Another example, by using the stag-hunt game:
Table 2.2. The stag-hunt game with a < 0 < b < 1.

	Cooperate(share)	Defect(grab)
Cooperate(share)	(1,1)	(a,b)
Defect(grab)	(b,a)	(0,0)

Grab (not unlike PDs) is not a dominant strategy. Skyrms (2004) studied the signals the players could have sent in order to meet the good nash equilibrium (share, share)=(1,1).

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So, let's now proceed to asymmetric games

We have **dictator, ultimatum**, **trust games**.
We will deal woth classical V-N (Von-Neumann utility functions), with
u(0) = 0
and u(1) = 1.

We analyse immediatly **the stochastic dictator game**.

The traditional problem is to find a solution to expected utility:
E(u) = (1/2)(u(x) + u(1 − y))
Nevertheless, the **SKE** is different:
Max $_x$ E(u)
And the solution yields for the first player:
x = 1/2 and of course for the second player x = 1/2.

The **standard dictator game** is **asymmetric**, but to put the game symmetric, by beginning before Nature moves.

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So, let's now proceed to asymmetric games

Ultimatum stochastic game.
i)   Nature chooses the ultimatum.
ii) Ultimator presents an offer.
iii) other player accepts or rejects the offer.
Traditional approach: the unique sub-game perfect equilibrium is:
$(x, z) = (1, 0)$.

But if we follow this new approach:
$\max(1/2)(u(x) + (1/2)u(z)$ st
$z \le 1 − x$
This yields a unique solution:
$(x, z) = (1/2, 1/2)$.

Accordingly to Roemer, this **solution (SKE) is more nearer** to the **world we observe**, rather than **simple Nash equilibrium.**

Intuitively, we use the **SKE protocol**, because "**we are all in the same boat".**

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So, let's now proceed to asymmetric games

Public good game.
2 players.
Each has M units of money.
Nature draws who plays first.
Player 1 choose x to player 2.
Player 2 receives a.x with a > 1, yet constant.

A. Conventional approach: **Nash equilibrium** yields a sub-game perfect equilibrium, with:
x = y = 0.

B. KE: Kantian equilibrium:
Before: (1/2).u(M − x + ay) + (1/2).u(M + ax − y) in order to choose (x, y)
This yields the following solution approach.

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So, let's now proceed to asymmetric games

Public good game.
2 players.
Max(1/2).u(M − x + ay) + (1/2).u(M + ax − y)
in order to choose (x, y)
s.t.
0 ≤ x ≤ M(λ)
0 ≤ y ≤ M + ax
So, the first consatraint binds (λ) and the second lacks, using Khun-Tucker
(KT) conditions:

(δx) −u'(M − x + ay) + a.u(M + ax − y) = λ ≥ 0
(δy) au'(M − x + ay) = u(M + ax − y)
This yields, as solution x = M.

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So, let's now proceed to asymmetric games

Public good game. (SKE continued)

2 players.

(KT) conditions:

(δx) $-u'(M - x + ay) + a.u(M + ax - y) = \lambda \geq 0$

(δy) $au'(M - x + ay) = u(M + ax - y)$

This yields, as solution $x = M$.

By substituting, (δy) in (δx), Roemer finds:

$(a2 - 1).u'(M - x + ay) \geq 0$

which is surely true as $a > 1$.

Thus, (δy) leads us to:

$M - x + ay > M + ax - y$

because u is traditionally declining (marginal utility), so we have $x < y$

and

$y > M$.

So, we should expect $y < (1 + a).M$.

Thus, we find SKE as:

$x = M$ and $M < y < (1 + a).M$.

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So, let's now proceed to more analysis

We could tackle the issue of Kantian Additive versus multiplicative equilbria, a simple extension Roemer does quite well.

We could abridge a game among Kantian versus Nashers.

And finnally last but not least the global commons problem is approached in his Roemer (2019, chpt. 11, pp.159-175).

Instead of criss-crossing all the mathemaitcal details, from addtiive to multiplicairve and to the generalzation of public goods with externalities, IN SHORT the maths is CORRECT,

BUT and this is a great BUT

The interpretation can be instead of a kibutz, from the leftist tender lean or, for our case proposal, a Christian ethics approach.

The Kantian equilibrium is not just a new objective function, is really a new problem.
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Christian Ethics in Roemer's thought

IN SHORT the maths is CORRECT,

BUT and this is a great BUT

The interpretation can be instead of a kibutz, for our case proposal, a Christian ethics approach.

The colective approach for the COMMON G(O)OD can be tackled by a COMMUNITARIAN Approach.

The Kantian equilibrium is not just a new objective function, is really a new problem.
A new parametrization, a new approach. **OURS a new Christian Ethics.**

Christian Ethics in Roemer's thought

The colective approach for the COMMON GOOD can be tackled by a COMMUNITARIAN Approach, detailing it:

i) Ostrom (1989) did it in small numbers for lobsters and aquaculture provision and water provision for small communities.

ii) we can make it for the common G(o)od! A truly ecumunical holistic approach can realign incentives.

iii) This is the main NEWNESS of our PAPER- redefine Kant versus Nash equilibria passing from nashian egoistic self centered equilbria to a COMMUNITARIAN approach (eg. **Jesuitic community** and **Laudatio si and EoF** by Pope Francis sj)

The Kantian equilibrium is not just a new objective function, is really a new problem.
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Furher
Nptes
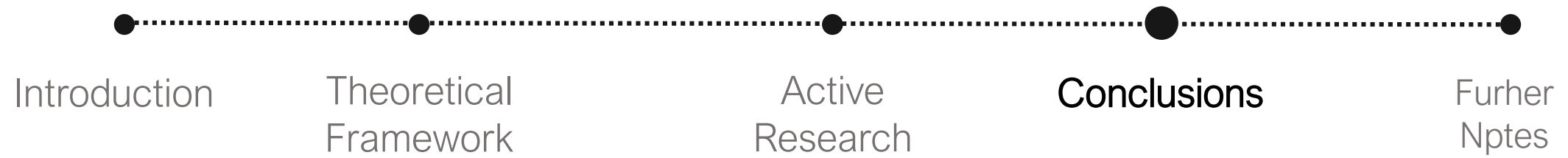
Environmental Heritage

Cooperation

Sustainable Development

Kant vs Nash

Communitarian Approach

Christian Ethics

Limits of Analysis and Further Work

- Log linear deterministic model

  Stochastic model

- Simulations contingent on the positive ortant

  Cover the most important results to other ortants

- Equal intergenerational concern for young and old

  Extend to different parameters for both generations

- ***NEWNESS OF THIS APPROACH***

- Equal mathematical formulation of SKE BUT

  Extend to different parameters for both Christian

  Commutarian ethics vs Kibbutzian ethics.

Limits of Analysis and Further Work

- ***NEWNESS OF THIS APPROACH***

- Equal mathematical formulation of SKE BUT

  Extend to different parameters for both Christian Commutarian ethics and Kibbutzian ethics.

- ***WE USE THE SAME LANGUAGE BUT WITH DIFFERENT ENDS/AIMS.***

- ***We all pray to the SAME G(O)OD but with different versions and intents?***

"Climate change is the greatest market failure the world has ever seen"

(Stern, 2007)