UNIVERSITY OF ÉVORA

SCHOOL OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

Trade Openness and Inflation in Pakistan: A Cointegration and Causality Analysis (1973-2015)

Muhammad Fahad Khan Israr

Supervisor: Miguel Rocha de Sousa, Ph.D.

Supervisor: Fernanda Peixe, Ph.D.

Master in Economics

Dissertation

Évora, 2017

UNIVERSITY OF ÉVORA

SCHOOL OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

Trade Openness and Inflation in Pakistan: A Cointegration and Causality Analysis (1973-2015)

Muhammad Fahad Khan Israr

Supervisor: Miguel Rocha de Sousa, Ph.D.

Supervisor: Fernanda Peixe, Ph.D.

Master in Economics

Dissertation

Évora, 2017

Abstract:

This study examines the effect of openness on inflation for the Pakistan economy over the period 1973-2015. In the first of its kind, this paper investigates the openness-inflation relationship with Johansen's maximum likelihood cointegration procedure along with impulse response functions and forecast error variance decomposition of vector autoregressive models in the Pakistan context. The framework of the analysis is a five-variable vector autoregressive model with different permutation of variables. The results show that there is significance of openness and inflation relationship in the long run but not in the short run. In the long run openness is positively related to inflation (although the effect is small), hence refutes the well-known Romer (1993) hypothesis. Moreover, no causality was found between inflation and trade openness as investigated by the Toda-Yamamoto approach. The impulse response functions indicate that an innovation to openness has a significant positive effect on growth rates of inflation in the short run but the effect becomes negative in the long run. However, when we use financial openness as an alternative openness measure, the effect in inflation is negative in the short run but becomes significantly positive in the long run. The variance decomposition analysis indicates that shocks to import prices and exchange rate in the short run, and output and money supply in the long run, have greater impact on inflation than does the openness shock.

Keywords: Openness, Inflation, Cointegration, Causality, Impulse Response, Variance Decomposition

JEL classification: E31; F14; F41; O53

Abertura ao Exterior e Inflação no Paquistão: Uma Análise de Cointegração e causalidade (1973-2015).

Resumo:

Este estudo examina o efeito da abertura ao exterior na inflação para a economia paquistanesa no período 1973-2015. Esta relação é investigada conjugando, pela primeira vez, a abordagem de cointegração de máxima verosimilhança de Johansen com as funções impulso resposta e a decomposição da variância do erro de previsão de modelos autorregressivos vetoriais, no contexto paquistanês. A base da análise é um modelo autorregressivo vetorial com cinco variáveis em diferentes permutações. Os resultados mostram que a relação entre abertura e inflação é significativa no longo prazo, mas não no curto prazo. No longo prazo a abertura ao exterior relaciona-se positivamente com a inflação (embora o efeito seja pequeno em magnitude), o que refuta a conhecida hipótese de Romer (1993). Além disso, não se encontrou causalidade entre inflação e abertura comercial ao exterior através da abordagem de Toda-Yamamoto. As funções impulso resposta indicam que uma inovação na abertura ao exterior tem um efeito positivo e significativo no crescimento da inflação no curto prazo, mas o efeito torna-se negativo no longo prazo. No entanto, quando se usa a abertura financeira ao exterior como uma medida alternativa de abertura, o efeito na inflação é negativo no curto prazo é negativo no curto prazo, mas torna-se positivo e significativo no longo prazo. A análise de decomposição da variância indica que os choques nos preços de importação e na taxa de câmbio no curto prazo, e no produto e na oferta de moeda no logo prazo, têm maior impacto na inflação do que os choques na abertura ao exterior.

Palavras-chave: Abertura ao exterior, Inflação, Cointegração, Causalidade, Impulso Resposta, Decomposição da variância.

Classificação JEL: E31; F14; F41; O53

Preface

This dissertation is submitted for the degree of Masters of Science in Economics at University of Evora, Portugal. Under the supervision of Prof. Miguel Rocha de Sousa, co-supervisor Prof. Fernanda Peixe.

I have selected to work on open economy macroeconomics. The Pakistan economy is rapidly integrating with the global economy, so the domestic price level cannot remain affected to external shocks. In the global scenario, this issue is imperative to address because as most emerging economies are open, rapid inflation can be a serious barrier in the process of their economic growth.

In line with this view, Romer (1993) postulates the hypothesis that inflation is lower in small and open economies. The motivation of this study is to examine Romer hypothesis in the Pakistan context.

In this framework, the empirical question, this study pursue to address is whether the expected inflation is the outcome of increased outward orientation or this dominant economic theory is a statistical chance of occurrence. This study empirically analyses the relationship between trade openness and inflation for the Pakistan economy using annual time series data for the period 1973 to 2015.

An important feature of this study is that it allows the impact of trade openness on inflation with several combinations of variables to investigate the long run and short run dynamics of openness and inflation relations by employing VAR techniques in a multivariate regression analysis.

Acknowledgement

I wish to express my warmest gratitude to my thesis advisors Prof. Miguel Rocha de Sousa and Prof. Fernanda Peixe for their academic supervision and personal support throughout all my years in the School of Social Sciences, University of Évora, Portugal.

I am especially grateful to them, their keen support and diligence helped me a lot to get solid background in data analysis and statistical programming. Their encouragement, motivation and guidance provide me with hand on experience in research activities and made me proficient in using econometric software's EViews and SPSS. Their excellent work enhances my skill and knowledge to gain sound understanding of economic policy in the matter of trade and finance.

I gratefully acknowledge the funding received towards my M.Sc. from the Erasmus Mundus Action 2 (Fusion) programme. Thanks to Prof Teresa Gonçalves for her valuable input. My sincere thanks to her who provide me an opportunity to participate in the short course, trade and monetary policy at Saarland University Germany.

I am also thankful to the funding received through the German Academic Exchange Service to undertake this course. The knowledge gain from this course put a valuable contribution to my dissertation.

Finally, I would like to thank my parents for supporting me spiritually throughout writing this thesis and my life in general. My gratitude to them is beyond words.

Contents

Abstract: ii

List of Figures viii

List of Tables ix

Acronyms x

Chapter 1: Introduction **11**

1.1 Trade Openness and Inflation in Pakistan: 11

1.2 Background of the study: 13

1.3 Statement of Problem: 15

1.4 Significance of the study: 16

1.5 Objectives of the study: 16

1.6 Hypothesis: 16

1.7 Organization of the Study: 17

Chapter 2: Literature Review **18**

2.1 Openness and Inflation Puzzle: Analysis of OECD Countries: 18

2.2 Openness and Inflation Puzzle: Single Country Analysis: 20

2.3 Openness and Inflation Puzzle: Analysis of East Asian Economies: 24

2.4 Openness and Inflation Puzzle: Developed and Developing Countries: 25

2.5 Openness and Inflation Puzzle: Cross Country Analysis: 27

Chapter 3: Data, Modelling and Methodological Framework **34**

3.1 Data Sources and Variables Constructions: 38

3.2 Model Specification: 38

3.3 Johansen's Procedure for Testing Cointegration: 40

3.4 The Vector Error Correction Model: 41

3.5 Causality Analysis: 45

3.6 Further Analysis (IRFs and VDCs): 46

Chapter 4: Empirical Results and Discussion 47

4.1 Descriptive Statistics: 47

4.2 Unit Root Tests: 48

4.3 Cointegration Test: 49

4.4 VEC estimates of Long Run Cointegrating Vectors: 52

4.5 Short Run estimates (Error Correction Model): 57

4.6 Diagnostic test Statistics: 68

4.7 Toda-Yamamoto Causality test Analysis: 68

4.8 Pairwise Granger Causality test Analysis: 71

4.9 Impulse Response Functions: 73

4.10 Variance Decomposition Computations: 77

Chapter 5: Conclusion and Policy Recommendation 79

5.1 Conclusion: 79

5.2 Policy Recommendation: 80

References 82

List of Figures

Figure 1: Pakistan Trade Openness X+M/Y (1973-2015) 12
Figure 2: Pakistan Inflation (1973-2015) 13
Figure 3: Model A (CUSUM): Plot of cumulative sum of Recursive Residuals 59
Figure 4: Model A (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals .. 59
Figure 5: Model B (CUSUM): Plot of Cumulative sum of Recursive Residuals 61
Figure 6: Model B (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals .. 61
Figure 7: Model C (CUSUM): Plot of Cumulative sum of Recursive Residuals 63
Figure 8: Model C (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals .. 63
Figure 9: Model D (CUSUM): Plot of Cumulative sum of Recursive Residuals 65
Figure 10: Model D (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals 65
Figure 11: Model E (CUSUM): Plot of Cumulative sum of Recursive Residuals 67
Figure 12: Model E (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals 67
Figure 13: Impulse Responses Variable Ordering (1) 75
Figure 14: Impulse Responses Variable Ordering (2) 76

List of Tables

Table 1: Pakistan Inflation and Trade Openness Indicators (1973-2015) 12
Table 2: Descriptive Statistics (1973-2015) 47
Table 3: Results of ADF Unit Root Test 49
Table 4: Johansen Cointegration Tests (Trace Statistics) 50
Table 5: Johansen Cointegration Tests (Max-Eigen Statistics) 51
Table 6: VEC estimates of Model A 52
Table 7: VEC estimates of Model B 53
Table 8: VEC estimates of Model C 53
Table 9: VEC estimates of Model D 54
Table 10: VEC estimates of Model E 54
Table 11: Short Run estimates (ECM) Model A 58
Table 12: Short Run estimates (ECM) Model B 60
Table 13: Short Run estimates (ECM) Model C 62
Table 14: Short Run estimates (ECM) Model D 64
Table 15: Short Run estimates (ECM) Model E 66
Table 16: Toda-Yamamoto Causality estimates Model A 69
Table 17: Toda-Yamamoto Causality estimates Model B 69
Table 18: Toda-Yamamoto Causality estimates Model C 70
Table 19: Toda-Yamamoto Causality estimates Model D 70
Table 20: Toda-Yamamoto Causality estimates Model E 71
Table 21: Granger Causality Results F Statistics 72
Table 22: Variance Decompositions (Variable Ordering 1) 78
Table 23: Variance Decompositions (Variable Ordering 2) 78

Acronyms

AD	Aggregate Demand
AS	Aggregate Supply
ARDL	Autoregressive Distributive Lag
CPI	Consumer Price Index
CEN	Index of Wage Centralization
EIU	Economist Intelligence Unit
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GMM	Generalized Methods of Moments
IFS	International Financial Statistics
IMF	International Monetary Fund
IRF	Impulse Response Function
KOF	Index of Globalization
OECD	Organization of Economic Cooperation and Development
OLG	Overlapping Generations Model
OLS	Ordinary Least Squares
PPP	Purchasing Power Parity
UNCDB	United Nation Common Data Base
VAR	Vector Auto Regression
VAT	Value added Tax
VECM	Vector Error Correction Model
VDC	Variance Decomposition Computation
WPI	Whole Sale Price Index
WB	World Bank
2SLS	Two-Stage Least Squares

Chapter 1: Introduction

1.1 Trade Openness and Inflation in Pakistan:

Trade liberalization and inflation nexus is the most significant proposition found in every international trade text. During the early years, Pakistan economy pursued interventionist commercial policies to strengthen its industrial base that favored import substitution to protect its domestic fledgling enterprises with the high levies and import quotas. However, during the late 1980s, Pakistan moved towards outward looking strategy with a deduction in tariff slab, export taxes and quantitative restriction on trade and followed trade liberalization with flexible exchange rate and export promotion strategies. Pakistan trade share of GDP increased and the bias against exports declined. Despite making the economy liberalized, inflation doesn't remain within the acceptable limits in Pakistan.

Inflation in Pakistan is erratic with mid-1970s as high as 23 percent. Monetary broadness, nationalization, and oil shocks played a dominant role in increasing prices. Inflation was relatively low in the 1980s and early 1990s because of tight monetary and fiscal consolidation besides distinct dynamism in the framework of trade openness. During 2000, inflation remained lower, but started accelerating in 2005 and reached to its highly-commemorated figure of 20.77. The low export growth relative to import, reduction in foreign capital inflow, and oil price hike contributed to obstinately double-digit inflation during 2005-2008. In 2014, the inflation rate in Pakistan was recorded at 7.4.

The conventional inflation rate, which has a progressive influence on Pakistan economy is 3 to 6 percent, it increases investment, production, and the rise in wages. However, inflation provokes worse effects once it crosses the acceptable limits. Money value which serves as a medium of exchange rate decreases. The increase in prices impedes the real rate of return on financial assets as savings are deterred which supplement to lesser investment and economic growth.

This study undertakes basic research question from problem statement is that **"to what extent is inflation influenced by trade openness in Pakistan?"**

Table 1: Pakistan Inflation and Trade Openness Indicators (1973-2015)

Period	Inflation	Exports	Imports	Total Trade
1973	23.1	13.53	16.30	29.91
1980s	6.98	10.72	19/29	30.00
1990s	9.25	14.59	18.80	33.38
2000s	4.31	14.30	15.60	29.90
2010s	8.96	14.36	18.49	32.86
2015	7.8	12.57	19.05	32.52

Note: Inflation is percentage change in CPI, while exports, imports, and total trade (openness) are expressed as percentage of GDP. All values are period average except 1973.

Figure 1: Pakistan Trade Openness X+M/Y (1973-2015)

Source: IMF and World Bank Data

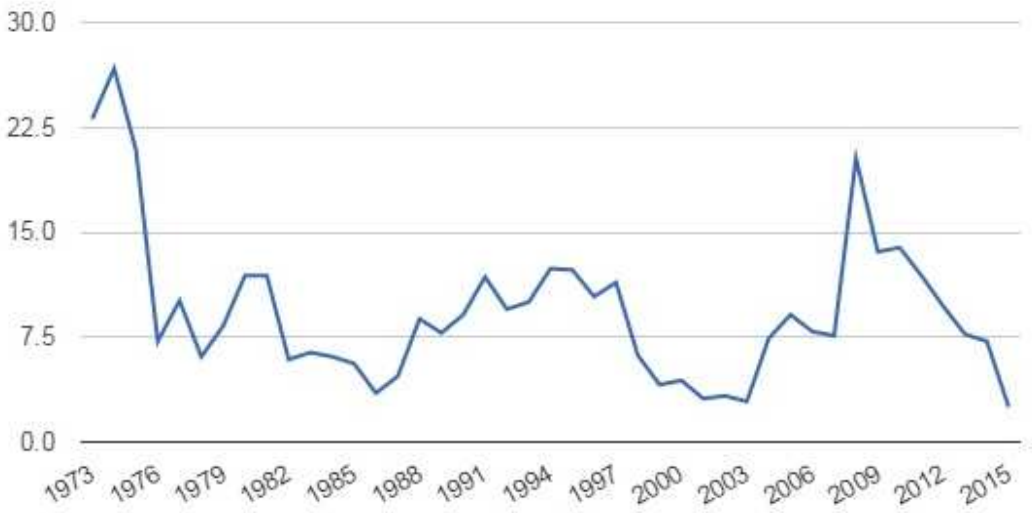

Figure 2: Pakistan Inflation (1973-2015)

Source: IMF and World Bank Data

1.2 Background of the study:

Temple (2002) convenes trade openness and inflation association, one of the contemporary puzzles of international macroeconomics. Openness with sustained low inflation contemplates inelastic international competition and high engagement of developing countries in the world trade integration (Rogoff, 2003). The adherent of trade openness contends that increased trade openness is linked with lower cost, prevailing trade restraint as progressiveness in prices (Musa, 1974; Mukhtar, 2010).

Inflation creates a precarious situation and that may abominably effect economic growth. Developing countries in today's world cannot bear to segregate itself from the world economy. The inquisition of inflation and openness nexus has been contingent to hypothetical as well as pragmatic analysis. More developing countries now have been a transparent shift toward pronounced opening up and abstain from the closed economy composition. Inflation is less in liberalized economies because principal monetary authorities in open economies manifested currency volatility provoked by the unanticipatory money expansion and increased the cost of production. Therefore, the authorities will expand less and hence inflation rate will be less (Romer, 1993). He argues that countries that acquire restrictive policies are relatively closed may also

acquire other policies supporting specific interest groups; this could take to high budget deficits and higher inflation rate (Romer 1993, p. 885). Wynne and Kersting (2007) examined that there is significant inverse relationship between a country openness to trade across countries and its long run inflation rate in the United States.

Lane (1997) propounds that it is the existence of stringent nominal prices in the service sector and the presence of imperfect competition that cause indirect syndicate between openness-inflation. New Growth Theory acquiesces that openness probably decreases inflation via its direct effect on output (Jin, 2000). It is mostly through increased efficiency, effective mobilization of resources, improved capacity utilization and accretion in the foreign flow of capital that put up invigorate output growth and ameliorate the prices (Ashra, 2002). Openness benefits are also attached with some expenses. Small open economies whose most of the revenues are generated through tariffs, revenue tariff is sunk by curtailing trade hurdle, which results in lower rates of inflation (Cukierman *et al.* 1992). If tax duties are cut down, these economies will procure other tariffs in order to maintain the desired level of budget.

In contrast, opponents of trade openness argue that inflation enhances with liberalization. Evans (2012) concluded the positive effect of openness amalgamated with colossal equilibrium inflation rate. The fact is driven by imperfect competition that in international markets, monetary authorities hold monopoly power. The goods manufactured in the domestic country have some proportion of inelastic demand for international consumers. The monetary authority verdict is to balance the increased money supply openness benefits setting with the consumption tax costs of inflation. However, as the economy liberalizes fiscal and monetary authorities lose the power to curb inflation through policies of fiscal and monetary sources. Similarly, Batra (2001) argues that, at least in the US, tariffs do not necessarily cause inflation. Gruben and Mcleod (2004) among OECD economies array the existence of no significant openness-inflation homogeneity. Kim and Beladi (2005) tested positive analogy among trade openness and inflation for some advanced economies. Daniels and VanHoose (2007) considers the financial openness aspect that make an effect on the output inflation trade off ambiguous and depends on the parameter constellation. However, the relation between financial openness and inflation leftover an empirical question. In general capital mobility has a positive impact on the output inflation tradeoff, if nominal wage rigidity is imperative, interest rate trends of domestic and foreign asset demands is comparatively high,

interest rate sensitivity of desired domestic expenditures is comparatively large, and if required domestic spending is relatively insensitive to variations in the real exchange rate (Daniels and VanHoose, 2007, p. 9).

Economists generally consider tariffs restrictions to be inflationary and free trade to be deflationary. Empirically, several studies have investigated the openness-inflation effect and have jurisdicted inconclusive results. Some analysis has examined Romer hypothesis in distinct manner and have bolstered the accustomed aspect of the antagonistic effects of trade openness on inflation (Triffin and Grubel, 1962; Iyoha, 1973; Romer, 1993; Lane, 1997; Terra, 1998; Ashra, 2002; Sachsida et al. 2003; Gruben and Mcloed, 2004; Kim and Beladi 2005; Bowdler and Nunziata, 2006; Danials and Vanhoose, 2006; Hanif and Batool, 2006; Al Naseer et al. 2009; Badinger, 2009, 2010; Bowdler, 2009; Mukhtar, 2010; Afzal et al. 2013; Sikdar, 2013; Atabay, 2016). Others confirmed positive or even insignificant relationship (Batra, 2001; Alfaro, 2005; Daniels et al. 2005; Kim and Baladi, 2005; Tauci et al. 2009; Cooke, 2010; Zakaria, 2010; Evans, 2012; Thomas, 2012; Kurihara, 2013; Feleke, 2014; Haq et al. 2014; Ajaz, 2016).

1.3 Statement of Problem:

Inflation creates an ambivalent situation in the country and agonizes the poor as their market basket grievously decreases. A pivotal concern for policy makers perpetually as it may inadequately execute the economic growth. Hence the primary intention of macroeconomic policies is to sustain economic growth with lesser inflation. Trade openness syndicate with decreased prices is a distinct proposition in international trade shifting the world towards higher economic integration. During the early years, Pakistan strongly followed interventionist economic policy and later on turned toward liberalization and export promoting trade strategy. However, inflation has never sustained within the desirable demarcation in Pakistan. Most previous studies on the role of openness are normally cross-country analysis, in which mean of the variables for different economies is tested for the relationship between openness-inflation. Our work departs from previous research that we identify country specific differences. This research is an attempt to test the correlation of trade openness on inflation in Pakistan. The empirical work on trade openness-inflation in Pakistan is meager, which will be addressed in this study. The study will be helpful for the government to control inflation.

1.4 Significance of the study:

Inflation abysmally effects the economic growth and has been a perturbation for decision makers. It forges skepticism in the economy. In many developing countries like Pakistan, stable economic growth with low inflation has been the key to macroeconomic policies. The openness-inflation repercussions have intensified an important altercation. This study tries to fill this gap at a country level.

1.5 Objectives of the study:

The study will attempt to pursue the following objectives:

- To test the validity of Romer's Hypothesis in case of Pakistan i.e. the existence of a negative relationship between openness and inflation;

- To empirically determine the short run and long run dynamics between inflation and openness in Pakistan using time series macroeconomic data;

- To provide suggestions and policy recommendations on the basic findings of the study.

1.6 Hypothesis:

The null hypothesis (H_o) is to determine the presence of Romer's Hypothesis (the extent of a negative link between inflation and trade openness) in Pakistan and the alternative hypothesis (H_1) is otherwise.

H_o: There is no validity of Romer's Hypothesis in the case of Pakistan.

H_1: There is the validity of Romer's Hypothesis in relation to Pakistan.

1.7 Organization of the Study:

The study will be organized as follows. The first chapter will provide a broad background of trade openness and inflation, with a brief review of openness process and inflation in Pakistan. The theoretical and empirical review, will be discussed in chapter 2. The methodology undertaken will be addressed in chapter 3. The discussion on estimated results will be presented in chapter 4. Finally, chapter 5 will conclude the study.

Chapter 2: Literature Review

Kenneth Rogoff has argued that globalization interacting with deregulation and privatization has played a strong supporting role in the past decade disinflation (Rogoff, 2003), which has reduced global inflation from 30% in the early 1990s down to some 4% today. In fact, since the influential paper by Romer (1993) there is growing manifestation that more trade openness and financial openness are linked with lower inflation. Cavelaars (2009) argues that increased competition may in fact fragile monetary policy discipline, since expenditure switching policies become more forceful as competition intensifies. However, it is an unsettled acknowledgement through which globalization affects inflation. Yet, the inception of this relationship make it a contemporary puzzle. The advantage of outward looking policies to apprehend the feasible benefits of international trade and capital flows are discussed in the literature.

2.1 Openness and Inflation Puzzle: Analysis of OECD Countries:

Cavallari (2001) investigates the effect of trade openness on inflation, across 19 OECD countries[1] in a strategic design by monopolistic production in the domestic sector and unionized labor markets. The results manifest that to a critical extent of trade openness economies have a lesser inflationary bias, above this point more openness in countries with a transitional degree of unionization[2] cause higher inflation.

Boschen and Weise (2003) model the probability of 73 episodes of inflation start in OECD economies since 1960s during a period of either stable or declining inflation. The findings show that three components provoke sustained inflation to trigger. First pursuit of high real GDP growth by policy makers, an attempt to exploit short term Philips curve precipitate the probability of an inflation start. Second world economies ensue US inflation policy concerning their exchange rate stability. The gap in US inflation and domestic inflation, i.e. inflation shocks in the world strongest economy contributed to highly propagate an inflation start. Third, if a general election takes place in a particular year, there is a high chance of an inflation episode in that year. The empirical

[1] OECD economies are: AU, AUS, BE, CA, DK, FI, FR, GE, IT, JA, NE, NO, NZ, PO, SP, SW, SWI, UK, US.
[2] Measured by the index CEN. The measure CEN assign score 1 to predominately decentralized wage setting economies, score 2 to intermediate and score 3 to centralized wage setting economies.

findings for other probable factors, oil and food price crisis, pegged exchange rate regime, fiscal and economic policy, transition in political adaptation, and an increase in the natural rate of unemployment do not exhibit a robust correlation to instigate an inflation start.

Bowdler and Nunziata (2006) comprehend Boschen and Weise (2003) study and contemplate the negative relation between trade openness and the probability of an inflation start using data from 19 OECD countries[3] for the period 1961-93. The findings of probit regressions empirically support that high openness is likelihood to reduce the inflation start[4] even after controlling variables, i.e. restraining the role of the general election both directly and indirectly in prompting inflation to start.

Pehnelt (2007) explores the effect of globalization-inflation nexus in 22 OECD countries[5] from 1980 to 2005 using panel technique with fixed effects. The study consists of various means by which globalization can alter dynamics of inflation. The simple inflation model consists annual inflation rate in a country based on the consumer price index[6], the difference between a country's actual and potential gross domestic product i.e. domestic output gap and a vector of different control variables such as a change in the unemployment rate, or change of the nominal effective exchange rate[7]. The findings of simple inflation model support that the effect of the domestic output gap on inflation has declined during the last 25 years. The national unemployment played a significant role in determining inflation in the early 1990s and seems to be relevant in recent years too. The relationship between exchange rate fluctuation and inflation rates seems to be rather negligible. The second model contains trend inflation[8] as a dependent variable, domestic output gap, foreign output gap[9] and the product of the foreign output gap and the import penetration as explanatory variables. Regression results of second model support the hypothesis that the effect of the foreign output gap has increased. The third model introduces two measures of globalization,

[3] Sample include the following economies. Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Sweden, Spain, Switzerland, the UK and the US.
[4] Data on Inflation start were taken from Boschen and Weise (2003).
[5] Sample Includes: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and the US.
[6] CPI contains the changes by households in the prices of expenditures.
[7] Used changes in the value add tax (VAT) and the trade to GDP ratio as controlled variables.
[8] A country trend inflation is approximated by Hodrick-Prescott filter of annual inflation between 1980-2005.
[9] Foreign output gap is the trade weighted gap of at least the five trading partners of the country under observation.

index of economic freedom of the world[10], KOF Index of globalization[11] along with the change in the national unemployment rate and the measure for the exchange rate fluctuations. The results of the third model confirm the significant relationship between a change of the natural rate of unemployment along with the both proxies for the level of globalization in the 1990s. It supports the hypothesis that the high degree of globalization is associated with low inflation rates in the 1990s. The fourth model incorporates GDP deflator instead of relative inflation to analyze the indirect effect of globalization on inflation dynamics. The results showed that the foreign output gap, unemployment rate, economic freedom and the degree of globalization contributed to disinflation in OECD countries in the 1990s. The final model incorporates central bank independence[12] and shows weak robustness associated with lower inflation rates. The panel regression of the final model for the whole period 1980-2005 confirm the globalization effect as great part of the variance of inflation rates in OECD countries was explained by the foreign output gap and the degree of globalization (KOF). The changing national unemployment rates affect inflation, but do not find support for a strong labor market effect of globalization. Furthermore, the exchange rate has an impact on inflation rate but the effect is week.

2.2 Openness and Inflation Puzzle: Single Country Analysis:

- **South Korea**

Jin (2006) examined the effects of rising openness on output growth rate and price level for the South Korean economy before the economic crisis of 1997/1998. The vector autoregressive model was employed consisting of seven variables. Real gross domestic product as real output, GDP deflator as the price level, money supply M1 as monetary policy variable, real government expenditure, deflated by the GDP deflator as fiscal policy measure, industrial production index of industrialized countries as a proxy for foreign output shocks, world commodity price index of all exports for foreign price shocks and imports to GDP ratio as a proxy for openness level. Variance

[10] Annual survey published by the Fraser Institute.
[11] Calculated and published by Konjunkturforschungsstelle of ETH Zurich.
[12] See Cukierman et al. (1992).

decomposition computation (VDCs)[13] and impulse response function (IRFs)[14] applications were used to examine changes in openness on the output growth rate and the price level. The impulse response functions showed that shock to openness has a negative effect on growth rate and on the price level but no long run effects. The variance decompositions result also found to be significant on these variables.

- **Turkey**

Atabay (2016) using the OLS method examined openness-inflation relationship for Turkey over the period 1980-2011 The model contains trade openness, GDP per capita, real exchange rate, election and the crisis as controlled variables while implemented GDP deflator as a proxy for inflation as the dependent variable. The result showed negative nexus between openness and inflation, while the effect of crisis and election used as dummy variables found to be statistically insignificant.

- **Iran**

Samimi et al (2011) examined the openness and inflation nexus in Iran employing a bound test approach within the autoregressive distributive lag ARDL model during the period 1973-2009. The empirical findings of the model taking inflation rate as dependent variable while money growth, government size, openness and GDP per capita as explanatory variables showed that in the short run openness has an inverse effect on inflation however, in the long run the effect is not significant.

Salimifar et al (2015) examined the short run and long run correlation between trade openness and inflation for Iran using ARDL approach covering the period 1973-2010. Considering the Iranian economy is reliant on income from oil and have an influence on inflation, non-oil trade openness has been employed in the study. The results showed that non-oil openness has significant negative

[13] The variance decomposition indicates the amount of information each variable contributes to the other variables in the vector autoregressive models. It determines how much of the forecast error variance of each of the variable can be explained by exogenous shocks to the other variables.

[14] Impulse response function shows the effects of shocks on the adjustment path of the variables. It shows how an unexpected change in one variable at the beginning affects another variable with the passage of time. In time series analysis, it is important in determining the effects of external shocks on the variables of the system.

impact on inflation, while other explanatory variables, i.e. growth of liquidity, exchange rate have a positive effect and output gap has a negative effect on inflation.

- **Bangladesh**

Sikdar et al (2013) employed a single equation model to examine openness-inflation association for Bangladesh during the period 1976-2010, with inflation as an endogenous variable while real exchange rate, real GDP, trade openness, money supply and financial market openness as an exogenous variable. The empirical analysis showed that there is a robust negative long run nexus between openness and inflation in Bangladesh.

- **Ethiopia**

Feleke (2014) using annual time series data over the period 1970-2011 by applying ARDL approach investigated openness-inflation association for Ethiopia and indicated that trade openness effect on decreasing inflation is insignificant in both the long run and in the short run.

- **Sri Lanka**

Haq et al (2014) testified Romers (1993) hypothesis for Sri Lanka. The paper employs time series data on openness and inflation from 1968 to 2010 taking economic growth, supply of money and openness as explanatory variables. The empirical findings showed that economic growth, money supply and openness have a positive effect on inflation and hence refutes the existence of Romers hypothesis for Sri Lanka. The authors concluded that trade openness may trigger inflation, but has a positive impact on economic growth recommending that the Sri Lankan government should be very cautious in designing policies concerning money supply and openness as it affects consumers.

- **India**

Ajaz et al (2016) investigated the correlation between openness and inflation in the milieu of India during the time period 1970-2014. The authors use the nonlinear framework by employing a NARDL cointegration approach. The empirical findings both in short run as well in long run exhibit the asymmetrical link between openness-inflation. The whole sale price index (WPI) was used as a proxy for inflation and trade, including import plus exports as a percentage of GDP as a

proxy for openness. The other controlled variables determining steady state inflation include GDP per capita and exchange rate. The results viewed positive though a weak relationship between openness and inflation and thus contradicts the renowned Romer's (1993) Hypothesis that inflation reduces with openness. Furthermore, the study showed a positive significant relation of inflation with other variables, i.e. per capita income and exchange rate. The authors conclude that the inclusive behavior of inflation towards the positive and negative variations in explanatory variables shows the existence of price sickness in the Indian market.

- **Pakistan**

Hanif and Batool (2006) examined the hypothesis that inflation[15] is lesser in small and liberalized countries for the Pakistan economy using the annual time series data over the period 1973-2005. They inspect that increase in openness variable such as the aggregate trade to GDP[16] ratio also has a robust inverse effect on the rise of the domestic price level in Pakistan.

Ahmad and Shahbaz (2007) assessed the openness-inflation puzzle considering openness as an economic safety for Pakistan or not, both in the short run as well in the long run covering the period 1971-2006. They apply two advanced approaches[17]. Johansen co-integration and ARDL bounds testing to examine the validity of openness-inflation correlation in the long run and Error Correction Method (ECM) for short run dynamics. The findings showed export growth and real GDP per capita both in the short and long run decreases inflation, while imports reveal a positive link with inflation in both time periods. The money supply rises price level in the long run while exchange rate implies that deprecation in the value of money raises demand for money creation triggering inflation in the economy. The authors deduce that trade liberalization is robustness as a safety measure for a small developing economy like Pakistan.

Mukhtar (2010) analyzes the openness and inflation tradeoff for Pakistan by applying multivariate cointegration approach and vector error correction model over the period 1960-2007. The empirical findings on the budget deficit, gross domestic product, trade openness, exchange rate, and inflation under the cointegration test showed that there is a robust negative long-run

[15] Consumer Price Index (CPI) as a proxy for Inflation.
[16] Sum of exports and imports divided by GDP as a proxy for Openness.
[17] Used log linear model specification.

relationship between inflation and trade openness which validate the pertinence of Romer's hypothesis for Pakistan.

Zakaria (2010) conducted an annual time series analysis of data from 1947-2007 to explore the trade openness and inflation correlation for Pakistan. The empirical analysis employing Generalized Methods of Moments (GMM) taking inflation rate as explained variable while controlled variables, openness[18], money supply, fiscal deficit, exchange rate, foreign inflation, foreign debt, democracy[19] and terms of trade[20], showed that a positive linkage holds between openness in trade and inflation in Pakistan. The author argues that in highly open economies conversion of domestic currency into foreign currency is very easy that will cause an inflation to decrease.

Afzal et al (2013) applied ARDL method to cointegration to test the validity of the Romer's hypothesis in the trivariate analysis using annual time series data for Pakistan from 1970 to 2008. The authors consider three proxies for openness, i.e. export to GDP ratio, import to GDP ratio and trade to GDP ratio. Their findings contemplated bidirectional causality between openness-inflation and examined more robust negative correlation between them in the short run as compared to the long run. There was a positive relationship between economic growth and inflation and which appears to support the Phillips curve and Okun's law. The authors concluded that economic policy makers of Pakistan should adopt outward looking policies to control inflation and accelerate economic growth.

2.3 Openness and Inflation Puzzle: Analysis of East Asian Economies:

Jin (2000) in his study of East Asian economies[21] indicates openness as a significant variable for growth, but his analysis using vector actor regression (VAR) model[22] based on time series data reveals fiscal policy and foreign price shock as a more important variable for growth.

[18] Total trade share in GDP.
[19] Proxied by Polity2 score. Polity2 is an index ranging from -10 (full autocracy) to +10 (complete democracy).
[20] Ratio of exports prices to import prices.
[21] East Asian Economies include: Korea, Japan, Philippines, Thailand, Malaysia, and Singapore.
[22] Five variable vector autoregressive model consisting of real output, money supply, real government spending, foreign price shocks, and openness measures.

Furuoka and Mun Ho (2009) analyze the relationship between Phillips curve and openness from 1980 to 2005 for three Asian economics, Japan, South Korea and Malaysia with varied level of openness. OLS result shows as an economy liberalized to the world market by raising the quantity of imports, the slope parameter of the Philips curve turns shorter. The findings indicate that in high open economies Philips curve incline to be flatter.

Kurihara (2013) using panel data for Asian and OECD countries covering the period from 1990 to 2011 examined the linkage between international trade openness and inflation. Generalized Methods of Moments (GMM) and fixed effect models results showed a significant positive effects of trade liberalization on inflation. The strength of the correlation was robust in Asia region than the OECD countries.

2.4 Openness and Inflation Puzzle: Developed and Developing Countries:

Iyoha (1973) analyzed openness and inflation relationship of 33 less developed countries for both yearly and 5 years averaged data from 1960-1 to 1964-5 through ordinary least squares estimation. He found a negative relationship between inflation and openness measured by the import income ratio in a simple bivariate framework. The negative relationship implied that outward-looking trade policy will encourage total capital accumulation by decreasing inflation resulting in enhancing the domestic capital accumulation.

Kirkpatrick and Nixon (1977) commented on the paper by Iyoha (1973) and argued that import restrictions could deteriorate the inflationary situation causing to increase. They view that to substantiate the openness and inflation relationship the composition of imports needs to be examined and more authenticate measures of openness are required for a profound interpretation of the issues employed.

Alfaro (2005) tested panel data of 148 developed and developing countries from 1973-1998 and present regression analysis through fixed exchange rate and time fixed effects[23] to explore openness and inflation relationship. The finding shows that in the short run pegged exchange

[23] The fixed effect model is effectively more suitable than a random effects model for macro datasets. Most macro datasets tend to comprise most of the countries of interest as contrary to be a random sample from a larger universe. Moreover, Hausman specification tests comparing the fixed effect specifications with the random effect models the rejected the assumptions required for random effects.

regime serves to restrict inflation, while openness is non-significant in limiting inflation. She argues that the negative correlation of openness-inflation is possibly induced by the impact of the fixed exchange rate regime. Real exchange rate disparages more while the economy is open, hence decreasing incentives for inflation to proliferate.

Granato et al (2007) empirical findings contemplate the association between monetary policy and economic liberalization on a data sample of 15 developed countries[24] and support Romer's (1993) hypothesis. Their examination explicates why openness and inflation puzzle can be ambivalent through the nexus of outward looking trade strategy to the slopes of aggregate supply (AS) and aggregate Demand (AD). Their results manifest that more outward-looking economies acquire high tradeoff between inflation-output (a steeper AS). Moreover, policymakers in more open economies are robust to fluctuations in target inflation and thus exhort a flatter AD curve. Their empirical outcomes encourage their theoretical findings and expound the recent empirical failure to find the negative openness-inflation relation.

Tauci et al (2009) analyzes panel study of openness-inflation tradeoff in selected developing countries by using cross-sectional time series data during the period 1980-2006. The model contains nominal exchange rate, openness to foreign trade, foreign direct investment, GDP per capita, as explanatory variables while inflation an independent variable. The empirical findings of panel data models showed that openness and GDP per capita have a positive impact on inflation.

Samini et al (2012) employed the panel data technique to examine the Romer (1993) hypothesis that is inflation is lower in open economies for developed and developing countries over the last two decades 1990-1999 and 2000-2009. They delineate negative openness-inflation nexus is delicate to globalization measure, for which the authors imply the new economic globalization measure (the KOF Index) a better proxy for openness. The paper results indicated a significant positive relationship between trade openness and inflation which, contrast the prospect of the Romer (1993) hypothesis. However, the results concerning the new globalization index supports the hypothesis prompting that higher economic globalization will lower inflation.

[24] Sample countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

2.5 Openness and Inflation Puzzle: Cross Country Analysis:

Triffin and Grubel (1962) examined that openness conduces lower inflation by using data from 5 European Community countries. They concluded that openness acted as a safety wall and spillover inflationary burden on the balance of payments but for a short time period.

Rogoff (1985) proposed that government regime with autonomous control of monetary policy could acquire lower time consistent inflation rates than central bank regulation in which they cooperate. He intended that increased inflation takes an additional cost and the optimum level adopted by monetary authorities remained lesser as the deteriorating effect of the exchange rate increases. He found a negative relation among openness-inflation, which becomes fragile in politically precarious economies with sovereign central banks[25].

Romer (1993) contemplated a hypothesis of a negative correlation between trade openness and inflation. He examined the hypothesis for cross-sectional data of 114 economies over the Post-Bretton Woods period[26]. He assesses that unanticipated monetary expansion[27] depreciates real exchange rate, which increases production cost in more open economies, so monetary authorities will expand less and the outcome will be the lesser inflation rate. He concluded that in countries with more central bank reliance[28] there is a vigorous negative correlation between openness and inflation.

Lane (1997) envisage alternative transmission that is the existence of imperfect competition and the presence of price rigidity in the non-traded sector[29] that leads inverse relationship between openness and inflation. When country size is comprised as a control variable he empirically finds that openness-inflation is inversely related even for countries that exhibit terms of trade effect.

[25] Dynamic inconsistency of monetary policy depends on the model of closed economies.
[26] Romer (1993) the post-Bretton Woods Pre-Euro period dispense more desirable milieu for testing the dynamic inconsistency problem of discretionary monetary policy in open economies.
[27] In theoretical models for open economies, monetary expansion conduces to real currency depreciations, lowering the benefits in terms of product, of an inflationary surprise.
[28] See Cukierman (1992).
[29] Lane (1997) introduce different model compatible with the idea in which domestically produced traded goods are perfect substitutes for foreign goods, but which maintain the Romer intimation that the gains to a surprise monetary expansion are decreasing in openness.

Terra (1998) empirical findings, applying regression for 114 countries which were alienated into 4 syndicates of countries according to indebtedness level marginally bolster Romer's argument by affirming that the negative link between openness[30] and inflation[31] is only apparent in heavily indebted countries[32] during the 1980s-debt crisis period.

Bleaney (1999) stipulates correlation of openness-inflation for over 100 countries from 1973-88 and 1989-98 and reckon that the robust inverse relation between openness and inflation emanated only during the 1970s and 1980s and has vanished in the 1990s. In 1989-98 high-income economies attaining disinflation there was a robust negative relationship between per capita GDP and inflation, despite it was week in 1973-88. The correlation between land area and inflation was positive and it was predicted that a shift from fixed exchange regime[33] to floating exchange regime in both periods adds at least 10 percent to country's inflation rate.

Batra (2001) in his paper disputes with the perspective that tariffs are inflationary and free trade to be deflationary. He argues that protectionism in the US never consorted with higher price level and trade openness with the lower price level. He derived a theoretical model to delineate the chronicle shift in tariff and consumer price index between 1800 and 1995 and elucidate that sharp tariffs invariably concur with reducing prices moreover lower tariffs were consistently followed by enhancing living costs.

Temple (2002) attempts to evince a linkage between trade openness and the slope of the Phillips curve. Openness in small outward looking economic paradigm with price stickiness is likely allied to the slope of the Phillips curve. Nevertheless, he didn't obtain strong indications that fortify the connection between openness and the standard measures of the output-inflation trade-off.

Sachida et al (2003) analyzed data constituting 152 countries for the period 1950 to 1992 using fixed and random effects model to test the proposition of Romer's findings (1993) using panel unit

[30] The ration between imports and GDP was used as a proxy for openness.
[31] Inflation was measured as the annual change in the logarithm of the GDP deflator.
[32] The categorization taken was the one in the World Bank Development Report, 1993, p.328-329, using customary World Bank definitions of degree of indebtedness averaged over three years (1989-1991). High income countries which did not have a debt problem, were not classified according to indebtedness level, and the group" all other countries" was created for them.
[33] Because of the transformation of the dependent variable, the effect is estimated to be higher at higher inflation rates.

root test. The author affirms the negative relationship between openness and inflation, but illustrates that this correlation is neither explicit to a group of countries nor specific time span.

Gruben and McLeod (2004) applied dynamic panel framework[34] comprising five-year average for inflation and import share for the time period 1971-2000. The author's findings support the sentiment that trade openness is consorting with lower inflation and shows in 1990's interdependence over whole country groups strengthened. The openness-inflation correlation aside through 1980's was robust in less indebted countries contradicting the (Terra, 1998) hypothesis. After 1985, the more trade open economies tend to have less inflation volatility. He concludes that openness-inflation relationship becomes stronger in the 1990's[35]. The slowing down of inflation rate was stronger in economies with floating exchange rates.

Daniels et al (2005) considering the degree of central bank independence manipulating ball data set examined that trade openness has a robust positive impact on the output-inflation trade off. Their findings contradict with the negative relationship between openness and inflation proposed by Romer (1993) and Lane (1997). In their models, equilibrium inflation, would increase when larger output-inflation tradeoff is implied. Their results find that greater central bank independence increases the sacrifice ratio[36].

Kim and Beladi (2005) investigate the trade openness and inflation relationship for 62 countries[37]. They analyze whether or not the inverse relationship between openness-inflation is robust in countries with more degree of central bank dependency. The panel analysis for certain advanced economies[38] such as the US[39], Belgium, and Ireland displays a positive correlation between trade

[34] The focus here is mainly on the bivariate inflation and openness relationship following Terra (1998). The results are robust to the addition of structural variables such as per capita income, latitude, total PPP GDP (size) and regional dummies. See Lane (1997). However, many of the variables used in these cross-country regressions are not available in time series or for the 1990s (Central bank independence measures for example).

[35] Between the late 1980s and the late 1990s, the weighted average import share for the 118 countries in the sample rose from 19% to 24% of GDP while the weighted average inflation rate fell from 70% to 5%.

[36] Sacrifice ratio ($u + \pi$ = Unemployment + Inflation) is the cost associated with the slowing down in economic output due to fluctuation in inflationary trends.

[37] The 62 countries include 28 OECD and 34 developing countries and are chosen based on the index of the central bank interdependency presented by Romer (1993).

[38] The 13 advanced countries Denmark, Finland, France, Honduras, Hungary, Indonesia, Italy, Japan, Mexico, New Zealand, Sweden, Turkey and United Kingdom also showed positive correlation between openness and inflation though not significant.

[39] The authors explained this in terms of a large enough wage differential between the protected sector may be the skilled labor-intensive sector where the wage rate is not lower than the other sectors (say agricultural sector)

openness and inflation. The findings for most developing economies depicts that protectionism probably causes inflationary bias indicating a negative correlation between free trade and price level. The authors interpret that central bank dependency either high or less is not crucial in expressing either positive or negative correlation between price level and openness.

Daniels and VanHoose (2006) considered new Keynesian model by instituting price or wage stickiness and imperfect competition. They put the time inconsistency framework into multisector, imperfectly competitive, liberalized economy model in which nominal wages are determined prior to price and output affirmation and illustrate that high trade openness raises the output-inflation trade off yet receding the inflationary bias. Furthermore, the high trade openness raises demand for imported goods and thus initiates more inflation.

Al Nasser et al (2009) revised the evidence correlating trade openness and inflation for 152 countries for the period 1950-1992 with a panel data methodology. Their empirical results persist Romers (1993) argument and were robust for distinct specifications and time periods. The author's findings also repudiate Terra's (1998) critique that the inverse relationship between openness and inflation is due to critically indebted countries in the debt crisis period. Their paper proposed that models with the lack of a pre-commitment in monetary policy, cause to ineffectively high inflation, which is an imperative indicator that high open economies ought to have lesser inflation rates.

Badinger (2009) inclusively analyze globalization and inflation relationship measured in terms of trade and financial openness using cross sectional data of 91 countries from 1985-2004. He institutes two empirical regularities both high trade and financial openness. The first empirical model relates inflation to openness - trade openness, financial market openness or both and country size measured in terms of population and area and control variables (central bank dependency, political instability, to account for institutional environment and real GDP per worker as an indicator of economic development which might capture a variety of factors affecting inflation) with 2SLS. The second empirical model relates output-inflation trade off [40] to openness again trade or financial openness and country size and control variables (mean inflation and the variability of aggregate demand). The authors findings indicated that countries with high openness to trade and

[40] Since the author do not focus on disinflation periods only, he uses the term 'output-inflation tradeoff' rather than 'sacrifice ratio' ($u + \pi$) throughout the paper.

financial openness and reduced central bank interdependency yield lesser inflation rates and higher output-inflation tradeoff. Another important result was that the openness and inflation does not hold robust relation for the sub sample of 25 OECD countries, using data up to the end of 1980s, manifesting that highly developed countries for the mid has been successful in establishing a structure for central banks[41] that eliminated distortions due to time inconsistency problems for the mid-1980s.

Bowdler (2009) examined the Philips curve slope and found a negative effect of openness on the sacrifice ratio using data from 41 countries over the period 1981-1998. The author analysis suggests that trade openness and sacrifice ratio relationship depend on the type of exchange rate regime. The empirical evidence indicates countries controlling floating exchange rate regimes[42], amongst them Philips curve slope increases with trade openness, however, openness has a weak impact amongst countries controlling fixed exchange rate regimes.

Badinger (2010) in his article affirm globalization has been a vital aspect in deceleration of the global inflation rate, conducing policy makers to be more assertive in controlling inflation. He analyzes Taylor rule for 83 countries over the period 1985-2004 in a simple cross section model[43] linking the short-term interest rate[44] to real GDP growth and actual inflation. He considered real GDP growth as a proxy for economic activity because of lack of data on potential output for most of the countries. To determine cross country disparity, he first estimates the Taylor rule separately for each country due to unavailability of target inflation for most countries. He found that the output gap is negatively related to trade and financial openness of the economy.

[41] An alternative explanation consistent with Bowdler (2009), is that there has been a shift in the nature of the policy environment faced by central banks of these countries during this most recent period, in particular an increased reliance on floating exchange rate regimes and a more important role of monetary contradictions in anti-inflation strategies. This might have induced a negative effect between openness and the output-inflation tradeoff, offsetting the positive microeconomic effects emphasized by Daniels el al. (2005).

[42] Openness and Philips curve relationship is still possible when the exchange rate is fixed. The point here is that it is likely to be less strong than if the exchange rate were flexible, other things equal.

[43] Leaving the estimates unrestricted produces negative coefficients for β_1 or β_2 for several countries. This was resolved by respecifying the Taylor rule (using a dynamic variant or alternative lag structures), but the estimates from such country specific rules are very difficult to compare. Thus, a common approach was applied to all countries.

[44] As short-term interest rate used the discount rate provided in the UN common Database (UNCDB). For some countries (CHL, GBR, MYS, SLV, MDG, GTM) the data were supplemented using short term interest rates from the International Financial Statistics (IFS) and the Economist Intelligence Unit (EIU) database.

Cooke (2010) designed a two-country general equilibrium model to examine under discretion the optimum rate of inflation. He evinces that when monopoly markup is pertinent in terms of trade a high openness could maneuver a policy maker more sharply to exploit the short-run Phillips curve yet if it implicates little short-run gain. When agent's welfare maximization is the exclusive target policy author argues it plausible to explain that no negative openness-inflation correlation exhibits.

Lin (2010) investigated the openness and inflation relationship through the analysis of panel data[45] for 106 countries (including 58 countries in debt crisis in 1980) over the period 1970 to 2007. Lin found that there is an indirect effect of trade openness on inflation when inflation is higher but no effect when inflation is lower. The evidence was robust when controlled for an exchange rate regime and for indebted countries.

Evans (2012) proposes a long run study of hypothetical dynamics by formulating a two country overlapping generations model (OLG) arguing that high openness to international trade can have a positive effect that can allow to increase a country incentive to trigger inflation. The model predicts that the inflationary bias of openness was reduced by the level of imperfect competition in the country. The higher imperfect competition would have an inverse impact on equilibrium inflation and country's optimal inflation rate rises with the elasticity of labor supply.

Lartey (2012) analyzes responsiveness of inflation in non-traded goods to financial openness. The findings showed that non-tradeable inflation is highly sensitive under high level of openness in an economy and that the optimal monetary policy deviates with the level of openness. The author concluded when monetary policy is implemented optimally welfare progress with openness.

Thomas (2012) study the openness-inflation correlation for 8 Caribbean countries over the period 1980-2009. The findings exhibit a positive relationship between trade openness and inflation and authenticate the belief that Caribbean countries are at risk to external shocks. Furthermore, the empirical findings indicate that increase in per capita income and high fiscal deficits consequence in rising inflation rate.

[45] Inflation is measured by the GDP deflator, the share of imports as a percentage of GDP for trade openness measures and the growth rate of GDP per capita was used to control country size.

Gosh (2014) tested how inflation is influenced by three aspects of country outward looking linkages i.e. trade openness, financial openness and exchange rate regime. The study examines the effect of openness on inflation considering central banks time inconsistency problem an important issue for monetary policy makers. The author analyzes the impact of openness and exchange rate on inflation for 137 countries from 1999-2012 by developing de jure and de facto standards of capital openness and exchange rate regimes. The results showed more capital account openness as well as a shift towards a fixed exchange regime lowers the inflation rate. Nevertheless, there was no obvious manifestation of the robust inverse effect of inflation on openness, but for countries with less trade openness and high inflation rates.

The above discussion shows that most of the reviewed studies on the macroeconomic policy of openness have focused upon the analysis of cross country averages of many developed as well as developing economies. The focus on the dynamics of this relation to capture country specific nuances is meager. The cross-sectional estimations are appropriate to investigate the long run association between openness and inflation, nevertheless these studies cannot explore individual country difference.

Moreover, the impact of openness of one economy cannot be generalized to other economies of similar nature as each country may have their own trade policies and socio-economic factors quite different to each other. It is therefore imperative to study the effect of openness on a country to country basis. There are studies which have focused on the openness-inflation puzzle at a country level but little has been done in the context of Pakistan. The existing literature for Pakistan in this regard mostly find negative relationship between openness and inflation (Hanif and Batool, 2006, Ahmad and Shahbaz, 2007, Mukhtar, 2010, Afzal et al. 2013) except (Zakaria, 2010). Therefore, there is a need for some fresh evidences in the backdrop of openness and inflation relationship in case of Pakistan.

Chapter 3: Data, Modelling and Methodological Framework

The present study seeks to test the validity of Romer hypothesis and examines the dynamic relationship between openness and inflation for the Pakistan economy. Inflation is a bewildered phenomenon and is affected by many other important variables which must be included in the openness-inflation model to avoid the specification biasedness of the results in the openness-inflation relationship.

To assess the effect of openness on inflation the variables used in the study are consumer price index (CPI), real GDP per capita (Y), openness measure (TO), real effective exchange rate (ER), the broadly defined money supply (M2), government expenditure (G), import prices (IMPR), and financial market openness (FMO). In order to increase our understanding of the impact of trade openness on inflation for Pakistan economy we used five different models to examine the factors that determine the price level in Pakistan. The model one is designed on theory of aggregate demand and aggregate supply in which variables monetary policy (M2) and fiscal policy (G) can affect macroeconomic activities (Y, CPI, and TO). The rest of the models are built on the economic theory in which monetary and fiscal policy variables (M2 and G) may cause appreciation or depreciation of foreign exchange which would increase or decrease imports and exports and thus import + exports/GDP ratio which is our openness measure (TO) and financial market openness (FMO). We specify are regression models keeping in view the determinants with special emphasis to the impact of trade openness on inflation in Pakistan. The subsequent paragraphs argue the correspondence of each control variable included in the models.

$$CPI_t = (Y_t, TO_{t,} M2_t, G_t) \quad (1)$$

$$CPI_t = (Y_t, TO_{t,} M2_t, IMPR_t) \quad (2)$$

$$CPI_t = (Y_t, TO_{t,} ER_t, FMO_t) \quad (3)$$

$$CPI_t = (Y_t, TO_{t,} M2_t, FMO_t) \quad (4)$$

$$CPI_t = (M2_t, TO_{t,} G_t, IMPR_t) \quad (5)$$

Openness measured by total trade as a ratio to GDP reflects to what extent an economic activity is linked to the rest of the world. Openness effects positively economic growth through several channels like exposure to newly developed ideas, advanced technology, a platform for high access to the variety of inputs for production, and foreign market entry for domestically manufactured goods. This is particularly important for developing countries, as the rate at which they can trade and implement new technologies is central to their growth. Output growth shows the extent level of an economic growth of a country and is an important determinant of openness-inflation trade off. In their study of OECD economies, Boschen and Weise (2003) showed that policy makers target of high real GDP growth triggers an inflation to start while, Pehnelt (2007) indicated that output gap of the major trading partner is imperative in determining national inflation rates. Similarly, Afzal et (2013) for Pakistan found a positive effect of increasing openness on economic growth and negative price effect of openness. Following, Fisher (1993) growth is negatively linked to high inflation. He argues high inflation generates ambiguity which decreases the incentive for investment and thus growth. The volume of trade may be increased only due to increase in imports. An economy with more openness can easily adopt newly innovative ideas and equipment's from the rest of the world rather than an economy with strict trade regimes. It is particularly important for Pakistan, as the rate at which they can trade and implement the new technologies is central to its growth.

Romer (1993) propounds that high trade openness pretence to lower inflation. This hypothesis is well supported by empirical evidence that greater trade openness exhibits a robust negative effect on inflation across countries (Lane, 1997; Terra 1998; Badinger, 2009, 2010 and Afzal et al, 2013 see among others). Bowlder and Nunziata (2006) explored that high openness lower the chances of inflation in OECD economies. Moreover, Samimi et al. (2012) implying a new globalization measure showed a positive correlation of trade openness with inflation and revealed that more openness to trade actually raises inflation. This was found by Zakaria (2010) for the Pakistan economy. The expectations regarding inflation are based upon government trade restrictive or openness measures which contribute to inflation.

The effect of trade openness and inflation on exchange rate cannot be attained one without achieving the other; hence there is a certain relationship between them. Alfaro (2005) study analyzes that openness does not significantly restrict inflation in the short run rather fixed exchange rate plays a significant role. Furthermore, Bleaney and Francisco (2007) finds robust correlation between exchange rate volatility and trade openness and conclude that countries with higher openness will have lower volatility of real effective exchange rate. Bowdler (2009) recommends that relationship between trade openness and sacrifice ratio depends on the type of exchange rate. His empirical analysis shows that Phillips curve slope increases with openness in countries with floating exchange rate regime rather that countries controlling with fixed exchange rate regime. From the last three decades, the exchange rate of Pakistan was continuously depreciating except in the early 2000s. The gradual depreciation of the Pakistani currency implicates, the diminish value of rupee against dollar putting further hike to imports costly. Thus, we put real effective exchange rate into the openness-inflation regression.

Most of the theoretical and empirical research argue inflation is a monetary phenomenon and links the price fluctuation to monetary policy particularly to money supply. Economic theory suggests that the effects of monetary policy on output and the price level depend on the openness of the economy. In particular, the ability of money towards the inflationary effects of changes in the money supply increase with openness with effects of a given change in the money supply (Romer, 1993, Karras, 1999, Daniels et al. 2005, Daniels and VanHoose, 2006, Granato et al. 2007, Badinger, 2009). Thus, increase in money supply coefficient is expected to positively link with inflation.

The most recent economic theories in determining price level says that price level is not independently determined by monetary authorities but rather the result of interdependence of fiscal and monetary policies. Although money supply is not autonomously determined by the central banks rather it is the financial requirements of the fiscal authorities that induce more money supply. Moreover, developing countries like Pakistan who are involved in debt servicing the new debt issue internally or borrowing from an external source stands a low chance and is very costly. In most of the developing countries like Pakistan the fiscal authorities finance their deficit by printing more money through central bank as the other source of financing like imposition of tax have political cost and are not easy to implement. Hence central bank is not autonomous in forming

monetary policy due to fiscal deficit of the government. The high fiscal deficits have caused inflation in Pakistan economy and these deficits are unsustainable and is more of a fiscal phenomenon.

In Pakistan, due to fiscal consolidation and relative ease of financing by seigniorage, the fiscal position of government is another determinant of inflation. It is the consumption component of government expenditure that leads to fiscal deficit growth in the long run while the investment expenditures are more sustainable in the long run. The fiscal policy impact on inflation is important in case of developing countries because it is predominantly recognized that the developing countries have less efficient tax collection, political instability, and restricted access to external borrowing (Cukierman et al. 1992). Fiscal authorities attempt to persuade intertemporal budget constraints and therefore in the progression promote inflation. The price level is mostly influenced by fiscal budget positions in fiscal dominant regimes. Specially Jalil et al. (2014) tested the fiscal theory of price level for Pakistan and shows that fiscal deficit has a positive impact on inflation considering it a major determinant of the price level. Thus, we expect government expenditure to affect openness and inflation.

Pakistan imports largely consists of food, machinery and energy related goods which have observed increased prices over the several years. This has resulted in an imported inflation issue and more expansion of trade has caused inflation. Therefore, the import prices are an important factor which may predict the level of inflation because Pakistan is a net importer country.

When countries begin to liberalize in foreign markets, foreign direct investment (FDI) will be encouraged from aboard. Niroomand et al. (2014) empirically shown that financial market development including the stock market and the banking sector in emerging economies has robust effect on trade openness in both short run and long run dynamics in majority of countries including Pakistan. Similarly, Badinger (2009) indicated the countries with high trade openness and financial openness stipulate lower inflation. The model includes financial openness as important variable in explaining openness-inflation trade off.

To analyze the inflation in Pakistan is imperative as being a developing county that might negatively deteriorate the living standards and purchasing power of the vulnerable portion of the society. It implies that inflation creates the expectations to further trigger the price hike in the

economy. This has persuaded the need to determine the underlying causes of inflation in Pakistan economy. This take into account the lag value of dependent variable that is inflation.

The relationship between trade liberalization and inflation is a central topic of debate in developing countries among development economist. The issues in Pakistan policy arena, today is how to put inflation under effective control as well as the imperative for developing country to embark on comprehensive trade liberalization policies in order to accelerate and sustain economic growth.

3.1 Data Sources and Variables Constructions:

The annual time series data of the variables is used in this study for the period 1973 to 2015. The data on the variables are taken from the data base of World Bank (WB), and International Monetary Fund (IMF). The model variables include consumer price index (CPI),[46] 2010=100 for inflation, real gross domestic product GDP per capita constant 2010, US $ is used as real output (Y), the imports plus exports/GDP ratio as trade openness measure (TO), money and quasi money as in local currency unit for broadly defined money supply (M2), real effective exchange rate (ER), real government consumption (G), import value index deflated (2000=100) for import prices (IMPR), and foreign direct investment, net inflows as percentage of GDP for financial market openness (FMO).

The import and export share in GDP is used as a proxy for openness of an economy. The real effective exchange deflated by the price deflator in 2010 prices and broadly defined money supply are used as a monetary policy variables. The real government expenditure is measured as government final consumption expenditures (constant 2010, US $), and is used as a fiscal policy variable. The import price is used as a proxy for foreign price shock.

3.2 Model Specification:

For this study, a pragmatic approach is taken. Rather than developing explicit theoretical models for explaining the price level, implications that emanate from a number of models are considered

[46] Typically, CPI, whole sale price index (WPI) and GDP deflator are taken as measures of inflation. But we deliberately drop of idea of using WPI and GDP deflator, because Pakistan is aa net importer country and its basket of consumption includes a number of commodities which are not domestically produced. Therefore, it can underestimate the impact of openness on the inflation in Pakistan.

in the empirical analysis. The macroeconomics effects of openness-inflation tradeoff are examined by five vector autoregressive (VAR) models with different combinations of variables are employed for the Pakistan economy. A vector autoregressive model of order p, VAR (p) for a system of k variables can be written as:

$$x_t = \beta + \Pi(L)x_t + u_t \tag{6}$$

$$x_t = \beta + \Pi_1 x_{t-1} + \Pi_2 x_{t-2} + \cdots\cdots\cdots + \Pi_p x_{t-p} + u_t \tag{7}$$

Where x_t is the $k \times 1$ vector of variables, β the $k \times 1$ vector of constants (intercepts), $\Pi(L)$ the $k \times k$ matrix of polynomials in the lag operator L, and u_t is $k \times 1$ vector of serially uncorrelated white noise residuals. The standard Sims (1980) VAR is an unrestricted reduced form approach and uses a common lag length for each variable in each equation. That is no restrictions are imposed on coefficient matrices to be null, and the same lag length is used for all system variables.

In general, we can write the matrix form as follows

$$\begin{bmatrix} x_{1,t} \\ x_{2,t} \\ \vdots \\ x_{k,t} \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix} + \begin{bmatrix} \Pi^1_{1,1} & \Pi^1_{1,2} & \cdots & \Pi^1_{1.k} \\ \Pi^1_{2,1} & \Pi^1_{2,2} & \cdots & \Pi^1_{2.k} \\ \vdots & \vdots & \ddots & \vdots \\ \Pi^1_{k,1} & \Pi^1_{k,2} & \ldots & \Pi^1_{1.k} \end{bmatrix} \begin{bmatrix} x_{1,t-1} \\ x_{2.t-2} \\ \vdots \\ x_{k,k-1} \end{bmatrix} + \cdots + \begin{bmatrix} \Pi^p_{1,1} & \Pi^p_{1,2} & \cdots & \Pi^p_{1,k} \\ \Pi^p_{2,1} & \Pi^p_{2,2} & \cdots & \Pi^p_{2,k} \\ \vdots & \vdots & \ddots & \vdots \\ \Pi^p_{k,1} & \Pi^p_{k,2} & \Pi^p_{k,2} & \Pi^p_{k,k} \end{bmatrix} \begin{bmatrix} x_{1,t-p} \\ x_{2.t-p} \\ \vdots \\ x_{k,k-p} \end{bmatrix} \begin{bmatrix} u_{1,t} \\ u_{2,t} \\ \vdots \\ u_{k,t} \end{bmatrix}$$

Rewriting the x variables one to one gives:

$$x_{1,t} = \beta_1 + a^1_{1,1}\, y_{1,t-1} + a^1_{1,2}\, y_{2,t-1} + \cdots + a^1_{1,k}\, y_{k,t-1} + \cdots + a^p_{1,1}\, y_{1,t-p} + a^p_{1,2}\, y_{2,t-p} + \cdots + a^p_{1,k}\, y_{k,t-p} + e_{1,t}$$

$$x_{2,t} = \beta_2 + a^1_{2,1}\, y_{2,t-1} + a^1_{2,2}\, y_{2,t-1} + \cdots + a^1_{2,k}\, y_{k,t-1} + \cdots + a^p_{2,1}\, y_{1,t-p} + a^p_{2,2}\, y_{2,t-p} + \cdots + a^p_{2,k}\, y_{k,t-p} + e_{2,t}$$

$$\vdots$$

$$x_{k,t} = \beta_k + a^1_{k,1}\, y_{2,t-1} + a^1_{k,2}\, y_{2,t-1} + \cdots + a^1_{k,k}\, y_{k,t-1} + \cdots + a^p_{k,1}\, y_{1,t-p} + a^p_{k,2}\, y_{2,t-p} + \cdots + a^p_{k,k}\, y_{k,t-p} + e_{k,t}$$

3.3 Johansen's Procedure for Testing Cointegration:

Each of the models is tested for the existence of cointegration relationship among the variables. The basic purpose of cointegration is to determine the long run relationship between variables. The cointegration tests were performed with the multivariate method developed by Johansen (1998, 2000), and Johansen and Juselius (1992). It involves estimating a vector autoregression by full information maximum likelihood.

The Johansen procedure to determine the presence of cointegration amongst variables with different combinations in each of the VAR model to empirically examine the long run relationship are given in the equation as under:

Model: (A)

$$CPI_t = \beta_1 + \Pi_1 Y_{t-1} + \Pi_2 TO_{t-2} + \Pi_3 M2_{t-3} + \Pi_4 G_{t-4} + u_t \quad (8)$$

Model: (B)

$$CPI_t = \beta_1 + \Pi_1 Y_{t-1} + \Pi_2 TO_{t-2} + \Pi_3 M2_{t-3} + \Pi_4 IMPR_{t-4} + u_t \quad (9)$$

Model: (C)

$$CPI_t = \beta_1 + \Pi_1 Y_{t-1} + \Pi_2 TO_{t-2} + \Pi_3 ER_{t-3} + \Pi_4 FMO_{t-4} + u_t \quad (10)$$

Model: D

$$CPI_t = \beta_1 + \Pi_1 Y_{t-1} + \Pi_2 TO_{t-2} + \Pi_3 M2_{t-3} + \Pi_4 FMO_{t-4} + u_t \quad (11)$$

Model: E

$$CPI_t = \beta_1 + \Pi_1 M2_{t-1} + \Pi_2 TO_{t-2} + \Pi_3 G_{t-3} + \Pi_4 IMPR_{t-4} + u_t \quad (12)$$

Now to identify cointegrating vector r Johansen approach suggested two likelihood based tests of significance, the trace statistic and maximum eigenvalue statistic. We use the trace statistic and maximum eigenvalue statistic for testing the hypothesis of at most r cointegrating vectors in each model.

The trace statistic tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors. Monte Carlo simulation and tabulation have been used to calculate the critical value (Johansen, 1988). The test statistic is given by:

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \quad (13)$$

The maximum eigen value statistics, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of $(r+1)$ cointegrating vectors and is given by:

$$\lambda_{\max} = -T(1 - \hat{\lambda}_{r+1}) \quad (14)$$

where T is the sample size, and $\hat{\lambda}_i$ is the i^{th} largest canonical correlation.

The multivariate cointegration model is very appropriate for this type of empirical work because it explicitly involves classification into non-stationary and stationary components that provide interpretation in terms of the dynamics of short run and long run impacts in the model (Ssekuma, 2011).

3.4 The Vector Error Correction Model:

After establishing the long run relationship between the variables, short run disequilibrium may be assumed. Johansen long run cointegrating methodology has been extended to vector error correction model (VECM) that helps to analyze time series more efficiently for which data is

available for short periods (Pesaran et al. 2000). Vector error correction model is also termed as short run model. Vector error correction model examined the short run and long run dynamics among variables i.e. how short run changes in trade openness and its determinants contributes to its relationship with inflation in the long run. The variables to be tested are expressed in vector error correction form.

$$\Delta x_t = \beta + \sum_{i-1}^{k-1} \Gamma_1 \Delta x_{t-1} + \Pi x_{t-k} + \Phi D_t + u_t \tag{15}$$

Where x_t is the $k \times 1$ vector of variables in the system, D_t refers to the matrix of deterministic variables, such as intercept and time trend, k is the number of lags, and u_t is the error vector, it is normal and independent across observations.

Reparametrizing the equation 2, that is subtracting x_{t-1} on both sides, the following equation is formulated for VECM:

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \Gamma_2 \Delta x_{t-2} + \cdots\cdots + \Gamma_{p-1} \Delta x_{t-p+1} + \Pi x_{t-p} + \Phi D_t + u_t \tag{16}$$

Where, $\Gamma_1 = \Pi_1 - I$, $\Gamma_2 = \Pi_2 - \Gamma_1$, $\Gamma_3 = \Pi_3 - \Gamma_2$ and $\Pi = I - \Pi_1 - \Pi_2 - \ldots - \Pi_p$. The matrix Π determine the extent to which the system is cointegrated and is called the impact matrix. Returning to the general reparametrized equation 7, if we consider the equation of the system as:

$$\Delta x_{1t} = \gamma_{11} \Delta x_{t-1} + \gamma_{12} \Delta x_{t-2} + \ldots\ldots + \gamma_{1p-1} \Delta x_{t-p+1} + \Pi_1^{/} x_{t-p} + u_{1t} \tag{17}$$

Where γ_{ij} is the first row of Γ_j, $j = 1, 2, \ldots p-1$ and are all $I(0)$, u_t is assumed to be $I(0)$ and so for a meaningful equation, $\Pi_1^{/} x_{t-p}$ must be stationary, $I(0)$.

If none of the components of x_t are cointegrated, they must be zero. On the other hand, if they are cointegrated, all the rows of Π must be cointegrated but not necessarily distinct. This is because the number of distinct cointegrating vectors depends on the row rank of Π. The matrix Π is of

order $k \times k$. If it has rank r, that is, r number of linearly independent rows or columns, then it forms a basis for k-dimensional vector space. This implies that all $k \times 1$ vectors can be generated as linear combinations of its row. Any of these linear combinations of the row would lead to stationary, meaning that x_{t-p} has stationary components if the rank of Π is $r < k$. According to Granger representation theorem, if the coefficient matrix, Π has reduced rank then there exist $k \times r$ matrices β and Φ each with rank such that $\Pi = \beta \Phi^{/}$ and $\Phi^{/} x$ is stationary (Engle and Granger, 1987). The elements of β are called the adjustment parameters in the vector error correction model and r is the cointegrating rank. So here:

$$\underline{\Phi^{/}} = \begin{bmatrix} \Phi_1^{/} \\ \Phi_2^{/} \\ \vdots \\ \Phi_r^{/} \end{bmatrix} \tag{18}$$

$$\underline{\beta} = [\beta_1, \beta_2 \ldots\ldots \beta_r] \tag{19}$$

Then $\Pi x_{t-p} = \underline{\beta}\ \underline{\Phi^{/}}\ x_{t-p}$ and all linear combinations of $\underline{\Phi^{/}}\ x_{t-p}$ are stationary. It should be noted that we have to perform the ADF test to access the order of integration of each variable before applying Johansen's procedure. Johansen procedure estimates the VAR subject to $\Pi = \underline{\beta}\ \underline{\alpha^{/}}$ for various values of r number of cointegrating vectors, using the maximum likelihood estimator assuming $u_t \approx iidN(0, \sum)$. The estimate can thus be rewritten as.

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \Gamma_2 \Delta x_{t-2} + \ldots\ldots + \Gamma_{p-1} \Delta x_{t-p+1} + \underline{\beta}\ \underline{\Phi^{/}}\ x_{t-p} + u_t \tag{20}$$

The vector error correction estimates for all models to obtain information about the causal factors that may affect the variables are presented below:

Vector Error Correction (VEC) Model: (A)

$$\Delta CPI_{1t}=\beta_{10}+\sum_{i=1}^{p}\beta_{11,i}\Delta CPI_{1,t-1}+\sum_{i=1}^{p}\beta_{12,i}\Delta Y_{2,t-1}+\sum_{i=1}^{p}\beta_{13,i}\Delta TO_{3,t-1}+\sum_{i=1}^{p}\beta_{14,i}\Delta M2_{4,t-1}+ \sum_{i=1}^{p}\beta_{15,i}\Delta G_{5,t-1}+\lambda_1 ECT_{t-1}+u_{1t} \quad (21)$$

Vector Error Correction (VEC) Model: (B)

$$\Delta CPI_{1t}=\beta_{10}+\sum_{i=1}^{p}\beta_{11,i}\Delta CPI_{1,t-1}+\sum_{i=1}^{p}\beta_{12,i}\Delta Y_{2,t-1}+\sum_{i=1}^{p}\beta_{13,i}\Delta TO_{3,t-1}+\sum_{i=1}^{p}\beta_{14,i}\Delta M2_{4,t-1}+ \sum_{i=1}^{p}\beta_{15,i}\Delta IMPR_{5,t-1}+\lambda_1 ECT_{t-1}+u_{1t} \quad (22)$$

Vector Error Correction (VEC) Model: (C)

$$\Delta CPI_{1t}=\beta_{10}+\sum_{i=1}^{p}\beta_{11,i}\Delta CPI_{1,t-1}+\sum_{i=1}^{p}\beta_{12,i}\Delta Y_{2,t-1}+\sum_{i=1}^{p}\beta_{13,i}\Delta TO_{3,t-1}+\sum_{i=1}^{p}\beta_{14,i}\Delta ER_{4,t-1}+ \sum_{i=1}^{p}\beta_{15,i}\Delta FMO_{5,t-1}+\lambda_1 ECT_{t-1}+u_{1t} \quad (23)$$

Vector Error Correction (VEC) Model: (D)

$$\Delta CPI_{1t}=\beta_{10}+\sum_{i=1}^{p}\beta_{11,i}\Delta CPI_{1,t-1}+\sum_{i=1}^{p}\beta_{12,i}\Delta Y_{2,t-1}+\sum_{i=1}^{p}\beta_{13,i}\Delta TO_{3,t-1}+\sum_{i=1}^{p}\beta_{14,i}\Delta M2_{4,t-1}+ \sum_{i=1}^{p}\beta_{15,i}\Delta FMO_{5,t-1}+\lambda_1 ECT_{t-1}+u_{1t} \quad (24)$$

Vector Error Correction (VEC) Model: (E)

$$\Delta CPI_{1t}=\beta_{10}+\sum_{i=1}^{p}\beta_{11,i}\Delta CPI_{1,t-1}+\sum_{i=1}^{p}\beta_{12,i}\Delta M2_{2,t-1}+\sum_{i=1}^{p}\beta_{13,i}\Delta TO_{3,t-1}+\sum_{i=1}^{p}\beta_{14,i}\Delta G_{4,t-1}+ \sum_{i=1}^{p}\beta_{15,i}\Delta IMPR_{5,t-1}+\lambda_1 ECT_{t-1}+u_{1t} \quad (25)$$

The coefficients on lag values of the variables are the short run parameters measuring the immediate impact of independent variables on dependent variables. Where ECT_{t-1} is error correction term and is given by a stationary linear combination of the residuals at single lag. The error correction term represents the deviation from the long run equilibrium which is correlated gradually through a series of partial short run adjustments. The sign and magnitude of the estimated coefficient of error correction term reflects the direction and speed of adjustment of the dependent variable to temporary deviations from the long run equilibrium. A negative and significant ECT is an indication of cointegration among the variables and presence of a stable long run path (Ssekuma, 2011).

3.5 Causality Analysis:

Causality existence in either direction is examined through Toda-Yamamoto causality test. According to Guajarati (1995) there are few shortcomings in granger causality like first one is model specification problem and number of lags second one drawback of this approach is spurious regression non-stationary problem. Toda and Yamamoto (1995) proposed causality test which is robust for cointegration and stationarity properties. Toda-Yamamoto causality test is valid irrespective of whether a series is I(0), I(1) or I(2), non-integrated or integrated of any uniformed order. This approach makes granger causality easier because this technique has no need to test cointegration or convert VAR into ECM.

The Pair Wise Granger Causality test has been used to verify the direction of causality between the variables for Pakistan. The test measures two-way causality means cause and effect relationship between two or more variable.

3.6 Further Analysis (IRFs and VDCs):

The sources of openness and inflation correlation are examined through computation of impulse response functions (IRFs) and variance decomposition computations (VDCs) which are based on the moving average representation of the VAR model. The impulse response function trace the impact of a single SD shock to each variable in the system over a specific forecast horizon. To identify the responsiveness of endogenous variable to shocks in the system, the Choleski decomposition[47] is used to orthogonalize the variance-covariance matrix. The ordering of variables is done by the investigator based on structural assumptions, theoretical considerations are employed. Sims (1980) argued that, there is no unique way of ordering the variables thus the responses change as the order of the variables changes. As structural changes take place in the economy we argue that the ordering of variable herein is plausible. We have given a positive shock of one standard deviation to the VAR model to see the response. We apply the impulse response to VAR to see the response of all the variables.

The VDCs show the percentages of the forecast error variance for each variable that may be ascribed to its own innovation and to variations in other system variables as well. The IRFs further indicate the signs of effect, whether positive or negative over time. The VDCs and IRFs here indicate the effects of a shock to a change in openness on the growth rates of the price level.

[47] $A = LL^*$. A closely related variant of the classical Cholesky decomposition is the LDL decomposition. $A = LDL^*$

Chapter 4: Empirical Results and Discussion

Prior to starting the cointegration tests, it is essential to determine whether the time series are stationary or not. A large number of time series is not stationary in levels; the number of differences we must take to achieve stationarity is called the order of integration of the original series. (See for example, Engle and Yoo, 1987; Johansen, 1988, 2000; or Davidson and Mackinnon, 1993).

4.1 Descriptive Statistics:

The data on the determinants of trade openness and inflation of all eight variables used for the period 1973-2015 are shown in Table 2. All the variables except trade openness (TO) and financial market openness (FMO) were converted to logarithms. We used TO and FMO as annual percentage change of GDP, to manifest its significance from the prospect of macroeconomic stability to determine the economic performance for the Pakistan economy.

Table 2: Descriptive Statistics (1973-2015)

	Δ CPI	Δ Y	Δ TO	Δ ER	Δ M2	Δ G	Δ IMPR	Δ FMO
Mean	0.086	0.021	-0.053	-0.009	0.146	0.049	0.108	0.010
Median	0.077	0.020	-0.031	-0.011	0.152	0.062	0.108	0.066
Max	0.237	0.064	5.730	0.125	0.375	0.394	0.528	1.103
Min	0.025	-0.014	-4.190	-0.192	-0.012	-0.162	-0.057	-1.807
Std. Dev	0.043	0.017	2.566	0.063	0.065	0.093	0.110	0.446
Skewness	1.317	0.314	0.317	-0.295	0.723	0.786	1.453	-1.144
Kurtosis	5.357	2.695	2.299	3.748	5.759	6.077	7.138	8.500
Obs	43	43	43	43	43	43	43	43

Since the raw data is annual time series, log differences from the previous year generate year on year growth rates for all variables. The annualized average changes in the consumer price index are 8.6 percentage points over time. The average annual growth rate of real GDP per capita are 2.1 percent over the entire sample period. The growth rates of exchange rate and real government expenditures are found to be -0.9 and 4.9 percent respectively. The growth rates of money supply, and import value index are relatively high, 14.6 and 10.8 percent respectively over time.

Trade openness decreases 0.053 percentage points each year, on average, and financial market openness increases 0.01 percentage points each year, on average. For all series, the mean and the median are nearly equal. The kurtosis statistics provide a measure of the thickness of the tails of a distribution. The skewness statistics are used to check with the symmetry of a probability distribution.

4.2 Unit Root Tests:

To determine the stationarity of the variables used in the analysis we use the conventional Augmented Dickey Fuller (ADF) unit root test. The tests and regression were performed with the EViews 9.5 statistical package (QMS, 2016).

The results of unit root are shown in Table 3. The results indicate that all the variables are integrated of order one at 5% level of significance. It is insured that variables are not I(2), implying that stationary was achieved after differencing the series once. This means that the basic conditions for the applications of VAR modelling are met and we can safely move to the next step of the analysis. The following step involves estimating the existence of long run relationship with several combinations of the variables included in each model.

Table 3: Results of ADF Unit Root Test

Variables	ADF Test Statistics		Order of Integration 5% Level of Significance	Order of Integration 10 % Level of Significance
	Level	First Difference		
CPI	-2.801	-4.307**	I(1)	I(1)
Y	-1.251	-4.789**	I(1)	I(1)
TO	-2.922	-7.486**	I(1)	I(1)
ER	-0.473	-4.333**	I(1)	I(1)
M2	-3.459***	-5.811**	I(1)	I(0)
G	-2.105	-8.556**	I(1)	I(1)
IMPR	-3.234	-7.573**	I(1)	I(1)
FMO	-3.016	-4.287**	I(1)	I(1)

Note: The test statistics significant at 5% and 10% are indicated by ** and *** respectively.

4.3 Cointegration Test:

The subsequent phase of the analysis comprise testing for the existence of cointegration among variables in each of the models that is to determine the long run behavioral relationship between the variables. The conception of cointegration utter that variables in the system may fluctuate from their equilibrium path or deviate in the short run but will attain equilibrium in the long run. Johansen (1988, 2000), developed an approach to estimate long run relationship among non-stationary variables. We use several combinations of variables in five different models based on the economic concept. The data constraints preclude the inclusion of a large number of variables since the inclusion of lags further reduces the number of observations available for estimation. The Akaike information criterion and Schwarz information criterion are used for lag lengths. After the selection of lag length, next step concerns the identification of cointegration vectors amongst variables in each of the models using Johansen cointegration technique. Table 4 and 5 presents the results of cointegration tests and list of variables included in each model.

Table 4: Johansen Cointegration Tests (Trace Statistics)

Model	Number of Lags and DT	Hypothesized # of CE(s)	Eigenvalue	Trace (LR) t-statistics	5% critical value	Rank (r)
A	1, CT	$r \leq 0$	0.757	116.108	88.803	$r = 1$
		$r \leq 1$	0.563	58.068	63.876	
		$r \leq 2$	0.267	24.056	42.915	
		$r \leq 3$	0.154	11.286	25.872	
		$r \leq 4$	0.101	4.40.3	12.517	
B	1, CT	$r \leq 0$	0.687	96.718	88.803	$r = 1$
		$r \leq 1$	0.398	49.080	63.876	
		$r \leq 2$	0.262	28.226	42.915	
		$r \leq 3$	0.209	15.718	25.872	
		$r \leq 4$	0.138	6.101	12.517	
C	1, CT	$r \leq 0$	0.596	95.849	88.803	$r = 1$
		$r \leq 1$	0.469	58.612	63.876	
		$r \leq 2$	0.351	32.637	42.915	
		$r \leq 3$	0.192	14.883	25.872	
		$r \leq 4$	0.138	6.111	12.51	
D	1, CT	$r \leq 0$	0.699	112.159	88.803	$r = 1$
		$r \leq 1$	0.461	62.841	63.876	
		$r \leq 2$	0.398	37.449	42.915	
		$r \leq 3$	0.254	16.575	25.872	
		$r \leq 4$	0.104	4.525	12.51	
E	1, CT	$r \leq 0$	0.665	100.768	88.803	$r = 1$
		$r \leq 1$	0.399	55.817	63.876	
		$r \leq 2$	0.301	34.904	42.915	
		$r \leq 3$	0.275	20.188	25.872	
		$r \leq 4$	0.156	6.989	12.517	

Note: DT refers to the type of deterministic trends that were present in the data. For instant, a constant; and constant and trend (CT) were included in the cointegrating equation (CE). The variables included in the various models are:
Model A: CPI, Y, TO, M2, G.
Model B: CPI, Y, TO, M2, IMPR.
Model C: CPI, Y, TO, ER, FMO.
Model D: CPI, Y, TO, M2, FMO.
Model E: CPI, M2, TO, G, IMPR.

Table 5: Johansen Cointegration Tests (Max-Eigen Statistics)

Model	Number of Lags and DT	Hypothesized # of CE(s)	Eigenvalue	Max-Eigen t-statistics	5% critical value	Rank (r)
A	1, CT	$r \leq 0$	0.757	58.039	38.331	$r = 2$
		$r \leq 1$	0.563	34.011	32.118	
		$r \leq 2$	0.267	12.769	25.823	
		$r \leq 3$	0.154	6.883	19.387	
		$r \leq 4$	0.101	4.403	12.517	
B	1, CT	$r \leq 0$	0.687	47.638	38.331	$r = 1$
		$r \leq 1$	0.398	20.853	32.118	
		$r \leq 2$	0.262	12.508	25.823	
		$r \leq 3$	0.209	9.616	19.387	
		$r \leq 4$	0.138	6.101	12.517	
C	1, CT	$r \leq 0$	0.596	37.237	38.331	$r = 0$
		$r \leq 1$	0.469	25.974	32.118	
		$r \leq 2$	0.351	17.753	25.823	
		$r \leq 3$	0.192	8.772	19.387	
		$r \leq 4$	0.138	6.111	12.517	
D	1, CT	$r \leq 0$	0.699	49.318	38.331	$r = 1$
		$r \leq 1$	0.461	25.391	32.118	
		$r \leq 2$	0.398	20.874	25.823	
		$r \leq 3$	0.254	12.049	19.387	
		$r \leq 4$	0.104	4.525	12.517	
E	1, CT	$r \leq 0$	0.665	44.915	38.331	$r = 1$
		$r \leq 1$	0.399	20.912	32.118	
		$r \leq 2$	0.301	14.716	25.823	
		$r \leq 3$	0.275	13.198	19.387	
		$r \leq 4$	0.156	6.989	12.517	

Note: DT refers to the type of deterministic trends that were present in the data. For instant, a constant; and constant and trend (CT) were included in the cointegrating equation (CE). The variables included in the various models are:
Model A: CPI, Y, TO, M2, G.
Model B: CPI, Y, TO, M2, IMPR.
Model C: CPI, Y, TO, ER, FMO.
Model D: CPI, Y. TO, M2, FMO.
Model E: CPI, M2, TO, G, IMPR.

We used the likelihood ratio (trace) statistic and (maximum eigen value) statistic for testing the hypothesis of most r cointegrating vectors in each model. The trace statistic reveals that there is one cointegrating vector in each Model. The maximal eigen values shows that there are two cointegrating vector in Model A, no cointegrating vector in Model C and one cointegrating vector in each Model B, D and E at 5% level of significance respectively. Therefore, the annual data from 1973 to 2015 tends to support the proposition that in Pakistan there exists a long run relationship between inflation and its determinants that are real GDP per capita, trade openness, real exchange rate, money supply, real government expenditure, import prices, and financial market openness.

4.4 VEC estimates of Long Run Cointegrating Vectors:

The vector error correction estimates i.e. the long run parameters for all the models are presented in Table 6, 7, 8, 9 and 10 with normalization made on the variables with the coefficient 1.000.

Table 6: VEC estimates of Model A

Model	CPI	Y	TO	M2	G	Trend
A	1.000	-2.467 (7.899*)	0.034 (7.435*)	0.693 (9.435*)	0.197 (2.745*)	0.019
Adjustment Coefficients	-0.267 (4.305)	-0.074 (1.661)	5.913 (0.953)	0.336 (2.428)	0.226 (1.128)	-

Note: Number in parentheses is the absolute t-value. *Significant at 1% level, respectively. Dash denotes data not available.

The long run equilibrium relation is:

$$CPI = -2.467Y + 0.034TO + 0.693M2 + 0.197G$$

Table 7: VEC estimates of Model B

Model	CPI	Y	TO	M2	IMPR	Trend
B	1.000	-3.103 (7.872*)	0.055 (8.333*)	0.659 (6.075*)	-0.039 (0.403)	0.051
Adjustment Coefficients	-0.120 (1.952)	-0.074 (2.007)	12.880 (2.616)	0.201 (1.637)	-0.429 (2.237)	-

Note: Number in parentheses is the absolute t-value. *Significant at 1% level, respectively. Dash denotes data not available.

The long run equilibrium relation is:

$$CPI = -3.103Y + 0.055TO + 0.659M2 - 0.039IMPR$$

Table 8: VEC estimates of Model C

Model	CPI	Y	TO	ER	FMO	Trend
C	1.000	-3.197 (5.252*)	0.066 (7.058*)	0.337 (3.523*)	0.014 (0.714)	0.153
Adjustment Coefficients	-0.076 (1.258)	-0.075 (2.171)	14.005 (3.312)	-0.041 (0.369)	0.187 (0.217)	-

Note: Number in parentheses is the absolute t-value. *Significant at 1% level, respectively. Dash denotes data not available.

The long run equilibrium relation is:

$$CPI = -3.197Y + 0.066TO + 0.337ER + 0.014FMO$$

Table 9: VEC estimates of Model D

Model	CPI	Y	TO	M2	FMO	Trend
D	1.000	-2.048 (7.508*)	0.037 (7.847*)	0.629 (8.250*)	-0.042 (3.538*)	0.031
Adjustment Coefficients	-0.187 (2.151)	-0.140 (2.868)	12.973 (1.792)	0.324 (1.939)	-0.615 (0.484)	-

Note: Number in parentheses is the absolute t-value. *Significant at 1% level, respectively. Dash denotes data not available.

The long run equilibrium relation is:

$$CPI = -2.048Y + 0.037TO + 0.629M2 - 0.042FMO$$

Table 10: VEC estimates of Model E

Model	CPI	M2	TO	G	IMPR	Trend
E	1.000	0.703 (7.818*)	0.004 (1.169)	-0.041 (0.607)	0.270 (3.615*)	0.049
Adjustment Coefficients	-0.272 (4.142)	0.274 (1.744)	-6.499 (0.944)	-0.292 (1.277)	-0.594 (2.489)	-

Note: Number in parentheses is the absolute t-value. *Significant at 1% level, respectively. Dash denotes data not available.

The long run equilibrium relation is:

$$CPI = 0.703M2 + 0.004TO - 0.041G + 0.270IMPR$$

The coefficients of all variables can be interpreted in terms of elasticity. According to normalized equation, coefficient of trade openness enters significantly positive (though weak) in all regressions. However, the level of significance and magnitude of the coefficient varies form case to case. The long run coefficient of trade openness concludes analytically that a 1% decrease in trade openness leads to 0.06% decrease in inflation (see Table 8, model C). The positive relationship between openness and inflation is in line with the general preposition that outward looking orientation being inflationary for developing countries (Daniels et.al 2005; Evans 2012; Zakaria 2010, and Ajaz et al 2016 see among others). This positive link in Pakistan directives seems to be logical because Pakistan is a net importer and imports largely consists of oil and other manufacturing goods in total trade. This has resulted in an intensifying effect on the inflationary process because of increasing oil prices and manufactured goods in the world market (Jalil et al. 2014). The results of the study explicitly show that with several combinations of variables the relationship between trade openness and inflation is positive in case of Pakistan economy.

The growth rate measured by real per capita income enters significantly negative in all cases. The significant long run coefficient suggests that increase in country productivity and improvement in quality of life can reduce inflation by high levels. Inflation creates instability, depreciates the real value of money, harms growth by reducing investment and efficiency of productiveness. Therefore, we may conclude that a 1% increase in income leads to a 2.4% decrease in inflation (see Table 6, model A). The results of negative relationship between growth and inflation are in accordance with the observation of (Fisher, 1993).

Moving to the real effective exchange rate the estimated long run coefficient is positive and statistically significant. So, we can conclude that a 1% increase in the exchange rate (depreciation) leads to 0.33% increase in inflation (See Table 8, Model C). The exchange rate of Pakistan from 1980's after the adoption of managed floating exchange regime is continuously depreciating in real terms. The depreciation of Pakistan currency implicit costly imports. The lower import content in the production of exportable allows exchange rate depreciation and persistent volatility is deteriorating export price competitiveness. The positive correlation between exchange rate and inflation is in view with the conventional theory of purchasing power parity.

The rate of money supply measured as broadly defined M2 enters significantly positive in the all the regressions which implies that a 1% increase in money supply leads to 0.70% increase in inflation (See Table 10, Model E). This positive association is in accordance with the monetarist theory. A possible explanation may be due to the fact, that the State Bank of Pakistan (the central bank) stance of adopting ease of monetary policy to promote growth and ensure price stability triggers an inflation to start. The expansionary monetary policy of Pakistan resulted in high inflation reaching double digit in 2005. Its implies that an increase in money supply have adverse effects leading to an increase in the price level in the long run supporting (Lucas, 1996) who finds strong relationship between money growth and inflation.

Similarly, the fiscal policy measure that is real government expenditure estimated long run coefficient is also statistically significant and positive supporting the idea of fiscal theory of price level. The analysis concludes that 1% increase in real government expenditure will increase inflation by 0.19% (See Table 6, Model A). During the last three decades Pakistan has consistently faced fiscal deficit and in case of developing countries, it is predominantly accepted that developing countries have a low tax collection, political vulnerability and limited access to external borrowing that cause the crowding effect. The positive link in Pakistan context is in accordance with the mode of financing through printing money, internal borrowing and debt service that leads to inflation in the economy. Its reflects that inflation in case of Pakistan is determined by the interdependence of both monetary and fiscal phenomenon.

Regarding foreign price shock variable import prices coefficient is significant and signs being positive that is in line with theory. The estimated long run coefficient of IMPR is 0.27. Therefore, we may conclude that 1% increase in import prices leads to 0.27% increase in inflation. The results are in support of structural theory of inflation. Pakistan major imports includes imported fuels. Refined petroleum being the second largest source of energy consumption in Pakistan. The feasible elucidation for the long run coefficient of import prices being positive and significant might be because of strong volatility in recent oil prices in the world market. The energy prices seem to have vital role behind imported inflation in Pakistan.

The estimated long run coefficient of financial market openness is negative and statistically significant (See Table 9, Model D). The result concludes that 1% increase in financial openness

leads to 0.04% decrease in inflation. The findings show that increase in financial openness and capital account liberalization can mitigate inflation. The capital account liberalization is desirable because it avoids the problem of time inconsistency in the management of the monetary policy. This negative link is particularly important for developing countries as an economy with market globalization can quickly adopt newly developed ideas and equipment's from the rest of the world. The increase in capital mobility and financial openness work as a commitment technology central to their growth and contributes to the settlement of lower inflation targets (Rogoff, 2003, Gruben and McLeod, 2004, Badinger, 2009).

The relatively large coefficients 0.70 of money supply, 0.33 of exchange rate and 0.27 of import prices (See Table 8, Model C, and Table 10, Model E) appears to be more important factors in determining the inflation for Pakistan.

4.5 Short Run estimates (Error Correction Model):

The short run error correction estimates to obtain information about causal factors that may affect the variables included in each of the model are shown in Table 11, 12, 13 14, and 15. The important outcome of ECM is the ecm_{t-1} term. The adjustment coefficients capture the short run changes in inflation, trade openness and other variables that are required to eliminate departures from long run equilibrium levels.

The negative and significant estimate of the ecm_{t-1} coefficient shows that there exists short run relationship as well in the model. This means that whenever there is any shock that deviate the relationship from the long run equilibrium the model will adjust back and the coefficient of ecm_{t-1} reflects the speed of adjustment from short run equilibrium towards long run equilibrium. A negative and significant sign implies that disequilibrium will converge toward long run equilibrium. The result shows that negative and significant short run coefficient of government expenditure has short run impact on the inflation (See Table 11 and 15, ECM Model A and E). It concludes that in the short run 1 % increase in real government expenditure leads to 0.14% decrease in inflation. The magnitude of ECT coefficients shows satisfactory shift adjustments towards the long run equilibrium path.

Table 11: Short Run estimates (ECM) Model A

Dependent Variable ΔCPI Repressor	Parameter Estimate	T-Ratio	P-values
Intercept	0.062	3.955	0.000
$\Delta Y(-1)^a$	0.107	0.478	0.635
$\Delta TO(-1)$	-0.002	-1.520	0.137
$\Delta M2(-1)$	-0.027	-0.393	0.696
$\Delta G(-1)$	-0.145	-2.931	0.006*
$ECT(-1)$	-0.269	-4.642	0.000*
R^2		0.655	
Adj. R^2		0.594	
S.E. of Regression		0.023	
D-W statistic for autocorrelation		2.079	
F-statistic (Prob)		0.000	
LM: $\chi^2(1)$ for serial correlation		0.614 (0.438) [b]	
ARCH $\chi^2(1)$		0.000 (0.977)	
White $\chi^2(6)$ for heteroscedasticity		0.538 (0.775)	
JB $\chi^2(2)$ for normality		0.230 (0.890)	
RESET for functional form		0.597 (0.444)	
CUSUM		Stable	
CUSUMSQ		Stable	

Notes: [a] Refers to the number of lags. [b] The degrees of freedom for the other tests are in parentheses adjacent to the distributions.

*, **, *** Significant at the 1.0, 5.0, 10% levels respectively.

D-W is the Durban Watson test for autocorrelation. LM is the Lagrange multiplier test of residual serial correlation. ARCH and white are tests for heteroscedasticity based on Engle (1982) and White (1980), respectively. JB statistics tests for normality in the residuals. RESET is a test for specification error. ECT is the lagged residual from the cointegration regression., and Δ is the first difference operator.

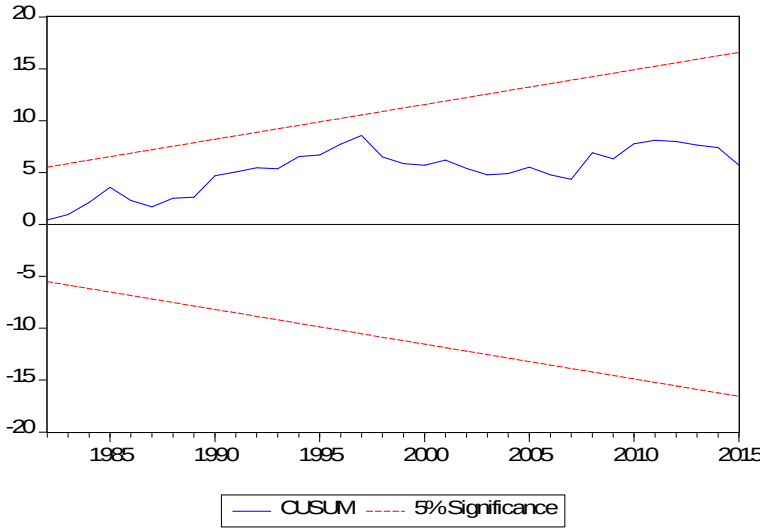

Figure 3: Model A (CUSUM): Plot of cumulative sum of Recursive Residuals

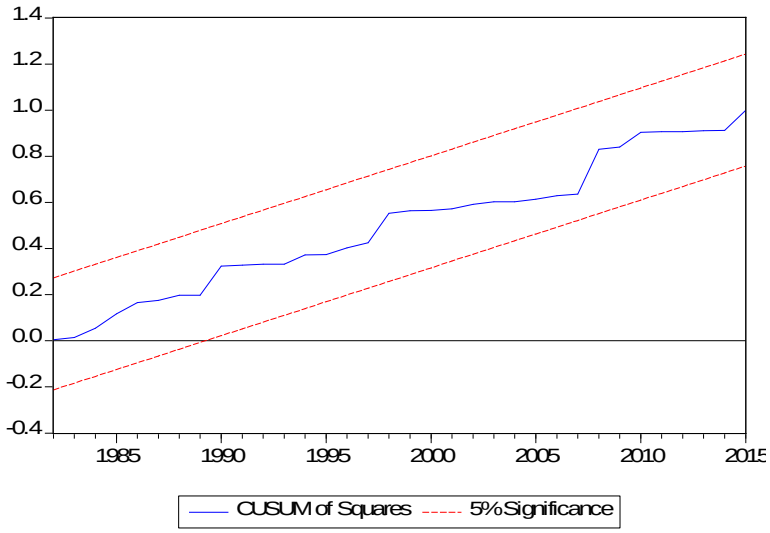

Figure 4: Model A (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals

Table 12: Short Run estimates (ECM) Model B

Dependent Variable ΔCPI Repressor	Parameter Estimate	T-Ratio	P-values
Intercept	0.043	2.240	0.031
$\Delta Y(-1)^a$	0.038	0.144	0.885
$\Delta TO(-1)$	-0.001	-0.839	0.406
$\Delta M2(-1)$	0.006	0.074	0.941
$\Delta IMPR(-1)$	0.080	1.279	0.209
$ECT(-1)$	-0.121	-2.286	0.028**
R^2		0.522	
Adj. R^2		0.438	
S.E. of Regression		0.027	
D-W statistic for autocorrelation		2.166	
F-statistic (Prob)		0.000	
LM: $\chi^2(1)$ for serial correlation		0.812 (0.373) [b]	
ARCH $\chi^2(1)$		0.244 (0.623)	
White $\chi^2(6)$ for heteroscedasticity		0.579 (0.743)	
JB $\chi^2(1)$ for normality		1.407 (0.494)	
RESET for functional form		0.469 (0.497)	
CUSUM		Stable	
CUSUMSQ		Stable	

Notes: [a] Refers to the number of lags. [b] The degrees of freedom for the other tests are in parentheses adjacent to the distributions.

*, **, *** Significant at the 1.0, 5.0, 10% levels respectively.

D-W is the Durban Watson test for autocorrelation. LM is the Lagrange multiplier test of residual serial correlation. ARCH and white are tests for heteroscedasticity based on Engle (1982) and White (1980), respectively. JB statistics tests for normality in the residuals. RESET is a test for specification error. ECT is the lagged residual from the cointegration regression., and Δ is the first difference operator.

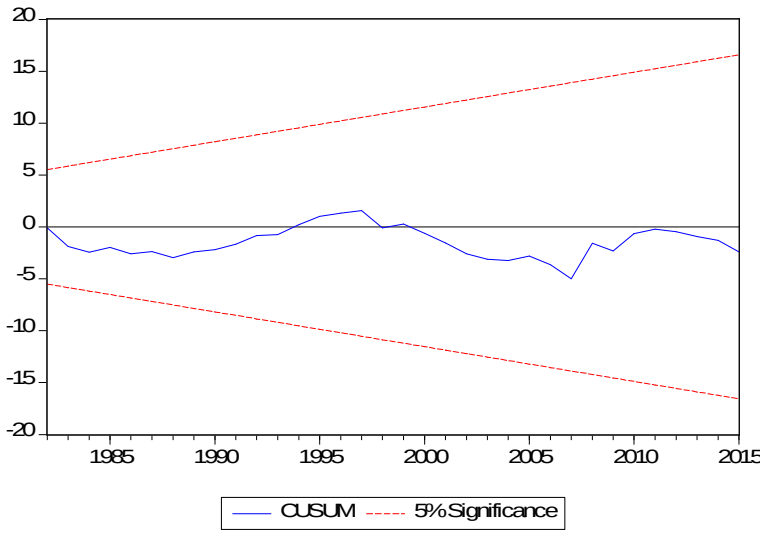

Figure 5: Model B (CUSUM): Plot of Cumulative sum of Recursive Residuals

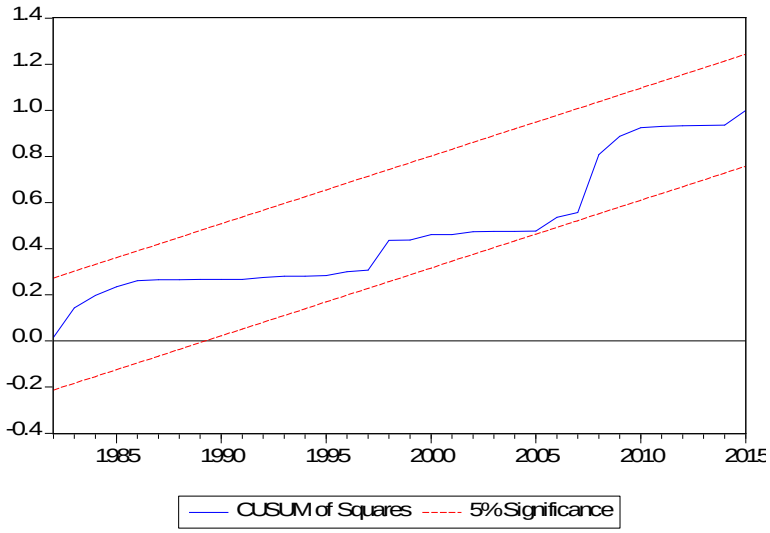

Figure 6: Model B (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals

Table 13: Short Run estimates (ECM) Model C

Dependent Variable ΔCPI Repressor	Parameter Estimate	T-Ratio	P-values
Intercept	0.040	2.294	0.028
$\Delta Y(-1)^a$	0.044	0.155	0.877
$\Delta TO(-1)$	0.001	0.857	0.397
$\Delta ER(-1)$	-0.059	-0.631	0.531
$\Delta FMO(-1)$	-0.012	-0.983	0.332
$ECT(-1)$	-0.011	-2.195	0.035**
R^2		0.503	
Adj. R^2		0.415	
S.E. of Regression		0.028	
D-W statistic for autocorrelation		2.321	
F-statistic (Prob)		0.000	
LM: $\chi^2(1)$ for serial correlation		2.492 (0.123) [b]	
ARCH $\chi^2(1)$		0.526 (0.472)	
White $\chi^2(27)$ for heteroscedasticity		8.187 (0.067)	
JB $\chi^2(1)$ for normality		5.873 (0.053)	
RESET for functional form		0.402 (0.529)	
CUSUM		Stable	
CUSUMSQ		Stable	

Notes: [a] Refers to the number of lags. [b] The degrees of freedom for the other tests are in parentheses adjacent to the distributions.

*, **, *** Significant at the 1.0, 5.0, 10% levels respectively.

D-W is the Durban Watson test for autocorrelation. LM is the Lagrange multiplier test of residual serial correlation. ARCH and white are tests for heteroscedasticity based on Engle (1982) and White (1980), respectively. JB statistics tests for normality in the residuals. RESET is a test for specification error. ECT is the lagged residual from the cointegration regression., and Δ is the first difference operator.

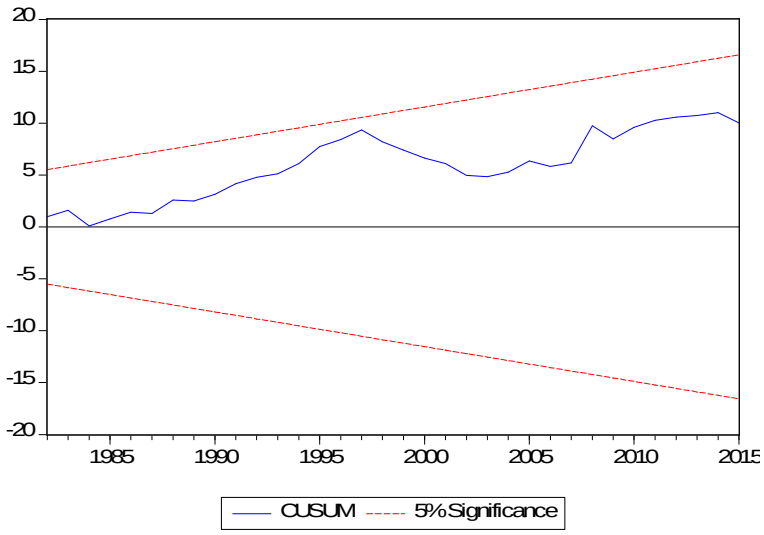

Figure 7: Model C (CUSUM): Plot of Cumulative sum of Recursive Residuals

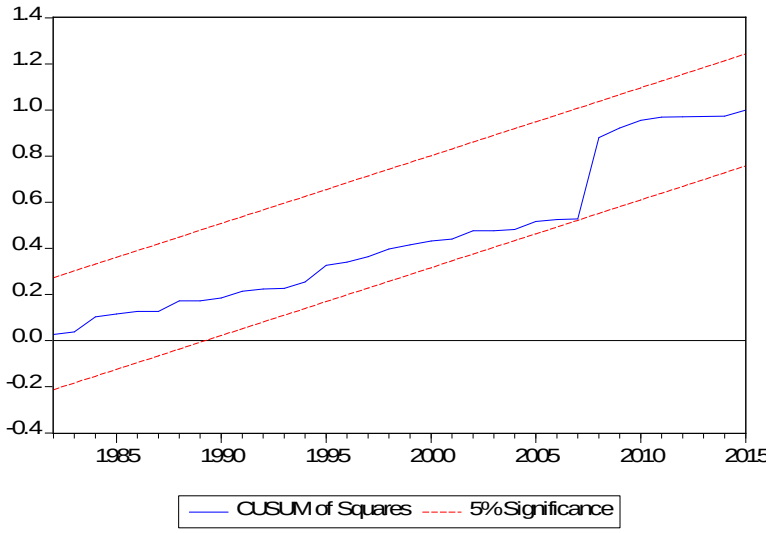

Figure 8: Model C (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals

Table 14: Short Run estimates (ECM) Model D

Dependent Variable ΔCPI Repressor	Parameter Estimate	T-Ratio	P-values
Intercept	0.045	2.446	0.019
$\Delta Y(-1)^a$	0.049	0.173	0.863
$\Delta TO(-1)$	-0.001	-0.624	0.536
$\Delta M2(-1)$	-0.035	-0.429	0.670
$\Delta FMO(-1)$	-0.002	-0.182	0.856
$ECT(-1)$	-0.201	-2.445	0.019**
R^2		0.509	
Adj. R^2		0.422	
S.E. of Regression		0.028	
D-W statistic for autocorrelation		2.021	
F-statistic (Prob)		0.000	
LM: $\chi^2(1)$ for serial correlation		0.150 (0.701) [b]	
ARCH $\chi^2(1)$		0.079 (0.780)	
White $\chi^2(6)$ for heteroscedasticity		0.138 (0.990)	
JB $\chi^2(1)$ for normality		2.763 (0.251)	
RESET for functional form		0.400 (0.531)	
CUSUM		Stable	
CUSUMSQ		Stable	

Notes: [a] Refers to the number of lags. [b] The degrees of freedom for the other tests are in parentheses adjacent to the distributions.

*, **, *** Significant at the 1.0, 5.0, 10% levels respectively.

D-W is the Durban Watson test for autocorrelation. LM is the Lagrange multiplier test of residual serial correlation. ARCH and white are tests for heteroscedasticity based on Engle (1982) and White (1980), respectively. JB statistics tests for normality in the residuals. RESET is a test for specification error. ECT is the lagged residual from the cointegration regression., and Δ is the first difference operator.

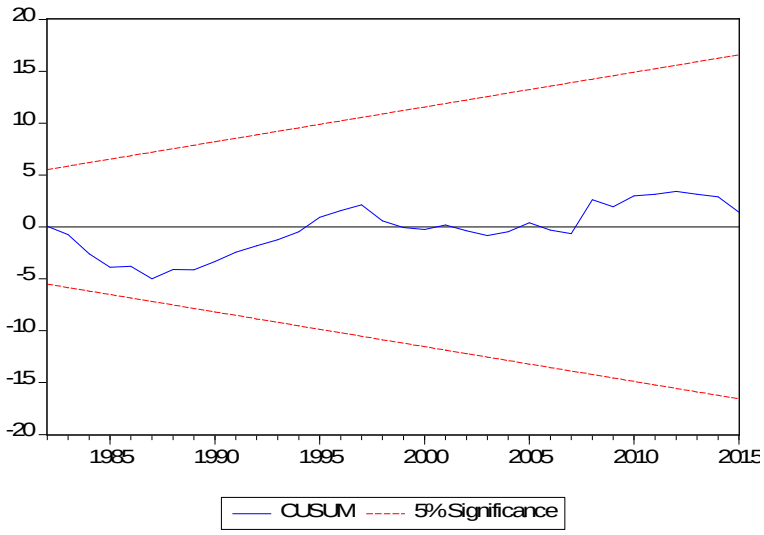

Figure 9: Model D (CUSUM): Plot of Cumulative sum of Recursive Residuals

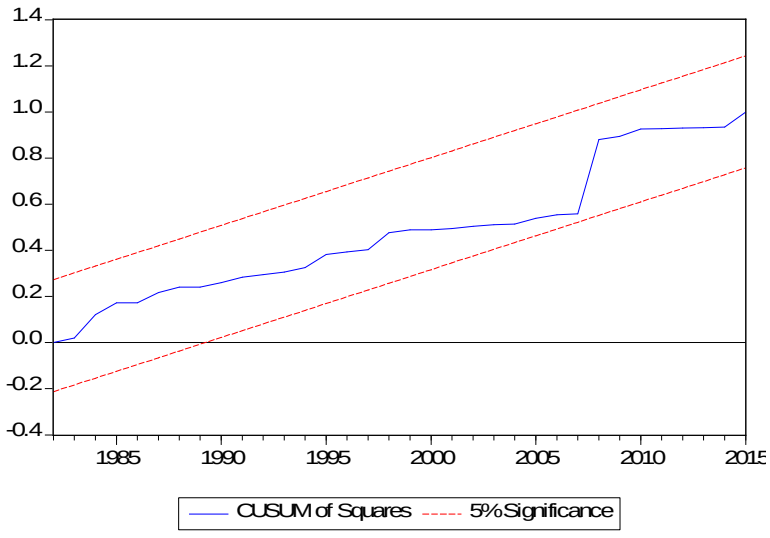

Figure 10: Model D (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals

Table 15: Short Run estimates (ECM) Model E

Dependent Variable ΔCPI Repressor	Parameter Estimate	T-Ratio	P-values
Intercept	0.054	3.193	0.003
$\Delta M2(-1)^a$	0.007	0.092	0.926
$\Delta TO(-1)$	-0.000	-0.524	0.603
$\Delta G(-1)$	-0.098	-1.959	0.058***
$\Delta IMPR(-1)$	-0.013	-0.214	0.831
$ECT(-1)$	-0.317	-3.632	0.000*
R^2		0.613	
Adj. R^2		0.545	
S.E. of Regression		0.025	
D-W statistic for autocorrelation		2.115	
F-statistic (Prob)		0.000	
LM: $\chi^2(1)$ for serial correlation		0.497 (0.485) [b]	
ARCH $\chi^2(1)$		0.010 (0.918)	
White $\chi^2(6)$ for heteroscedasticity		1.174 (0.343)	
JB $\chi^2(1)$ for normality		1.006 (0.604)	
RESET for functional form		0.489 (0.488)	
CUSUM		Stable	
CUSUMSQ		Stable	

Notes: [a] Refers to the number of lags. [b] The degrees of freedom for the other tests are in parentheses adjacent to the distributions.

*, **, *** Significant at the 1.0, 5.0, 10% levels respectively.

D-W is the Durban Watson test for autocorrelation. LM is the Lagrange multiplier test of residual serial correlation. ARCH and white are tests for heteroscedasticity based on Engle (1982) and White (1980), respectively. JB statistics tests for normality in the residuals. RESET is a test for specification error. ECT is the lagged residual from the cointegration regression., and Δ is the first difference operator.

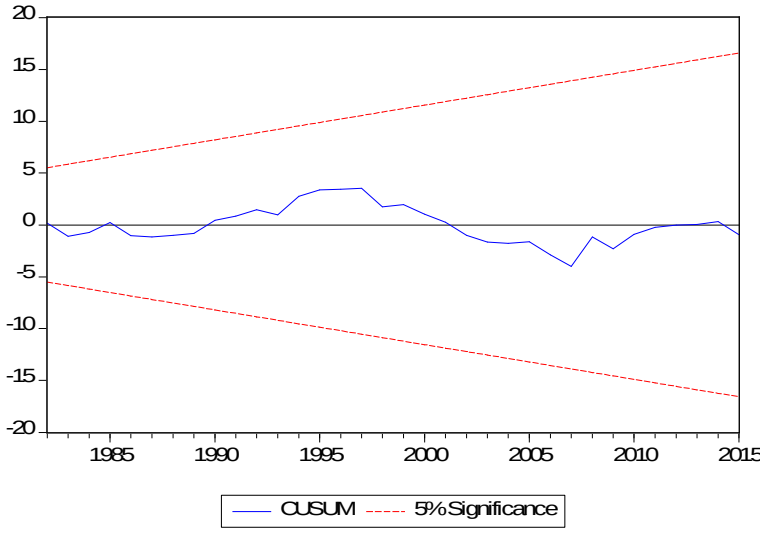

Figure 11: Model E (CUSUM): Plot of Cumulative sum of Recursive Residuals

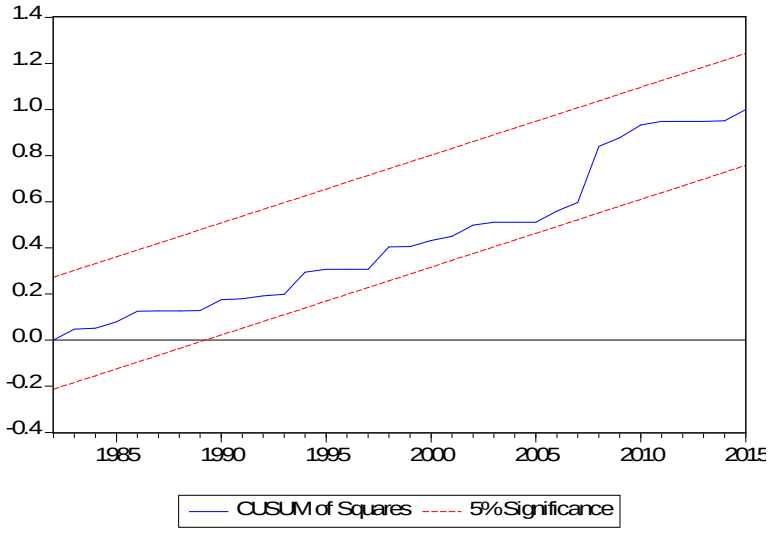

Figure 12: Model E (CUSUMSQ): Plot of Cumulative sum of Squares of Recursive Residuals

4.6 Diagnostic test Statistics:

All the estimated equations pass through the conventional diagnostic tests. Lagrange multiplier and Durbin-Watson statistic for serial correlation, ARCH and white tests for heteroscedasticity, Jarque-Bera test for normality and Ramsey's RESET for functional form. The diagnostic test statistics shows no evidence of misspecification, no serial correlation nor any problem of heteroskedasticity and no problem of normality in the residuals. The estimated regressions supported by various diagnostic tests suggests a reasonable fit of the models on the data.

4.7 Toda-Yamamoto Causality test Analysis:

Toda and Yamamoto (1995) causality tests are shown in Table 16, 17, 18, 19, and 20. The cointegration among the variables in each of the model indicates expected causal relationship among the variables in either direction. The number of optimal lags is determined by the Akaike information criterion and Schwarz information criterion.

The result concludes that there is a causal flow running from money supply to inflation, output growth and trade openness to money supply. The overall significance of the variable money supply in the short run are in line with the long run relationship (See Table 6 and 16, Model A). There is short run causality running from money supply to inflation and import value index. The joint significance of import value index shows only the short run relationship (See Table 17, Model B).

There is short run causality running from trade openness and inflation to exchange rate, and output growth to financial market openness. Exchange rate is statistically significant indicating both short run and long run relationship with inflation (See Table 8 and 18, Model C) while significance of financial market openness shows only short run relationship. There is short run causality from inflation, money supply and financial market openness to output growth. Output growth is statistically significant indicating both short run and long run relationship with inflation (See Table 9 and 19, Model D). The variable trade openness has short run relationship with inflation but no long run relationship while import value index have both short run and long run relationship with inflation (See Table 10 and 20, Model E).

Table 16: Toda-Yamamoto Causality estimates Model A

Dependent Variables ↓ / Independent Variables →	CPI	Y	TO	M2	G	Overall Significance $\chi^2(3)$
CPI	-	1.010 (0.798)	1.359 (0.715)	10.345 (0.015**)	4.062 (0.254)	0.001*
Y	3.616 (0.306)	-	2.339 (0.505)	0.775 (0.855)	1.713 (0.633)	0.708
TO	2.187 (0.534)	0.619 (0.892)	-	0.821 (0.844)	1.819 (0.610)	0.370
M2	5.859 (0.118)	12.504 (0.005*)	8.214 (0.041**)	-	3.475 (0.324)	0.062***
G	0.304 (9.59)	1.422 (0.700)	5.112 (0.163)	0.239 (0.970)	-	0.259

Notes: Number in parentheses is the P-value. *, **, *** Significant at the 1%, 5.0% and 10% levels respectively. Dash denotes variable with itself.

Table 17: Toda-Yamamoto Causality estimates Model B

Dependent Variables ↓ / Independent Variables →	CPI	Y	TO	M2	IMPR	Overall Significance $\chi^2(3)$
CPI	-	1.640 (0.650)	1.917 (0.589)	10.421 (0.015**)	4.928 (0.177)	0.010**
Y	4.184 (0.242)	-	3.531 (0.316)	1.084 (0.780)	1.326 (0.722)	0.667
TO	2.678 (0.443)	1.910 (0.591)	-	2.101 (0.551)	1.629 (0.652)	0.399
M2	4.982 (0.173)	5.212 (0.156)	4.118 (0.249)	-	1.414 (0.702)	0.281
IMPR	3.190 (0.363)	2.611 (0.455)	3.128 (0.372)	15.906 (0.001*)	-	0.020**

Notes: Number in parentheses is the P-value. *, **Significant at 1% and 5%, levels, respectively. Dash denotes variable with itself.

Table 18: Toda-Yamamoto Causality estimates Model C

Independent Variables → / Dependent Variables ↓	CPI	Y	TO	ER	FMO	Overall Significance $\chi^2(1)$
CPI	-	0.543 (0.461)	0.402 (0.526)	0.021 (0.882)	0.042 (0.836)	0.894
Y	0.271 (0.602)	-	0.118 (0.731)	0.045 (0.830)	0.343 (0.557)	0.933
TO	0.411 (0.521)	5.309 (0.021)	-	1.231 (0.267)	0.071 (0.789)	0.148
ER	4.104 (0.042**)	0.444 (0.505)	6.290 (0.012**)	-	0.160 (0.688)	0.007*
FMO	0.966 (0.325)	4.949 (0.026**)	0.206 (0.649)	0.216 (0.642)	-	0.095***

Notes: Number in parentheses is the P-value. *, **, *** Significant at the 1%, 5.0% and 10% levels respectively. Dash denotes variable with itself.

Table 19: Toda-Yamamoto Causality estimates Model D

Independent Variables → / Dependent Variables ↓	CPI	Y	TO	M2	FMO	Overall Significance $\chi^2(3)$
CPI	-	2.136 (0.544)	2.674 (0.444)	5.650 (0.129)	0.899 (0.825)	0.072***
Y	12.195 (0.006*)	-	5.881 (0.117)	7.224 (0.065***)	9.24 (0.026**)	0.084***
TO	5.015 (0.170)	0.893 (0.827)	-	1.882 (0.597)	4.048 (0.256)	0.148
M2	5.689 (0.127)	3.015 (0.389)	4.232 (0.237)	-	2.883 (0.409)	0.145
FMO	5.069 (0.166)	0.343 (0.951)	0.565 (0.904)	5.408 (0.144)	-	0.190

Notes: Number in parentheses is the P-value. *, **, *** Significant at the 1%, 5.0% and 10% levels respectively. Dash denotes variable with itself.

Table 20: Toda-Yamamoto Causality estimates Model E

Independent Variables → / Dependent Variables ↓	CPI	M2	TO	G	IMPR	Overall Significance $\chi^2(3)$
CPI	-	21.449 (0.000*)	4.801 (0.186)	3.820 (0.281)	4.394 (0.221)	0.000*
M2	5.218 (0.156)	-	0.568 (0.903)	1.930 (0.587)	3.944 (0.267)	0.584
TO	4.052 (0.255)	6.567 (0.087***)	-	5.618 (0.131)	2.497 (0.475)	0.054***
G	5.661 (0.129)	0.289 (0.962)	9.692 (0.021**)	-	3.241 (0.355)	0.157
IMPR	0.768 (0.857)	15.041 (0.001*)	1.710 (0.634)	1.271 (0.735)	-	0.007*

Notes: Number in parentheses is the P-value. *, **, *** Significant at the 1%, 5.0%, and 10% levels respectively. Dash denotes variable with itself.

4.8 Pairwise Granger Causality test Analysis:

The pairwise granger causality test to determine the direction of relationship among proposed variables for Pakistan are shown in Table 21. The number of optimal lag is determined by the Akaike information criterion and Schwarz information criterion.

The results show that there is unidirectional causality between exchange rate and inflation, money supply and inflation, import prices and inflation, financial openness and inflation, output growth and government spending, exchange rate and import prices, money supply and government expenditure.

The bilateral causality is observed between government expenditure and inflation, import prices and money supply, and import prices and government expenditure.

Table 21: Granger Causality Results F Statistics

Variables	F-statistics	P-value
lnY → lnCPI	2.38	0.13
lnCPI → lnY	0.25	0.61
TO → lnCPI	1.33	0.25
lnCPI → TO	1.51	0.22
ER → lnCPI	4.42	0.04**
lnCPI → ER	0.01	0.90
M2 → lnCPI	19.61	0.00*
lnCPI → M2	14.32	0.22
lnG → lnCPI	3.64	0.06***
lnCPI → lnG	3.93	0.05**
lnIMPR → lnCPI	7.27	0.01**
lnCPI → lnIMPR	0.30	0.58
FMO → lnCPI	7.34	0.00*
lnCPI → FMO	0.01	0.89
TO → lnY	0.09	0.76
lnY → TO	0.42	0.51
lnER → lnY	0.50	0.47
lnY → lnER	1.08	0.30
M2 → lnY	0.00	0.41
lnY → M2	14.1	0.66
lnG → lnY	0.01	0.90
lnY → lnG	11.03	0.00*
lnIMPR → lnY	0.34	0.56
lnY → lnIMPR	2.28	0.13
FMO → lnY	0.74	0.39
lnY → FMO	0.26	0.61
lnER → TO	2.1E-05	0.99
TO → lnER	0.01	0.88
M2 → TO	0.11	0.31
TO → M2	0.07	0.44
lnG → TO	0.39	0.53
TO → lnG	0.18	0.66
lnIMPR → TO	1.62	0.21

TO	→	lnIMPR	0.14	0.70
FMO	→	TO	0.00	0.92
TO	→	FMO	0.00	0.97
M2	→	lnER	1.76	0.94
lnER	→	M2	4.19	0.83
lnG	→	lnER	0.91	0.34
lnER	→	lnG	0.40	0.53
lnIMPR	→	lnER	0.06	0.79
lnER	→	lnIMPR	4.71	0.03**
FMO	→	lnER	0.20	0.65
lnER	→	FMO	1.33	0.25
lnG	→	M2	10.69	0.26
M2	→	lnG	0.24	0.04**
lnIMPR	→	M2	14.18	0.04**
M2	→	lnIMPR	21.15	0.00*
FMO	→	M2	3.89	0.40
M2	→	FMO	2.3E-06	0.76
lnIMPR	→	lnG	5.72	0.02**
lnG	→	lnIMPR	2.87	0.09***
FMO	→	lnG	0.28	0.59
lnG	→	FMO	0.03	0.86
FMO	→	lnIMPR	2.60	0.11
lnIMPR	→	FMO	0.00	0.95

*, **, *** Significant at the 1%, 5.0%, and 10% levels respectively.

4.9 Impulse Response Functions:

The VAR shocks will be biased if relevant variables are omitted. To avoid the variable biasness the VAR model is constructed based on structural assumptions. A one standard deviation band is constructed around point estimates. If this band excludes zero the effect is considered significant. The ordering chosen for study are following. (1) IMPR, TO, M2, G, ER, Y, CPI. (2) FMO, M2, G, ER, TO, Y, CPI.

The import value index as foreign price shock variable is placed first in ordering one as Pakistan is a net importer country with increasing trade deficit from a decade so that current period shock to foreign prices are allowed to influence domestic policy variables (TO, M2, G, ER). The domestic policy variables are placed next in which current period shock to the policy variables can affect the price level and output growth contemporaneously. It is assumed that current period shock to price level and output growth have no contemporaneous effect on the policy variables.

Finally, the placement of CPI and Y last allows the domestic prices and output level to respond directly and indirectly to contemporaneous shocks to domestic policy variables as well as foreign price shock. The VAR order is set to one lag with 10-year forecast horizon. Impulse response functions generated by the VAR model ordering (1) are shown in Figure 13.

The price effect of IMPR innovation initially rises during the first 2 years, after which start decreasing. The price effect of IMPR is observed to be significantly positive at 7-year forecast horizons however in the long run the effect become negative. In case of shock to openness the price effect increases in the short run up to 2-year horizon. A significant positive effect is observed at the 5-year horizon. In the longer run the price effect of openness innovation become significantly negative.

The price effect of M2 appears to be initially negative but quickly become positive. Th effect is constantly increasing up to the 5-year horizon, however in the long run start decreasing. The price effect of money supply found to be positively significant throughout the time horizon. The price effect of a shock to government expenditure are observed to be negative and significant both in the long and short run.

In case of innovation to exchange rate a significant positive effect is observed at 2-year time horizon, however in the long run, the effect become significantly negative. The price effect of output growth initially decreases at horizon of 2-years. The effect is significantly negative at 5-year horizon. However, in the long run the effect significantly positive.

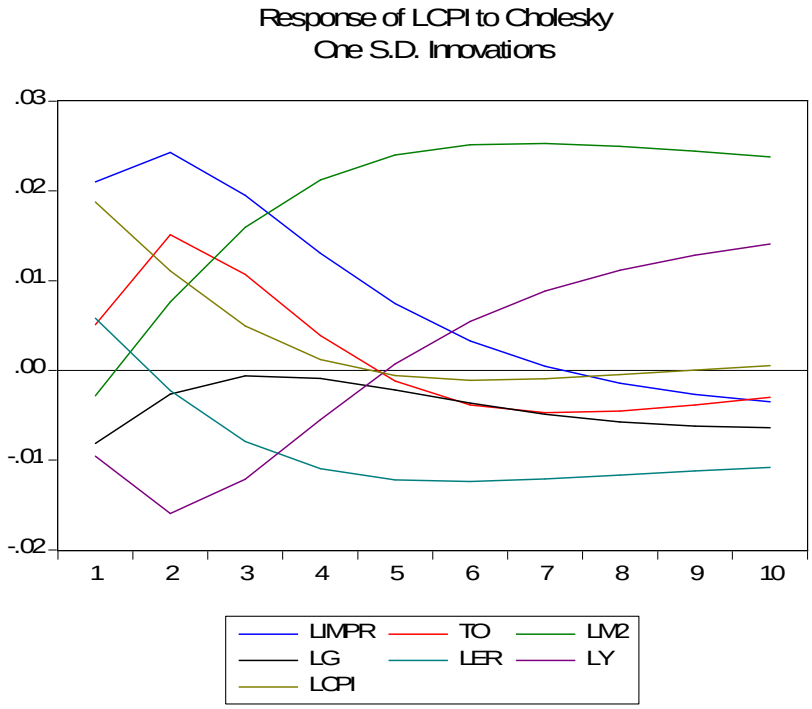

Figure 13: Impulse Responses Variable Ordering (1)

The second ordering of variables employs finical market openness an alternative openness measure. The openness relation with inflation and growth may occur through investment and hence increasing openness may increase long run growth and reduce inflation as long as openness provides high access to investment goods. The FMO is placed first on the assumption that Pakistan is a developing country so that the shock to capital inflow are allowed to influence domestic variables. The monetary and fiscal policy variables M2 and G are placed next in order to allow trade openness to be affected by contemporaneous shocks to M2 and G.

The exchange rate is placed next as monetary and fiscal policy shocks may cause large foreign exchange depreciation, the depreciation would increase exports but decrease imports and thus may cause trade openness and output growth to be affected by exchange rate. Finally, the placement of CPI last is assumed to respond to contemporaneous shocks to exchange rate, domestic policy variables and capital inflow. The lag one is employed to VAR ordering with 10 years forecast horizon. Impulse response functions generated by the VAR model ordering (2) are shown in Figure 14.

The price effect of FMO innovation is negative in the short run at 2-yeat time horizon but increasing. The rise in FMO innovation is observed at 8 horizons after which it becomes stable. It is observed that the price effect of FMO is significantly negative in the short run but become positive in the long run. One possible explanation for the positive price effect on FMO for Pakistan being the instability of financial institutions and local currency. The Pakistan rupee is continuously depreciating from decades with major collapse in 2008 and 2009, the time which has been recorded as global financial crises together with peaked oil prices. The argument is that financial liberalization of a developing country whose economic fundamentals are not strong increased international capital inflows may cause high exchange rate volatility which reduces the probability and efficiency of investment projects. Thus, conventional view of purchasing power parity puts an upward pressure on the price level. In case of innovation to money supply the price effect initially appears to be negative but quickly become positive. In the long run the price effect innovations to money supply is significantly positive.

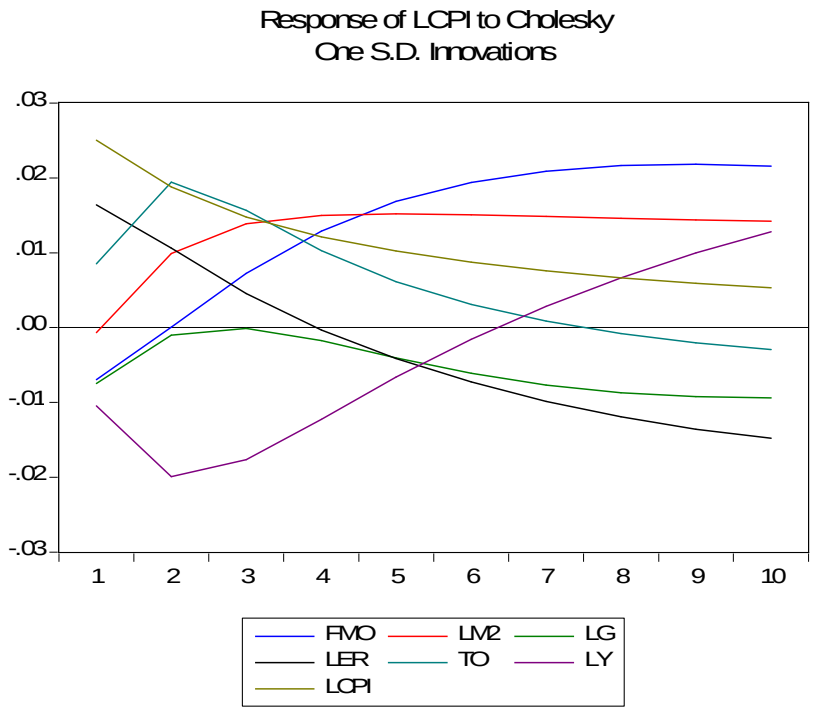

Figure 14: Impulse Responses Variable Ordering (2)

The price effect of government expenditure is negative at 3-year horizon after which the effect become close to zero. However, afterwards the effect is significantly negative again. The price effect of government expenditure shock is observed to be significantly negative both in the long and short run. The exchange rate has positive and significant impact on the price level at the 4-year horizon. Afterwards the effect become significantly negative in the long run. In case of shock to openness again price effect is significantly positive at the 8 year-horizon but afterwards the effect become negative. The price effect of output level is significantly negative at the 6-year horizon while in the long run the effect is significantly positive.

4.10 Variance Decomposition Computations:

The variance decomposition provides information about the relative importance of each random shock to the variables in the VAR system. The higher the variance attributed to cross variable innovations, the stronger the interactions among the variables in the system. Table 20 and 21 reports variance decompositions over 20-year period generated by the VAR model ordering (1) and (2). The Monte Carlo integration procedure is employed to estimate standard errors for the VDCs (e.g., Runkle, 1987). The draws used in Monte Carlo procedure are one thousand.

The forecast error variance of price level explained by openness is not significant and appears to decrease over horizons in each of the variable ordering. The effects of openness are greater than fiscal policy variable G but less than monetary policy variables M2 and ER in most of the time horizon.

However financial openness shocks are found to be increasing in the long run but no significant. The point estimates of the VDCs explained by IMPR innovation are significant in the short run. Shocks to monetary policy variables M2 appear to be significant in the long horizon while ER is observed to be significant in the short run. The effects of fiscal policy variable G innovations are observed to be relatively small and insignificant. Output growth found to have significant effect on the price level in the long run. Thus, the shocks emanating from import prices and exchange rate in the short run, while output growth and money supply in the long horizon are an important sources of price level in Pakistan. One prominent view is that government policies controlling monetary measures (M2 and ER) are an important source of inflation in Pakistan.

Table 22: Variance Decompositions (Variable Ordering 1)

Forecast error in	Horizon (Years)	Explained by shocks to						
		IMPR	TO	M2	G	ER	Y	CPI
CPI	1	43.3 (12.2) *	2.5 (4.0)	0.7 (2.7)	6.5 (5.3)	3.3 (3.9)	8.9 (5.3)	34.6 (7.9)
	4	39.0 (13.6) *	9.4 (8.7)	19.0 (9.6)	1.8 (3.8)	5.4 (4.1)	12.8 (6.6)	12.3 (4.2)
	8	21.8 (11.1)	5.8 (8.3)	42.9 (13.8) *	1.9 (6.0)	10.6 (7.7)	9.9 (6.5)	6.6 (2.8)
	12	15.1 (9.9)	4.1 (8.8)	48.2 (15.2) *	2.7 (7.7)	11.0 (9.9)	14.1 (10.4)	4.4 (2.8)
	16	12.0 (9.7)	3.1 (9.4)	48.6 (16.2) *	2.8 (8.7)	10.5 (9.6)	19.3 (13.0)	3.3 (3.3)
	20	10.3 (9.7)	2.5 (10.1)	47.6 (17.0) *	2.6 (9.2)	9.5 (9.5)	24.4 (14.7)	2.7 (3.7)

Notes: The number in parentheses shows standard errors estimated by using Monte Carlo integration procedure. The point estimates are significant if the estimate is at least twice the standard error.

Table 23: Variance Decompositions (Variable Ordering 2)

Forecast error in	Horizon (Years)	Explained by shocks to						
		FMO	M2	G	ER	TO	Y	CPI
CPI	1	4.0 (6.4)	0.0 (3.3)	4.7 (3.6)	22.7 (10.2) *	6.1 (5.7)	9.2 (5.9)	53.0 (10.5)
	4	6.1 (7.4)	11.8 (9.5)	1.3 (5.6)	9.2 (6.1)	18.3 (10.7)	22.2 (9.8)	30.8 (9.6)
	8	23.6 (14.4)	18.2 (11.9)	3.2 (7.3)	9.1 (6.5)	10.9 (8.5)	13.7 (8.5)	21.0 (8.8)
	12	28.9 (15.6)	17.6 (12.5)	4.7 (8.8)	12.8 (9.1)	7.0 (7.6)	14.9 (9.9)	13.8 (7.2)
	16	27.5 (15.5)	17.1 (12.9)	4.7 (9.7)	14.4 (10.4)	5.2 (7.5)	20.9 (12.4)	9.8 (6.0)
	20	24.8 (15.3)	17.7 (13.2)	4.3 (10.3)	14.1 (11.1)	4.0 (7.8)	27.1 (13.9) *	7.6 (5.4)

Notes: The number in parentheses shows standard errors estimated by using Monte Carlo integration procedure. The point estimates are significant if the estimate is at least twice the standard error.

Chapter 5: Conclusion and Policy Recommendation

5.1 Conclusion:

This study examines the effect of openness on the growth rates of inflation in Pakistan using annual time series data for the period 1973 to 2015. This study differs from other studies as we investigate the relationship between openness and inflation with Johansen's maximum likelihood cointegration procedure along with impulse response functions and forecast error variance decomposition of vector autoregressive model. In orders words, it helps to separate the effect of short run and long changes in the explanatory variables to the dependent variable. The empirical analysis employed five variable VAR models with different permutation of variables.

The long run cointegration estimates show that openness has a significant positive impact on inflation along with other variables exchange rate, money supply, government expenditure and import prices. The output growth and financial openness have significant negative impact on inflation in the long run. In the short run, ECM estimates show only the coefficient of government expenditure appears to be significant having negative impact on inflation. The results are in line with IRFs except for exchange rate, government expenditure and financial openness. The government expenditure and financial openness short run estimates are in line with IRF but in the long run the effect is inconclusive. However, the curve of exchange rate is increasing and financial openness is decreasing in the long run in variable ordering thus supporting the results.

The Toda Yamamoto causality test indicates the short run causality among the variables. Inflation in the short run causes a change in exchange rate and output growth. The output growth in the short run causes a change in money supply and financial openness. There is no short run causality from exchange rate, government expenditure and import prices to other variables. In case of trade openness, the causal relationship is with money supply, exchange rate and government expenditure. Moving to money supply in the short run can cause inflation, import prices, output growth and trade openness while financial openness can cause short term changes in output growth.

The Toda Yamamoto causality estimates show that overall significance of the variables money supply, import prices, exchange rate, financial openness, output growth, and trade openness have

short run relationship with inflation as well in each of the VAR model. The variance decomposition also indicates that shocks to import prices and exchange rate have significant effects on inflation in the short run.

The direction of causality has been investigated by applying the Pair Wise Granger Causality test. The bidirectional causality is found between government expenditure and inflation, import prices and money supply and import prices and government expenditure.

The effects of changes in the growth rates of inflation by shocks to openness and other explanatory variables is evaluated through impulse response functions (IRFs) and variance decompositions (VDCs). The impulse response function indicates that significant effect of a shock to openness on the growth rate of inflation is positive in the short run while the effect become negative in the long run. The price effect of a shock to financial openness an alternative openness measure is however negative in the short run but becomes significantly positive in the long run. The variance decompositions indicate that shocks to import prices and exchange rate in the short run, output growth and money supply in the long run, have greater impacts on inflation than does the openness shock.

However, it can be concluded that the positive link of trade openness and financial openness with inflation set forth a relatively new area of modelling the Pakistan economic liberalization policy, particularly for optimal trade regime.

5.2 Policy Recommendation:

The response of output growth by shocks to trade openness and financial openness evaluated through IRFs and VDCs, however is significantly positive but not presented here due the domain of research. The results support the new growth theories in which openness affects long term economic growth through knowledge based economy. For developing like Pakistan, the liberalization should lieu in support of endogenous growth theory which will contribute to the success of both targeting economic growth and inflation.

The domestic policy variables used in this study such as money supply, exchange rate and government expenditure have expected statistically significant impact on the domestic inflationary process. On the basis of our quantitative analysis it is the interdependence of monetary and fiscal

policies that are important measures putting an inflationary impact in the economy. Pakistan is an importing economy whose major import constitute crude oil high openness may cause it vulnerable to external shocks. Therefore, there is a need to control monetary policy by making it less dependent and requires an immediate consolidation of fiscal policy by maintaining some threshold level for fiscal imbalances.

References

Afzal, M., Malik, M. E., Butt, A.R., and Fatima, K. (2013). Openness, Inflation, and Growth relationships in Pakistan: An Application of ARDL bounds testing approach, Pakistan Economic and Social Review, 51 (1), 13-53.

Ahmad, K., Shahbaz., M. (2007). Openness-Inflation puzzle for Pakistan. Under two alternative approaches, European Journal of Economics, Finance and Administrative Sciences, 8, 39-50.

Ajaz, T., Nain, M. Z., and Kamaiah, B. (2016). Inflation and openness in India: an asymmetric approach, Macroeconomics and Finance in Emerging Market Economies, 9 (2), 190-203.

Al Nasser, O. M., Sachsida, A., and Mario, M. (2009). The openness-inflation puzzle: panel data evidence. International Research Journal of Finance and Economics 28, 1450-2887.

Alfaro, L. (2005). Inflation, openness and exchange rate regimes: The quest for short-term commitment. Journal of Development Economics, 77 (1), 229-249.

Ashra, S. (2002). Inflation and Openness: A case study of selected developing economies, Working Paper 84. Indian Council of Research on International Economic Relations (ICRIER).

Atabay, R. (2016). The Relationship between Trade Openness and Inflation in Turkey, Research in Business and Social Science, 5 (3), 137-145.

Badinger, H. (2009). Globalization, the output-inflation tradeoff and inflation. European Economic Review, 53 (8), 888-907.

Badinger, H. (2010). Globalization, Taylor rules and inflation. Applied Economic Letters, 17 (3), 263-267.

Batra, R. (2001). Are Tariffs Inflationary? Review of International Economics, 9, 373-382.

Bleaney, M. (1999). The disappearing openness-inflation relationship: A cross country analysis of inflation rates. IMF Working Paper No 1999 (161), Washington DC.

Bleaney, M, and Francisco, B. (2007). Exchange rate regimes, inflation and growth in developing countries-An assessment. Berkley Journal of Macroeconomics, 7 (1), 1-18.

Boschen, J, and Weise, C. (2003). What starts inflation: Evidence from the OECD Countries, Journal of Money, Credit and Banking, 35 (3), 323-349.

Bowdler, C. and Nunziata, L. (2006). Trade Openness and Inflation Episodes in the OECD, Journal of Money, Credit and Banking, 38 (2), 553-563.

Bowdler, C. (2009). Openness, exchange rate regimes, and the Phillips curve, Journal of International Money and Finance, 28 (1), 148-160.

Cavallari, L. (2001). Inflation and Openness with Non-Atomistic Wage Setters, Scottish Journal of Political Economy, 48 (2), 210-225.

Cavelaars, P. (2009). Does globalization discipline monetary policy makers? Journal of International Money and Finance, 28 (3), 392-405.

Cooke, D. (2010). Openness and Inflation. Journal of Money, Credit and Banking, 42 (2-3), 267-287.

Cukierman, A., Webb., S.B, and Neyapti, B. (1992). Measuring the independence of central banks and its effects on policy outcomes. World Bank Economics Review, 6 (3):353-398.

Daniels, J. P., Nourzad, F., VanHoose, D. D. (2005). Openness, central bank interdependence and the sacrifice ratio, Journal of Money, Credit and Banking, 37 (2), 371-379.

Daniels, J. P., VanHoose, D. D. (2006). Openness, the sacrifice ratio, and inflation: is there a puzzle? Journal of International Money and Finance, 25 (8), 1336-1347.

Daniels, J. P., VanHoose, D. D. (2007). Trade Openness, Capital Mobility, and the Sacrifice Ratio. Unpublished Manuscript.

Davidson, R. and Mackinnon, J. (1993). Estimation and Inference in Econometrics, Oxford University Press, New York.

Engle, R. F. (1982). Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation, Econometrica, 50, 987-1007.

Engle, R. F. and Granger, C. W. J. (1987). Co-integration and error correction: representation, estimation and testing, Econometrica, 55, 251-276.

Engle, R. F. and Yoo, B. S. (1987) Forecasting and testing in co-integrated systems, Journal of Econometrics, 35, 143-159.

Evans, R, W. (2012). Is openness inflationary? Policy commitment and imperfect competition, Journal of Macroeconomics, 34 (4), 1095-1110.

Feleke, M. (2014). Effect of Trade openness and Inflation in Ethiopia (An Auto Regressive Distributive Lag Approach, Economic Policy Analysis, M.Sc. Thesis, Addis Ababa University.

Fischer, S. (1993). The role of macroeconomic factors in growth. Journal of Monetary Economics, 32 (3), 485-512.

Food and Agriculture organization of the United Nations. (2012). FAOSTAT statistics database, Rome, Italy.

Furuoka, F. and Mun Ho, C. (2009). Phillips curves and Openness: New evidence from selected Asian economies. Economics Bulletin, 29 (1), 253-264.

Ghosh, A. (2014). How do openness and exchange-rate regimes affect inflation? International Review of Economics and Finance, 34 (0), 190-202.

Granato, J., Lo, M., Wong M.C. Sunny. (2007). A note on Romer's openness-inflation relation: the responsiveness of AS and AD to economic openness and monetary policy. Applied Economics 39, 191-197.

Gruben, W.C., McLeod, D. (2004). The Openness-Inflation puzzle revisited. Applied Economics Letters, 11, 465-468.

Gujarati, D. N. (1995). Basic Econometrics (3rd Ed). McGraw-Hill International Editions. New York.

Hanif, M. N., Batool, I. (2006). Openness and Inflation: a case study of Pakistan MPRA Paper No. 10214, University Library of Munich, Germany.

Haq, I. U., Alotaish, M. S. M., Kumara, N. G. S., and Otamurodov, S. (2014). Revisiting the Romer's hypothesis: Time series evidence from small open economy, Pakistan Journal of Applied Economics 24 (1), 1-15.

Iyoha, M. A. (1973). Inflation and openness in less developed countries: A cross country analysis. Economic Development and Cultural change, 22 (1), 31-38.

Jalil, A., Tariq, R., and Bibi, N. (2014). Fiscal deficit and inflation: New evidences from Pakistan using a bound testing approach, Economic Modelling, 37 (2), 120-126.

Jin, J. (2000). Openness and growth: an interpretation of empirical evidence from East Asian countries. Journal of International Trade and Economic Development, 9, 5:17.

Jin, J. (2006). Openness, growth and inflation: Evidence from South Korea before the economic crisis, Journal of Asian Economics, 17 (4), 738-757.

Johansen, S. (1988). Statistical analysis of cointegration vectors, Journal of Economics Dynamics and Control, 12, 231-254.

Johansen, S. (2000). Modelling of cointegration in the vector autoregressive model. Economic Modelling, 17, 359-373.

Johansen, S. and Juselius, K. (1992). Structural hypothesis in a multi variate cointegration analysis of the PPP and UIP for UK, Journal of Econometrics, 63, 7-36.

International Monetary Fund, International Financial Statistics Year Book, Washington, DC, IMF, various years.

Karras, G. (1999). Openness and the effects of monetary policy. Journal of International Money and Finance, 18 (1), 13-26.

Kim, M., and Beladi, H. (2005). Is Free Trade Deflationary? Economic Letters, 42, 327-347.

Kirkpatrick, C.H., and Nixon, F.I. (1977). Inflation and openness in less developed economies: a cross country analysis: comment, Economic Development and Cultural Change, 26 (1), 147-152.

Kurihara, Y. (2013). International Trade Openness and Inflation in Asia. Research in World Economy, 4 (1), 70-75.

Lane, P. R. (1997). Inflation in Open Economics. Journal of International Economics, 42, 327-347.

Lartey, E. (2012). Financial openness, nontradeable inflation and optimal monetary policy, Economics Letters, 117 (3), 782-785.

Lin, H. Y. (2010). Openness and Inflation Revisited, International Research Journal of Finance and Economics, 37, 40-45.

Lucas, R. E., Jr. (1996). Nobel lecture: Monetary neutrality, Journal of Political Economy, 104, 661-682.

Mukhtar, T. (2010). “Does Trade Openness Reduce Inflation? Empirical Evidence from Pakistan”. The Lahore Journal of Economics*:* 35-50.

Musa, M. (1974). Tariffs and the distribution of income. Journal of Political Economy, 82: 1191-1204.

Niroomand, F., Hajilee, M., and Al Nasser, O. M. (2014) Financial market development and trade openness: evidence from emerging economics, Applied Economics, 46 (13), 1490-1498.

Pehnelt, G. (2007). Globalization and inflation in OECD countries. Jena Economics Research Papers, 55, 1-38.

Pesaran, M. H., Shin Y., and Smith, R. J. (2000). Structural analysis of vector error correction models with endogenous I(1) variables, Journal of Econometrics, 97, 293-343.

Rogoff, K. (1985). Can international monetary policy cooperation be counterproductive? Journal of International Economics, 18, 199-217.

Rogoff, K. (2003). Disinflation: an unsung benefit of globalization? Finance and Development, 40, 54-5.

Romer, D. (1993). Openness and Inflation: Theory and Evidence. Quarterly Journal of Economics, 108 (4), 869-903.

Runkle, D. E. (1987). Vector autoregressions and reality. Journal of Business and Economic Studies, 5, 437-442.

Sachsida, A., Galrao, F., and Loureiro, P.R.A. (2003). Does greater Trade openness reduce Inflation? Futher evidence using panel data techniques, Economic Letters, 81, 315-319.

Salimifar M., Razmi, M. J., Taghizadegan, Z. (2015). A survey of the effect of trade openness size on inflation rate in Iran using ARDL, Theoretical and Applied Economics, 22 (3), 143-154.

Samimi, A. J., Ghaderi, S., and Sanginabadi, B. (2011). Openness and inflation in Iran, International Journal of Economics and Management Engineering, 1 (1), 42-49.

Samimi, A. J., Ghaderi, S., Hosseinzadeh, R., Nademi, Y. (2012). Openness and inflation: New empirical panel data evidence, Economic Letters, 117 (3), 573-577.

Ssekuma, R. (2011). A study of Co-integration models with Applications, University of South Africa, South Africa

Sikdar, A., Kundu, N., Khan, Z. S. (2013). Trade openness and inflation: A test of Romer hypothesis for Bangladesh MPRA Paper No. 65244, University Library of Munich, Germany.

Sims, C. A. (1980). Macroeconomics and reality, Econometrica, 48, 1-48.

Tauci, H. M., Esener, S. C., Darici, B. (2009). The effects of openness on inflation: panel data estimates from selected developing countries. Investment Management and Financial Innovations, 6 (4), 28-34.

Temple, J. (2002). Openness, inflation and the Phillips Curve: a puzzle. Journal of Money, Credit and Banking, 34 (2): 450-468.

Terra, C. T. (1998). Openness and inflation: a new assessment. Quarterly Journal of Economics, 113 (2), 641-648.

Thomas, C. (2012). Trade Openness and Inflation. Panel data evidence for the Caribbean. International Business and Economics Research Journal, 11 (5), 507-516.

Toda, H. Y. and Yamamoto, T. (1995). Statistical inferences in vector autoregressions with possibly integrated processes, Journal of Econometrics, 66, 225-250.

Triffin, R and Grubel, H. (1962). “The adjustment Mechanism to Differential Rates of Monetary Expansion among the Countries of the European Economic Community.” Review of Economics and Statistics, 44: 486-491.

World Bank, (2016). World Development Report. Oxford: Oxford University Press.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and direct test for heteroskedasticity, Econometrica, 48, 817-838.

Wynne, M., and E. Kersting. (2007). Openness and Inflation. Federal Reserve Bank of Dallas Staff Papers, No. 2, April.

Zakaria, M. (2010). Openness and inflation, Evidence form time series data. Doğuş Üniversitesi Dersigi, 11 (2), 313-322.