Essays on Inflation in Emerging Markets and Developing Countries

Inaugural-Dissertation
zur
Erlangung des Doktorgrades
der
Wirtschafts- und Sozialwissenschaftlichen Fakultät
der
Universität zu Köln

2018

vorgelegt
von

DİLA ASFUROĞLU, M.A.

aus
İstanbul

Referent:	Univ.-Prof. Dr. Andreas Schabert
Korreferent:	Univ.-Prof. Michael Krause
Tag der Promotion:	16.03.2018

"You have never actually known what the real question is."

Douglas Adams

Acknowledgements

During my PhD studies, I have received encouragement from a great number of individuals. First, I would like to express my gratitude to Andreas Schabert for his supervision, support in many aspects and patience throughout this dissertation.

I would also like to thank the other members of my thesis committee, Michael Krause and Thomas Schelkle, for sparing the time. My sincere thanks goes to Christian Bredemeier, who is always open for long and in-depth discussions; Dagmar Weiler for her cordial support and Diana Frangenberg for her assistance.

I am also indebted to several colleagues and friends. Especially, Selcen Ozturkcan Ozdinc for her endless encouragement, Zeynep Okten for her strong belief in me, Ceyhun Elgin for his support in my career development, Yu Han for his collaborations, Deniz Bayram for her comments as an outside eye, Bengisu Fries and Alex Ritschel for their sympathy as all helped me to stay on course and made finishing my PhD less agonizing.

Finally, I am deeply and genuinely grateful to my family; and would like to dedicate this dissertation to them.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

This dissertation consists of three self-contained chapters that contribute to the research field of monetary macroeconomics. In these three chapters that have a broad range of research questions on inflation in emerging markets and developing countries, I aim to better understand the redistributive effects of anticipated inflation on individual behaviours together with welfare consequences; proximate, socio-economical and political drivers of inflation; and the relationship between central bank targets and foreign aid with a focus on the implications of inflation in foreign aid-recipient countries.

Chapter 2 and Chapter 4 are based on theoretical models whereas Chapter 3 is an empirical study. In Chapter 2, a Real Business Cycle model with two types of households where the impatient faces a borrowing constraint is used. Chapter 4 introduces foreign aid into a New Keynesian model in which monetary policy is represented by a Taylor rule. Chapter 3 utilizes a panel vector autoregressive approach incorporating different theories that explain drivers of inflation. Common to all these three chapters is their high relevance for monetary policy as they provide normative results for policy planners.

Chapter 2 establishes a model where lenders and borrowers emerge due to the difference in time preferences. More patient lenders value future more while impatient households value the consumption of today more than the patient households. Thus, impatient households derive a higher marginal utility from consuming today, leading to a need for borrowing in order to increase their current consumption. On the other hand, patient households engage in consumption smoothing by saving today. In this setting, the distributional effects of inflation is explored and the non-neutrality of money is assessed without aggregate and idiosyncratic risks, distortionary taxes and generation differences. Finally, money demand motive is introduced to this cashless economy where the decisions regarding to money holding generate another distortion in addition to the borrowing constraint. The aim in this analysis is to distinguish the effects of inflation under the

presence of money demand motive; and compare the welfare consequences of inflation tax in this economy with the cashless economy so as to provide a guideline to the policy planner in setting inflation rate.

In the theoretical setting, bond market can be considered as incomplete with nominally non-contingent bonds. Bonds are non-contingent in the sense that when the period of maturity comes for repayment, the amount of repayment is diminished by the inflation rate at the time of maturity and the time preference of the borrowers due to the period difference between obtaining the loan and maturity. The term *incomplete* financial market is used here in a slightly different terminological way than the literature has been using. For instance, as in the explanation of Sheedy (2016), the financial markets are called incomplete when the debt contracts cannot guarantee the debt repayments for all future event realizations. Contrary to this line of literature, there is no aggregate and idiosyncratic risk in the framework. However, when the maturity of the debt comes (i.e future event), the debt repayment is not the same value with the amount of loan obtained from the lender (i.e realization) due to the period difference between getting the loan and paying it back. Furthermore, the lender cannot seize the income of the borrower in the case of this gap in the amount (i.e bad realization of future from the perspective of lender) as there is no durable goods and future income for pledge as a collateral for the debt obligations.

Considering a less developed financial market where neither future income nor durable goods can be pledged for securitization of the debt obligation requires the lending to be restricted by current income. This, however, results in a nominal friction, as higher inflation reduces the real value of debt in terms of commodities at maturity, which is advantageous for borrowers. Therefore, even anticipated inflation becomes non-neutral. Furthermore, since the debt contracts are predetermined in nominal terms, inflation influences the net worth of borrowers; thereby redistributing from lenders to borrowers. The introduction of heterogeneous productivity levels illustrates that the amplification of the redistributional effects from monetary policy is observed, suggesting that the different productivity levels between the lenders and the borrowers provide a second channel for redistribution. In other words, income inequality facilitates the redistribution of generating inflation as the welfare gain from generating inflation is higher when income inequality (i.e heterogeneous labor productivities) is present.

The concept that has been investigated in Chapter 2, in essence, can also be related to the inflation risk of bond. Bonds have nominal face values unless they are inflation-indexed. Hence, their real values change with inflation. In the case of firms, an increase in real liabilities might cause them to default when the corporate debt is nominal. The literature in this line of research prices fluctuations in real firm values into corporate bond spreads;

and Kang and Pflueger (2015) find that the inflation risk explains a large fraction of the variation in credit spreads. Specifically, a permanent decrease in log inflation from three to one percent per annum increases the expected real principal repayment on a 10-year nominal bond by 22 percent. In the case of government, while the prices of both nominal government and inflation-indexed bonds vary with real interest rate, the prices of nominal government bonds also change with the expected inflation, leading to an impact on investors' risk premia by inflation risk[1]. Furthermore, the nominal bond returns respond both to the real interest rates and the expected inflation; and Campbell et al. (2016) find that high inflation is associated with high bond yields and low bond returns. For investors (i.e lenders) to avoid the loss that stems from this inflation risk associated with bonds, hedging is made possible via holding the inflation-indexed bonds issued by governments or corporate firms. In this chapter, the debt securities (i.e bonds) are issued by the borrower households; and the results are compatible with the literature, implying a loss for the lenders (i.e investors) due to the higher expected inflation in the absence of inflation-indexed bonds.

Augmentation of money demand enables to prescribe on the varying inflation rates considering the welfare costs of inflation tax. Social planner can set a implausibly high inflation rate, without accounting for money holding decisions, because doing so would hurt only one type of household, namely the lender, by redistributing away from them. The cashless economy suggests that the borrowers always benefit while the lenders always suffer from higher inflation. In contrast, money-in-utility model demonstrates that the additional distortion in the form of inflation tax can affect even the constrained households negatively, resulting in a welfare loss from generating inflation.

The optimal monetary policy in the sense of a specific inflation rate offer is beyond the scope of Chapter 2. Instead, it is concerned with the long-run role of the monetary policy, how it influences patient and impatient households; and hence, affects utilitarian welfare. In turn, it attempts to provide a prescription to a policy planner in setting inflation rate. In this regard, this chapter shows that the inflation rate has long-run real impacts, disproportionately affects heterogeneous households by redistributing from lenders to borrowers with anticipated inflation; and whether the inflation rate can be used as an instrument to improve utilitarian welfare relies on the presence of money demand in the form of money-in-utility model, the concern with pro-lender/borrower bias, the relationship between intertemporal elasticity of substitutions and the heterogeneous productivity levels. In other words, the policy planner should be concerned about these features when targeting an inflation rate to account for the welfare effects of that policy implication.

[1] Campbell and Viceira (2001).

This chapter can also be considered as a guide for monetary policy makers in a globally interlinked environment. With an analogy of developing countries as borrowers and developed countries as lenders, this chapter suggests that an equilibrium inflation initiated for the benefit of the lenders is likely to be harmful for the borrowers and in turn social welfare worsening. The same proposition can also be applied to the economic and monetary unions as they are bound by the decisions of the planner institution. In unions, the member countries, where not all of the economies exhibit the same advancement in terms of characteristics and the structure with each other, are subject to non-customized decisions of the policymaker institution. This study suggests that the actions by the monetary authority can still achieve union-wide welfare gain although the particular policy benefits only some of the participant countries on the cost of a loss for some of the countries embodied in the union, accounting for the above stated factors. Particular example in this case could be European Union where the member countries are tied by the decisions of the European Central Bank (ECB). Some countries in the union such as Germany and Sweden are having relatively better economic conditions than other countries such as Greece and Bulgaria. Among these member countries, some funds are changing hands in order to sustain the solidarity in Europe. Keeping in mind that the ECB has a target of %0.2 inflation rate, this chapter place a question mark on the discussion whether such a target impairs the recipient countries or donor countries of these funds.

Most central banks share the same aim of achieving price stability although each requires to consider the structure and the characteristics of its own economy. With an approach taking into account these differences, sources and responses of inflation can be exhaustively elaborated. In the literature, the empirical strategies for examining the determinants of inflation, in general, can be classified into two. First, the pattern of inflation in a single country over a long horizon can be studied. Over 50 or 100 years, there may be sufficient changes in inflation and institutions so that meaningful tests on different theories of inflation determinants can be checked. Secondly, the experiences in several different countries over a shorter time span can be compared as the differences in economical and political drivers among countries serve for an understanding of the inflation dynamics. Following the second strategy, in Chapter 3, the determinants of inflation in emerging market and developing countries are investigated.

Understanding the factors driving inflation changes is vital for several reasons. Inflation affects economic agents unequally by redistributing from one group to another. In other words, it shifts the purchasing power of some group to another. Investment decisions are discouraged by inflation as it engenders uncertainty about future. The attempts of central banks' trying to control the inflation rate may provoke revaluation of currencies hindering foreign demand. Alternatively, in the absence of any reactions by the central

banks, inflation tends to cause currency devaluation, giving rise to a vicious cycle that leads to hyperinflation. When the sources that cause fluctuations in inflation expectations are known, the conduct of monetary policy is eased as it improves the ability of the central bank to evaluate its own credibility and to assess the influence of its policy actions. To avoid the negative effects of inflation on economy and be able to pinpoint optimal reactions, diagnosing the determinants of inflation and the transmission of shocks together with interrelationships between inflation and economic factors are crucial, adding to the understanding of the inflation dynamics.

Chapter 3, first, presents an extensive review of the literature on the determinants of inflation. Then, it aims to improve the knowledge on inflation dynamics with two types of annual data by incorporating different theories on the drivers of inflation. The *proximate* determinants refer to exchange rate, unemployment rate, money growth, oil price and public debt. Next, the analysis continues with a focus on institutional factor, socio-economical and political characteristics of the countries. In particular, central bank independence index, income inequality and political structure index are considered as sources of inflation. The findings demonstrate that inflation is mainly driven by money growth and inflation persistence when only *proximate* variables are considered. From the political perspective, greater democratization is found to lead to inflation as the inequality gap rises. The insignificance of the impact from *de juro* central bank independence on inflation is supported. In each specification regardless of the focus for the determinants of interest, the positive effect of the inflation inertia is shown to be the greatest in terms of both magnitude and significance, suggesting that the inflationary expectations and indexations schemes in price and wage are the most critical determinants of inflation in emerging and developing economies.

The results of this positive analysis give rise to the following policy implications. If the dominance of inflation inertia is claimed to be backward-looking wage settlements, wage negotiations should be arranged on productivity instead of past realizations of inflation in the future. Since the first round effects of adverse supply shocks could be amplified in a volatile environment affecting inflation expectations and credibility of the monetary authorities in applying policy regime, structural reforms should be considered. If the inertia is proven to arise from inflationary expectations with slow adjustment, price controls, such as controlled levels of exchange rate, wage and prices, may accelerate the adjustment of the expectations breaking the inflation inertia.[2] Inflationary inertia can also be broken when the monetary authority would be forward-looking and more responsive to the deviations of expected inflation from the inflation target. It tends to be reduced with credible disinflationary policies and plans. To maintain the downward

[2]It is important to note that these choices may lead to unemployment, shortages and speculative effect on exchange rate.

pressure on prices considering that inflation persistence is due to staggering of price-setting and price-indexation especially accompanied by high public sector deficit, control over the price of consumer goods and public services; and cuts in subsidies can be used.

The novelty of the analysis in Chapter 4 arises from the question that regarding the best response of the monetary policy authority is in aid recipient developing countries. The Millennium Development Goals emerged from the September 2000 Millennium Declaration at the United Nations and include measurable targets for halving world poverty between 1990 and 2015. Especially with these targeted goals, numerous studies on foreign aid have been entailed. Considering the fact that foreign aid in some less developed countries is quite substantial, it is evident that monetary authorities should not neglect these inflows in setting their monetary policies as the policy regime they follow has an impact not only on prices but also on the allocation of resources.

The development economists argue that an effective redistribution of resources from industrialized countries to developing countries is necessary in order for the poor countries to catch the rich ones. In doing so, foreign aid is suggested to fill up the gap between these country groups. The underlying assumptions for this growth stimulus idea are that the additional resources will be used for investments; and the most of the additional income that is generated from these productive investments will be saved and used for other productive projects. Hence, many donor countries tie their aids to specific projects in order to ensure the efficiency of the aid. Alternatively, growth stimulating effects of foreign aid are conditioned on the environmental, institutional and policy factors. As it can be observed from the literature, while most of the early contributions are predominantly empirical and concentrate on the growth effect of foreign aid, the limited number of theoretical papers that combines monetary policy and foreign aid concentrates either on the role of monetary policy in limiting the negative impacts of foreign aid or in a positive analysis. However, Chapter 4 aims to fulfill the normative analysis gap on this topic by comparing the optimal monetary policy responses in aid-receiving countries.

In this vein, in a New Keynesian model augmented with foreign aid, policy parameters of the Taylor rule, namely interest rate smoothing, inflation targeting and output growth targeting, are optimized in order to maximize unconditional welfare under three cases: (i) only cost-push shock (CP), (ii) only foreign aid shock (FA); and (iii) cost-push and foreign aid shocks $(CP + FA)$. Initially, a theoretical model where the government receives the foreign aid and directs it to the representative household as a lump-sum monetary transfer is constructed. Next, foreign aid is designed to be entirely spent on consumption goods that the household has no control over the decision on; yet, still derives utility from.

The results demonstrate that aid recipient developing countries also face a trade-off between stabilizing the inflation rate and output growth in the presence of cost push shock. The reason behind this finding is that cost push shocks directly affect prices whereas foreign aid has no direct impact on prices, yet influences the allocations through which affecting prices. Hence, the trade-off between two monetary targets does not vanish, making the inflation targeting still more desirable compared to output targeting in these countries. The findings also indicate that central banks exhibit non-desirability of responding to the output growth in the presence of foreign aid shock. The qualitative effects of a foreign aid shock are very similar to those of a positive productivity shock and preference shock in wealth transfer and consumption transfer setting respectively. By increasing output in the former; and consumption in the latter settings, foreign aid shock reduces the distortion introduced by cost-push shock; hence, facilitating the stabilization of the output growth. In other words, as an extra income or consumption, foreign aid supports the monetary policymakers by eliminating the trade-off that they are facing by mitigating the effects of the nominal rigidity that exists in the economy. In short, foreign aid is found to resolve the trade off between inflation and output stabilization faced by the monetary authority, leading to the conclusion that foreign aid recipient developing countries should act in favor of the inflation targeting as in industrialized countries.

Chapter 2

Disentangling the Impacts of Anticipated Inflation

2.1 Introduction

Most of the central banks aim inflation targeting where the positive rate of inflation target has a range between 1 percent and 3 percent (Bernanke and Mishkin (1997)). However, the welfare effects of such a policy implication are still debatable. Since many assets and liabilities are fixed in nominal terms, rather than being inflation-indexed, unanticipated inflation lowers the real value of nominal assets and liabilities, thereby redistributes wealth from lenders to borrowers. Hence, any elaborate analysis on redistribution of inflation necessitates abstaining from representative-agent models and focusing on heterogeneous agent models. Although superneutrality of money implies that the real economy is independent of the rate of money supply growth in the long run; and inflation has no real effects in the long run with lump-sum taxes, dynastic households and complete capital markets (Lucas (2000)), there are empirical studies that suggests otherwise, such as Bullard and Keating (1995)[1] and Kahn et al. (2006)[2] to name a few; and non-neutrality of inflation has also been theoretically demonstrated to be present when inflation has redistribution across generations (Weil (1991)) and when inflation has an impact on distortionary taxes (Chari et al. (1996)).

This chapter proposes a theoretical model with two types of households to explore the distributional effects of inflation and assess the non-neutrality of money without aggregate and idiosyncratic risks, distortionary taxes or generational gap. The differences

[1] They show that changes in money growth rate affect output level.

[2] They find that a small rise in money growth rate in economies which have a low inflation rate increases the long-run capital stock level.

in time preference of households define their types as lenders or borrowers. When introduced, different labor productivity levels create income inequality among the types per se. Both type of households optimize intertemporally while impatient borrowers are subject to the borrowing constraint; and the equilibrium level of lending and borrowing is endogenized. Although there is no risk in this setting, bond market can be considered as incomplete with nominally non-contingent bonds. Bonds are non-contingent in the sense that when the period of maturity comes for repayment, the amount of repayment is diminished by the inflation rate at the time of maturity and the time preference of the borrowers due to the period difference between obtaining the loan and maturity.[3] Moreover, a less developed financial market where neither future income nor durable goods can be pledged for securitization of the debt obligation is considered such that lending is restricted by current income.[4] This, however, results in a nominal friction, as higher inflation reduces the real value of debt in terms of commodities at maturity, which tends to benefit borrowers. Therefore, even anticipated inflation becomes non-neutral where the borrowing constraint causes non-neutral effects in employing monetary policy. Additionally, since the debt contracts are predetermined in nominal terms, inflation can influence the net worth of borrowers. In particular, an increase in inflation rate lowers the real debt repayments for given outstanding debt; thereby redistributing from lenders to borrowers.

In order to depict the non-neutrality of inflation and to gauge the redistributional effects, simulation exercises are conducted. They demonstrate that there is a conflict of interest on inflation between the borrowers and the lenders as the welfare of borrowers rises with inflation whereas that of lenders decays in all parameterizations, revealing the redistributional effect of inflation. Due to the welfare gain that the borrowers could attain by having high inflation, they would always prefer higher inflation rates than the lenders. Hence, this would cause a corner solution at either of the extremes in determination of inflation rate unless there is a social planner. A simple calculation of utilitarian welfare with different weights attached to two types shows that the importance that is given to the borrower in the utilitarian welfare by the hypothetical social planner matters. Specifically, utilitarian welfare can be decreasing in inflation with low weights (i.e $s < 0.5$) attached to the borrower depending on the parameterizations, thereby revealing that the negative impact of inflation on lenders outweighs the positive impact on borrowers when the social planner has pro-lender bias. In principle, a benevolent social planner who aims to maximize utilitarian welfare would act in favor of the constrained household. In this vein, since the borrowing constraint is the only distortion

[3]The term *incomplete* financial market is used here in a slightly different terminological way than the literature has been using. For instance, as in the explanation of Sheedy (2016), the financial markets are called incomplete when the debt contracts cannot guarantee the debt repayments for all future event realizations.

[4]See, such as Laibson, Repetto and Tobacman (2003), Korinek (2009) and Bianchi (2011).

in the economy, the social planner would set the inflation rate such that this friction is minimized. However, the utilitarian welfare highlights that even without favoring the borrowers, increasing welfare is achieved. Since this result is attained regardless of the assumption on the productivity levels, it can be said that the monetary policy redistributes resources from lenders to borrowers by generating inflation. Further, the comparison of changes in the productivity levels reflects that when the heterogeneous productivity levels are assumed, the utilitarian welfare gain is larger in both magnitude and level than the gain in the equal productivity case. Specifically, the welfare gain is larger in between 12.5-31% in heterogeneous productivity case than its homogeneous counterpart. As a result, the heterogeneous productivity levels form the second channel for redistribution. Hence, this chapter can be accounted for a further support to the existing empirical and theoretical literature for the positive relationship between income inequality and inflation. In particular, Crowe (2006), Dolmas et al. (2000) and Desai, Olofsgard and Yousef (2005) among many others, identified a positive relationship between these variables with different theoretical settings and empirical analyses. In this study, different labor productivity levels also facilitate the income inequality among the types and the simulation exercises quantify that the welfare gain from generating inflation is higher when income inequality (i.e heterogeneous labor productivities) is present, thereby suggesting that the policy planner can achieve more welfare gain by generating higher inflation when there is income inequality.

The money demand motive is introduced to the economy in order to assess the welfare effects of inflation in a setting where decisions regarding to money holding generate another distortion in addition to the borrowing constraint. Augmentation of money demand enables to prescribe on the varying inflation rates considering the welfare costs of inflation tax. Money in the utility (MIU) models, in principle, necessitates zero nominal interest rate in order to cancel out the opportunity cost of holding money when it is the only source of distortion; and by the Fisher relationship, it follows that the optimal changes in prices requires deflation (i.e Friedman Rule). Hence, in order to consider these corresponding relationships, investigating the effects of monetary policy requires a model with cash as the money demand is affected by the changes in inflation. Without accounting for money holding decisions, social planner can set a implausibly high inflation rate, because doing so would hurt only one type of household, namely the lender, by redistributing away from them. However, the introduction of money demand incurs the same distortion that is generated in the form of inflation tax on both types, preventing the social planner from choosing such a high inflation rate. Hence, the aim in this analysis is to distinguish the effects of inflation under the presence of money demand motive and compare the welfare consequences of inflation tax in this economy with the cashless economy so as to provide a guideline to the policy planner in setting

inflation rate. The results from the simulations imply that the additional distortion in the form of inflation tax can affect even the constrained households negatively, resulting in a loss in the utilitarian welfare from generating inflation. When borrowers are worse off because of the higher inflation, this renders a welfare loss as the lenders are always hurt by higher inflation. Nevertheless, the cases where the borrowers are better off due to higher inflation do not translate into welfare gain when the types are equally treated in the utilitarian welfare function, suggesting that the loss of the lenders are larger than the gain of borrowers from higher inflation. Furthermore, when the households take multiple decisions in addition to money holding, the relative magnitudes of intertemporal elasticity of substitutions (IES) of these choices have to be taken into account when setting inflation rate. In particular, when both inverse IES of labor and consumption are higher/lower than that of real money balances, the combination of effects from labor and consumption decisions is mirrored on the utility of borrowers. On the other hand, when only one of the inverse IESs is higher than that of the real money balances together with the smaller one being the inverse IES of consumption, the effect of real money balances designates the outcome on the utility of the borrowers. These results follow from the fact that the elasticity of marginal utility with respect to consumption has the largest impact on the utility of borrowers even when it is lower than real money balances and labor supply as there is no scale parameter that restricts its effect on the utility.

From the theoretical perspective, redistributional effects of monetary policy in the literature are generally attributed to unanticipated inflation changes and exogenous heterogeneity between households. In their paper, Beetsma and Van Der Ploeg (1996) define the inequality in a society where larger part of the government debt is held by the smaller group of individuals and heterogeneity arises when agents have different productivity of labour, thereby building up different stocks of assets. When the wealth is unfairly distributed, the median voter is more likely to be the poor. Hence, it is in the interest of the government to favor the poor; and in return, they levy unanticipated inflation taxes to erode the real value of debt, in an attempt to redistribute from rich to poor as this would hurt the rich more than the poor. Albanesi (2006) designs a bargaining game for the determination of the inflation between heterogeneous agents where they differ in their labor productivities and access to various payment methods, in which low income households hold more cash and hence, are more vulnerable to inflation. A large gap in labor productivities translates into larger inequality which generates a weakening in the bargaining position of the poor and, in turn, causes higher inflation as it is desired by the rich. Hence, the redistributional effect of inflation relies on the equilibrium differences in transaction patterns across households which depends on the labor productivity differences. Pescatori (2007) investigates optimal monetary policy in an

environment where rich and poor households are categorized according to an exogenous distribution of assets; and the inflation is found to have redistributional effects on rich and poor. The redistributional consequences of inflation in this chapter, however, are based neither on different productivity levels nor unexpected inflation changes. Inflation has a direct impact on household's net worth by reducing the maximum amount of debt that can be issued as the debt contracts are agreed in nominal terms. Due to the lowered real value of debt repayment received by the lender from the borrower, even expected inflation has redistributive effects from lenders to borrowers. In order to disentangle the effects of heterogeneous productivity levels, different productivity levels are introduced in the simulation exercise. Although the amplification of the redistributional effects from monetary policy is observed, redistribution is found to be still present even with homogeneous productivities.

Non-neutrality of monetary policy is in general investigated in theoretical frameworks where models have aggregate or idiosyncratic risks, capital market imperfections, capital tax distortions, labor supply distortions or distortionary redistribution of seigniorage. Algan and Ragot (2010) analyze the long-run effect of monetary policy where heterogeneous households face credit constraint and can partially insure themselves against idiosyncratic income shocks by using capital holdings and real balances. They show that the inflation has real effects as long as the financial borrowing constraint is binding as it would induce endogenous decision making in money demand. Sheedy (2016) studies the monetary policy targeting in an incomplete financial market setting where aggregate uncertainty in output results in non-contingent debt contracts as not all the future events are guaranteed for repayment. He shows that in the case where there is no uncertainty about the growth of real output and no unexpected changes in inflation, the equilibrium steady state is independent of monetary policy. Doepke and Schneider (2005) provide a calibrated OLG model to assess the inflation-induced redistribution under different fiscal policy rules. In their paper, there is no idiosyncratic labor income risk, yet, the heterogeneity in earnings is generated by the differences in skill profiles; and they are concerned with unanticipated inflation shocks on nominal asset holdings as these shocks would urge different positioning in portfolios of the households. They find that the redistribution caused by inflation has a negative effect on output. In this regard, the real effect of inflation rests on the choice of model setting. Specifically, OLG model gives rise to life-cycle effects in which the borrowers are the winners and the lenders are the losers. Since the borrowers tend to be younger than the lenders, the net effect is observed in aggregates. However, the theoretical model in this chapter is populated by two types of households, namely patient and impatient, generated by heterogeneity in time preferences and it is the same assumption that assures the binding borrowing constraint, which is the essence of this analysis as the otherwise would imply representative-agent

model. Therefore, the contribution of this chapter to the literature is that even in the absence of idiosyncratic income shock, of market incompleteness stemming from aggregate risk, of utilization of OLG model and of money demand together with anticipated inflation, changes in inflation has real effects.

There are only few papers which study the impact of anticipated inflation in heterogeneous agent economies. The existing heterogeneous-agent monetary economy studies examine the settings where money is valued, at least partly, as it grants the agents with self-insurance against idiosyncratic shocks (such as Molico (2006), Chiu and Molico (2010)). The motivation for holding money in these papers is derived from market timing frictions, cash-in-advance constraints, precautionary role of money and so on. They differ in whether the money is the only available asset for agents' portfolio decisions and also in their results. Akyol (2004) considers a pure exchange, incomplete market economy in which agents hold bonds and money for precautionary purposes against idiosyncratic productivity shocks. A market-timing friction ensures that in equilibrium only the high-endowment agents hold money as it allows for consumption smoothing. While bonds and money pay the same return at zero nominal interest rate, bonds allow for borrowing. Hence, positive inflation induces the bond demand while reducing the money demand of high-income agents by improving risk sharing. In turn, this effect redistributes income from the high- to low-income agents. The key finding of the paper is that 10% inflation is necessary in order to maximize social welfare. Molico (2006) introduces a random matching model where agents are hit by i.i.d shocks that restrict them to be a buyer or a seller and suggests that if inflation is low, higher inflation can enhance social welfare as it decreases price dispersion and wealth.

On the contrary, Wen (2010) reports that 10% inflation costs at least 8% of per-capita consumption. This paper is built up on a production economy where agents hold capital and precautionary money and inflation eliminates the self-insurance of money. In their matching model, Boel and Camera (2009) address that inflation does not cause large losses in social welfare; yet, the consequences on distribution can be immense, depending on the financial structure of the economy. Specifically, mostly the wealthier is hurt by inflation if the money is the only asset; and if assets other than money are available, inflation can harm the poorer households while benefiting the wealthier. Camera and Chien (2014) examine an economy where ex-post heterogeneity is formed with labour productivity shocks that follow a Markow process, agents are allowed to hold money and bond considering cash-in-advance constraint and the money supply evolves deterministically. They show that the inflation non-linearly affects the distribution of income with the strongest impact when small deviations from zero inflation occur; and suggest that the financial structure, the labor supply elasticity and the shock persistence alter how distributions and welfare are influenced by inflation. In particular, when only

money is available in self-insurance, inflation alleviates wealth disparities; otherwise, it may rise wealth inequality. In contrast, this chapter does not incorporate money into the framework to ensure self-insurance in the form of precautionary money demand. In other words, rather than substituting as a tool for guarantee, attaching value to money introduces an additional friction to the economy in the form of inflation tax. Additionally, this study endogenizes the labor supply decision and money creation[5] which some papers (e.g. Akyol (2004) and Camera and Chien (2014) respectively) in the literature lack; and attempts to reconcile the divergent results in this line of literature.

The remainder of the chapter is as follows. Section 2.2 lays out the model environment. Section 2.2.1 defines the equilibrium of the cashless economy, Section 2.2.2 discusses the steady state of the cashless economy and Section 2.2.3 contains the simulation exercises of the cashless economy. In Section 2.3, MIU model is introduced and the equilibrium together with simulation results of this environment are presented. Finally, Section 2.4 concludes.

2.2 Theoretical Model: Cashless Economy

The discrete time, infinite horizon model is populated by two types of households, patient and impatient. The heterogeneity in households stems from the difference between their time preference in addition to labor productivity. Both types of households decide on how much to consume, work and hold assets in the form of bonds. Additionally, impatient households are allowed to accumulate debt funded by patient households. Competitive firms produce the final good by utilizing the labor supplies from both types of households. Monetary policy is assumed to control the inflation rate.

The patient households differ from the impatient ones as they exhibit higher patience rate. This, in return, defines their position towards bond holding, which identify them as lenders or borrowers. The interaction between the borrowers and the lenders, therefore, occurs in the bond market. Lenders hold the bonds issued by borrowers in the sense that what is defined as inflow for one type means outflow for the other type of household. There is no explicit default and aggregate uncertainty in the economy. Yet, bond market can be considered as incomplete with nominally non-contingent bonds. Bonds are non-contingent in the sense that when the period of maturity comes for repayment, the amount of repayment is diminished by the inflation rate at the time of maturity and the time preference of the borrowers due to the period difference between obtaining the loan and maturity. In addition to this, a less developed financial market where neither

[5]How the real money balances grow root in the decisions of the two types of households instead of exogenously given rate. See equations (2.34), (2.35) and (2.22), (2.27).

future income nor durable goods can be pledged for securitization of the debt obligation is considered such that lending is restricted by current income. Monetary policy has direct impact on household's net worth by diminishing the real value of outstanding debt by determining a path for the price level.

The borrowers maximize a lifetime utility function given by

$$\max_{\{c_t^b, b_t^b, n_t^b\}} \quad \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t^b)^{1-\phi}}{1-\phi} - \nu \frac{(n_t^b)^{1+\sigma}}{1+\sigma} \right)$$

where the discount rate is $\beta \in (0,1)$, ϕ and σ denote the inverse elasticity of substitution for consumption and labor supply respectively; ν weighs the disutility from working, c_t is the consumption, n_t are working time.

The budget constraint is

$$P_t c_t^b + B_{t-1}^b \leq e^b P_t w_t n_t^b + \frac{B_t^b}{R_t}$$

where B_t represents the nominal debt, R_t denotes the nominal interest rate on debt; so that, $\frac{B_t^b}{R_t}$ is the current nominal value of debt issued (i.e discount bond) while B_{t-1}^b is the debt repayment. The left-hand side of the budget constraint indicates the uses of funds (i.e. consumption spending plus nominal debt service) while the right-hand side denotes the available resources (i.e new debt plus nominal labor income).

In addition to the budget constraint, the borrowers face a borrowing constraint in which the maximum amount B_t^b is bounded by:

$$B_t^b \leq \gamma e^b P_t w_t n_t^b$$

where $\gamma \in (0,1)$ represents propensity to raise debt, e^b denotes the productivity level and w_t is the real wage. In general, γ can be broadly thought of as an indirect measure of the tightness of the borrowing constraint. Notice that the decision towards labor supply endogenously affects the borrowing limit and the debt obligation is bound by the current income.

Household debt, in general, can be categorized into two groups, namely non-collateralized debt and collateralized debt. At the theoretical level, alternatives to this type of credit constraints are given in terms of durable goods, such as land and housing, in the case of collateralized debt (Kiyotaki and Moore (1997), Iacoviello (2005) among many others), of exogenous net indebtedness limit (such as Zeldes (1989)) and of tradable goods in an open economy context (see, Monacelli (2006)). However, this is a closed economy model and there is no durable goods market in order to be attached to the loan as collateral.

In his paper, Korinek (2009) models the borrowing on the current income in which the borrowers are able to engage in fraud at the contract period and if the lenders disclose the fraud, they could seize the current income of the borrowers. Although this type of contract enforcement scheme is not explicitly addressed here, it is accounted for that the debt repayment cannot always be guaranteed due to the lack of securitization of the debt obligation. Bianchi (2011) also designs the credit constraint such that loans amount to a debt that is a fraction of tradable and nontradable current income. Such modelling can be attributed to less developed financial markets where sophisticated financial instruments, compared to income, such as collateralized debt obligations are not available. Hence, the lenders can only guarantee the repayment of the borrowers, similar to Laibson, Repetto and Tobacman (2003)[6], by evaluating the borrowers according to their current income. In turn, loans provided by the lenders are assumed to be conditioned on the current income of the borrowers. In his paper, Fafchamps (2014) also emphasizes that granting the poor in developing countries with credit depends on whether they have regular income rather than collateral.

At the empirical level, there are studies supporting the assumption that the borrowing constraint is given by the current income. For instance, Japelli (1990) shows that the current income is a major determinant of the credit market access. Del-Rio and Young (2005) examine the determinants of participation in the unsecured loan market for 1995 and 2000 in the U.K and find that the main determinant is the individual income level. Additionally, Mishkin (1996) notifies that the legal system in developing countries makes securing the credits with collateral a time-consuming and costly process. Hence, attaching income for securitization of the debt obligation can be referred to both developing and developed country contexts.

The lender households maximize the following utility function subject to a budget constraint

$$\begin{aligned} \max_{\{c_t^l, b_t^l, n_t^l\}} \quad & \sum_{t=0}^{\infty} \delta^t \left(\frac{(c_t^l)^{1-\phi}}{1-\phi} - \nu \frac{(n_t^l)^{1+\sigma}}{1+\sigma} \right) \\ \text{subject to} \quad & P_t c_t^l + \frac{B_t^l}{R_t} \leq e^l P_t w_t n_t^l + B_{t-1}^l \end{aligned}$$

where $\delta > \beta$ and $e^l > e^b$.

The constraints of the households can be rewritten in real terms. For the borrowers, the budget and the borrowing constraints follow $c_t^b + \frac{b_{t-1}^b}{\pi_t} \leq e^b w_t n_t^b + \frac{b_t^b}{R_t}$ and $b_t^b \leq \gamma e^b w_t n_t^b$ respectively where $\pi_t = \frac{P_t}{P_{t-1}}$ is the gross inflation rate. The important feature of the budget constraint roots in the debt contracts' being predetermined in nominal terms;

[6] In their paper, they have two types of debt, collateralized and non-collateralized. To model non-collateralized borrowing, they introduce a loan limit which is proportional to current income.

so that, the inflation rate can influence the net worth of the borrowers. In other words, an increase in inflation rate lowers the real debt repayments for given outstanding debt. For the lenders, the budget constraint reads $c_t^l + \frac{b_t^l}{R_t} \leq e^l w_t n_t^l + \frac{b_{t-1}^l}{\pi_t}$. It is important to differentiate between the available debt services to the borrowers and the amount of debt obligations for repayment. The maximum amount of real (nominal) debt that the lenders provide the borrowers is b_t^b (B_t^b). They limit this amount, in order to secure the debt services they can offer to the borrowers, to the income of borrowers, rather than the debt repayment. In this vein, when they lend, the lenders hold the discount bonds issued by borrowers with a face value of $\frac{b_t^l}{R_t}$, and in return, receive back the amount of $\frac{b_{t-1}^l}{\pi_t}$ from the borrowers when the period of maturity comes. Therefore, the value of borrowing limit, B_t^b, is not affected by the inflation rate while the real debt repayment (i.e real value of outstanding debt), $\frac{b_{t-1}^l}{\pi_t}$, decreases with the inflation rate.

The first-order conditions for the borrowers require the marginal rate of substitution between labor supply and consumption and Euler Equation for labor supply respectively:

$$\frac{\nu({n_t}^b)^\sigma}{e^b w_t} = ({c_t}^b)^{-\phi} + \gamma\varphi_t$$

$$\left(\frac{\nu({n_t}^b)^\sigma}{e^b w_t} - \gamma\varphi_t\right)\frac{1}{R_t} = \beta\mathbb{E}_t\left(\frac{\nu(n_{t+1}^b)^\sigma}{e^b w_{t+1}} - \gamma\varphi_{t+1}\right)\left(\frac{1}{\pi_{t+1}}\right) + \varphi_t$$

where φ is the Lagrange multiplier associated with the borrowing constraint that takes positive values whenever the constraint is binding. Specifically, the borrowing constraint is binding at the steady state due to the assumption on time preferences.[7] Notice that, in the absence of borrowing constraint (i.e., $\varphi_t = 0$), the terms with φ_t drop out. Intuitively, if φ_t increases, the borrowing constraint binds more tightly; in other words, the marginal gain from relaxing the constraint is larger. Therefore, the marginal gain from supplying an additional unit of labor is higher as it allows to increase borrowing. Furthermore, as it can be seen from the first equation, the higher the marginal value of an additional borrowing, (i.e φ_t), the higher the benefit of providing an additional unit of working time (i.e $\frac{({n_t}^b)^\sigma}{e^b w_t} > ({c_t}^b)^{-\phi}$), which will be used to purchase an additional current consumption. Due to the binding borrowing constraint (i.e $\varphi_t > 0$), the borrower's marginal utility of current consumption exceeds the marginal utility of savings (i.e $\frac{({c_t}^b)^{-\phi}}{R_t} > \beta\mathbb{E}_t\frac{(c_{t+1}^b)^{-\phi}}{\pi_{t+1}}$). Consequently, they would like to increase the consumption spending more than the lender who acts as a consumption-smoother. In order to obtain that amount, the borrower has to optimally choose how much to borrow as it will depend on the increase in working time considering that would also cause disutility to them.

[7] See equation (2.13) for proof.

The solution to the lender's problem requires:

$$\frac{\nu(n_t^l)^\sigma}{e^l w_t} = (c_t^l)^{-\phi}$$
$$\frac{(n_t{}^l)^\sigma}{w_t}\frac{1}{R_t} = \delta\mathbb{E}_t\left(\frac{(n_{t+1}^l)^\sigma}{w_{t+1}}\frac{1}{\pi_{t+1}}\right)$$

the substitution between consumption and labor choices and Euler Equation for labor supply respectively.

The comparison between the first-order conditions of both types of household yields the differences in their decision making due to the borrowing constraint faced only by the borrower. In particular, in the absence of the borrowing constraint (i.e. $\varphi = 0$), φ drops out both sides of the labor Euler equation of the borrowers and the equation reduces to a standard intertemporal condition which would prevail for the lenders except the discount factor.

Competitive firms produce the final goods according to the following linear production function utilizing total labor supply n_t:

$$y_t = e^{z_t} n_t$$

and z_t is the technology that follows an AR(1) process

$$z_t = \rho z_{t-1} + e_t$$

where e_t is the independent, serially uncorrelated innovation and normally distributed with zero-mean and standard deviation σ_z.

This is a cashless economy where money is not needed for any transactions. Since there is no cash, the monetary authority is only responsible for determining the inflation rate, π_t.

2.2.1 Competitive Equilibrium

A competitive equilibrium is a set of sequences $\{c_t^b, c_t^l, n_t^b, n_t^l, b_t^b, b_t^l, y_t, n_t, w_t, R_t, \varphi_t, z_t\}$ satisfying

For households:

$$\frac{\nu({n_t}^b)^\sigma}{e^b w_t} = ({c_t}^b)^{-\phi} + \gamma\varphi_t \tag{2.1}$$

$$\left(\frac{\nu({n_t}^b)^\sigma}{e^b w_t} - \gamma\varphi_t\right)\frac{1}{R_t} = \beta\mathbb{E}_t\left(\frac{\nu(n_{t+1}^b)^\sigma}{e^b w_{t+1}} - \gamma\varphi_{t+1}\right)\left(\frac{1}{\pi_{t+1}}\right) + \varphi_t \tag{2.2}$$

$$b_t^b = \gamma e^b w_t n_t^b \tag{2.3}$$

$$c_t^b + \frac{b_{t-1}^b}{\pi_t} = e^b w_t n_t^b + \frac{b_t^b}{R_t} \tag{2.4}$$

$$\frac{\nu(n_t^l)^\sigma}{e^l w_t} = (c_t^l)^{-\phi} \tag{2.5}$$

$$\frac{({n_t}^l)^\sigma}{w_t}\frac{1}{R_t} = \delta\mathbb{E}_t\left(\frac{(n_{t+1}^l)^\sigma}{w_{t+1}}\frac{1}{\pi_{t+1}}\right) \tag{2.6}$$

(2.1), (2.2) and (2.5), (2.6) are the first-order conditions for the borrowers and the lenders respectively. [8] (2.3) and (2.4) are the constraints for the borrowers.

Market clearing conditions:

$$c_t^b + c_t^l = y_t \tag{2.7}$$

$$e^b n_t^b + e^l n_t^l = n_t \tag{2.8}$$

$$b_t^b + b_t^l = 0 \tag{2.9}$$

(2.7) for goods market, (2.8) for labor market and (2.9) for bond market.

The production follows:

$$y_t = e^{z_t} n_t \tag{2.10}$$

$$z_t = \rho z_{t-1} + e_t \tag{2.11}$$

$$w_t = \frac{y_t}{n_t} \tag{2.12}$$

where (2.12) is the solution to the firm's maximization problem.

[8] Alternative to equations (2.2) and (2.6), would be respectively:

$$\frac{({c_t}^b)^{-\phi}}{R_t} = \beta\mathbb{E}_t(c_{t+1}^b)^{-\phi}\left(\frac{1}{\pi_{t+1}}\right) + \varphi_t$$

$$\frac{({c_t}^l)^{-\phi}}{R_t} = \delta\mathbb{E}_t(c_{t+1}^l)^{-\phi}\left(\frac{1}{\pi_{t+1}}\right)$$

2.2.2 Steady State of the Competitive Equilibrium

This section analyses the features of the steady state of the competitive equilibrium. In the deterministic steady state, the constraints are always binding. Starting with the first order condition with respect to consumption for the borrowers would reveal that the budget constraint has to bind:

$$c = \lambda^{-\frac{1}{\sigma}}$$

where λ denotes the Lagrange multiplier of the budget constraint. The similar calculation also holds for the lenders. The borrowing constraint is binding

$$\varphi = \lambda\left(\frac{\delta - \beta}{\pi}\right) \tag{2.13}$$

due to the the assumption that the lenders are more patient than the borrowers. Therefore, the shadow value of borrowing is always positive. In other words, the borrower will always choose to hold a positive amount of debt.

The steady state consumption Euler equation of the lenders, (2.6), implies:

$$R = \frac{\pi}{\delta}$$

Due to the zero lower bound on nominal interest rate, the following restriction entails $\pi \geq \delta$.

Combining the result of R with the labor Euler equation of the borrowers (2.2) yields:

$$\varphi = \frac{\nu(n^b)^\sigma}{e^b w}\left(\frac{\delta - \beta}{\pi + \gamma(\delta - \beta)}\right) > 0 \tag{2.14}$$

Notice that, $\beta = \delta$ (i.e. no heterogeneity in discount rates) implies that the borrowing constraint does not bind. Furthermore, this hypothetical assumption would correspond to a representative agent economy. In order to facilitate the understanding of how the borrowing constraint alters the equilibrium, consider a model without a borrowing constraint, yet, with heterogeneous patience rates. No borrowing constraint implies that the impatient household trades her future working time with current consumption by borrowing against her future income, causing her consumption to approach to zero asymptotically. However, with a borrowing constraint, there is a limit on how much the impatient households can borrow, which will lead to a stable steady state with positive consumption for both types.

By rearranging the terms in (2.14), the labor supply decision of the borrowers is obtained:

$$n^b = \left(\frac{\varphi e^b w[\pi + \gamma(\delta - \beta)]}{\nu(\delta - \beta)} \right)^{\frac{1}{\sigma}} \tag{2.15}$$

The unit of labor supply for borrowers increases with the shadow value of borrowing. Intuitively, devoting more time to work enables marginally relaxing the borrowing constraint. Additionally, notice that the steady state is indeterminate when $\beta = \delta$. It is crucial to understand the role of the heterogeneous patience rates for two reasons. First, assuming away the heterogeneous patience rate implies no borrowing constraint. Secondly, it is due to the different time preferences that the impatient (borrower) and the patient (lender) households emerge as two types in equilibrium in the economy. With homogeneous patience rates, the economy comes down to a representative agent economy model where the agents are free to borrow and lend. In this environment, the borrowers would accumulate debt indefinitely causing an indeterminate steady state.

The positive amount of debt holding can be found by evaluating the borrowing constraint together with (2.15):

$$b^b = \gamma e^b w \left(\frac{\varphi e^b w[\pi + \gamma(\delta - \beta)]}{\nu(\delta - \beta)} \right)^{\frac{1}{\sigma}} > 0$$

It is also increasing in the shadow value of borrowing since the additional unit of labor supply accelerates the accumulation of debt.

Similarly, c^b can be obtained by replacing n^b in the marginal rate of substitution between labor supply and consumption, (2.1):

$$c^b = \left(\frac{\pi\varphi}{\delta - \beta} \right)^{-\frac{1}{\phi}} \tag{2.16}$$

As the shadow value of the resources within the period, i.e λ, increases, the marginal utility of consumption increases as well, resulting in less consumption. Since the shadow value of borrowing is positively affected by λ [9], the consumption of the borrowers is decreasing in φ.

Equations (2.15) and (2.16) are not closed form solutions as they are defined in terms of φ which is expressed by n^b. To get rid of this recursion, replace φ in (2.16) with (2.14) and substitute the borrowing constraint into the budget constraint. Equating the

[9] See equation (2.13).

resulting two equations of c^b gives the closed form solution of n^b [10]:

$$n^b = \left(\frac{e^b w}{\pi}\right)^{\frac{1-\phi}{\sigma+\phi}} \left(\frac{\pi+\gamma(\delta-\beta)}{\nu}\right)^{\frac{1}{\sigma+\phi}} [\pi-\gamma(1-\delta)]^{-\frac{\phi}{\sigma+\phi}} \tag{2.17}$$

Now, c^b can be obtained by substituting n^b into the budget constraint explained above:

$$c^b = \left(\frac{e^b w}{\pi}\right)^{\frac{1+\sigma}{\sigma+\phi}} \left(\frac{\pi+\gamma(\delta-\beta)}{\nu}\right)^{\frac{1}{\sigma+\phi}} [\pi-\gamma(1-\delta)]^{\frac{\sigma}{\sigma+\phi}} \tag{2.18}$$

Similarly, for c^l, first n^l should be solved as the equation (2.5) includes n^l. By using (2.5), (2.7), (2.8) and (2.10), one would get the following expression:

$$\frac{e^l (n^l)^{\frac{\sigma+\phi}{\phi}} - (e^l w)^{\frac{1}{\phi}}}{(n^l)^{\frac{\sigma}{\phi}}} = \left(\frac{e^b w}{\pi}\right)^{\frac{1-\phi}{\sigma+\phi}} \left(\frac{\pi+\gamma(\delta-\beta)}{\nu[\pi-\gamma(1-\delta)]^{\phi}}\right)^{\frac{1}{\sigma+\phi}} e^b \left(\frac{w[\pi-\gamma(1-\delta)]-\pi}{\pi}\right) \tag{2.19}$$

Although n^l does not have a closed-form solution, it can be traced that it and, in return, c^l, are affected by the inflation rate. The analytic solutions of the economy, therefore, show that the monetary policy is non-neutral. This implies that the monetary policy-maker can affect the real variables and thereby the utilitarian welfare of the economy by changing the inflation rate. Notice that, it is the steady state inflation rate that generates this impact on the economy rather than the unanticipated inflation rate as in Beetsma and Van Der Ploeg (1996) and Doepke and Schneider (2006), among many others. The underlying reason behind the monetary non-neutrality is the structure of the borrowing constraint. Specifically, in less developed financial markets where neither future income nor durable goods can be pledged for securitization of the debt obligation, lending is more likely to be restricted by current income. This, however, results in a nominal friction; as higher inflation reduces the real value of debt in terms of commodities at the maturity; hence benefiting borrowers. Therefore, even expected inflation is non-neutral.

On the other hand, an alternative to the given borrowing constrained in a well-established financial market would be a *rational* borrowing constraint where the lenders limit the borrowing of the impatient households to an amount of income earned in the period of maturity, i.e $B_t^b \leq \gamma e^b \mathbb{E}_t P_{t+1} w_t n_t^b$. Then, the borrowing constraint in real terms is $b_t^b \leq \gamma e^b \mathbb{E}_t \pi_{t+1} w_t n_t^b$; and the characterization of the maximization problem for the

[10] Then, the shadow value of borrowing can also be found from (2.14):

$$\varphi = \left(\frac{\nu(\delta-\beta)}{e^b w[\pi+\gamma(\delta-\beta)]}\right)\left(\frac{e^b w}{\pi}\right)^{\frac{(1-\phi)\sigma}{\sigma+\phi}} \left(\frac{\pi+\gamma(\delta-\beta)}{\nu}\right)^{\frac{\sigma}{\sigma+\phi}} [\pi-\gamma(1-\delta)]^{\frac{-\phi\sigma}{\sigma+\phi}}$$

borrowers requires:

$$\frac{\nu({n_t}^b)^\sigma}{e^b w_t} = ({c_t}^b)^{-\phi} + \gamma\varphi_t\pi_{t+1}$$

$$\left(\frac{\nu({n_t}^b)^\sigma}{e^b w_t} - \gamma\varphi_t\pi_{t+1}\right)\frac{1}{R_t} = \beta\mathbb{E}_t\left(\frac{\nu(n^b_{t+1})^\sigma}{e^b w_{t+1}} - \gamma\varphi_{t+1}\pi_{t+2}\right)\left(\frac{1}{\pi_{t+1}}\right) + \varphi_t$$

$$b^b_t = \gamma e^b \mathbb{E}_t\pi_{t+1} w_t n^b_t$$

At the steady state, one would get the following allocations for borrowers:

$$n^b = \left(\frac{(e^b w)^{1-\phi}[1+\gamma(\delta-\beta)]}{\nu[1-\gamma(1-\delta)]^\phi}\right)^{\frac{1}{\sigma+\phi}}$$

$$c^b = \left(\frac{\nu(n^b)^\sigma}{e^b w[1+\gamma(\delta-\beta)]}\right)^{-\frac{1}{\phi}}$$

The closed-form equations suggest that the *rational* borrowing constraint would impose monetary neutrality. The comparison of the Euler equations from the *rational* and the *nominally non-contingent* debt contracts indicates that when there is both inflation and interest rate on two sides of the equation at the same time, monetary neutrality is sustained, as the changes in inflation rate translate into the changes in the interest rate. Intuitively, the lag difference in time between obtaining the loan and paying it back is compensated by receiving back an amount that is inflation-indexed at the time of maturity. Therefore, departing from the *rational* borrowing constraint entails nominal friction which, in particular, stems from the bond market incompleteness that manifests itself in the form of nominal non-contingent debt contracts. In this regard, borrowing constraint in the *nominally non-contingent* debt contracts causes non-neutral effects in employing monetary policy.

2.2.3 Simulation

Monetary non-neutrality and redistributional effects of inflation are tractable via utilization of a simulation exercise. In the simulations below, the inflation rate varies between [1;4]; and under this variation, the behavior of the variables are plotted. In other words, the interest variables are calculated at the steady state for given inflation rates and those points are interpolated to be able to evaluate the trends of the these variables. In order to avoid any results that are dependent on some specific parameters, alternative parameter values are also checked (see, Table 2.1). The figures are organized according to the associated comparisons regarding to equal and different productivity levels in

order to identify the redistribution channels via the inflation rate and the heterogeneous productivity levels separately.

TABLE 2.1: Parameter Values

Parameter	Description	Value	Source
β	Discount rate of borrower	0.98	Monacelli (2006)
e^b	Labor productivity of borrower	1	Albanesi (2006)
γ	Securitization requirement	0.32	Bianchi (2011)
δ	Discount rate of lender	0.99	Monacelli (2006)
e^l	Labor productivity of lender	2	Albanesi (2006)
ϕ	Inverse IES consumption	$\{\frac{2}{3},2\}$	Standart RBC
σ	Inverse IES labor supply	$\{\frac{1}{2},\frac{3}{2}\}$	Standart RBC
ν	Weight of disutility from working	Respective values	First best calibration[11]
ρ	TFP AR(1) persistence	0.53	Bianchi, Mendoza (2011)
e	TFP standart deviation of innovation	0.014	Bianchi, Mendoza (2011)

When two types of households are homogeneous in terms of their productivity levels, their steady state labour supplies start at a similar level (i.e $n^b \approx n^l \approx 0.33$) when there is positive inflation. However, it increases for lenders while it decreases for borrowers with rising inflation rates. The same trends hold for the case where both types of households have different productivity levels. Since the differences in steady state levels of the choices are initiated by heterogeneous productivity levels, focusing on the comparison for the lenders between the two cases yields the following; when the inverse of intertemporal elasticity of substitution[12] of consumption is equal to 2, regardless of the value of inverse of elasticity of labor supply, the working time of lenders, when they have higher productivity than the borrowers, is less than they would supply in the case where the two types have the same productivity levels. On the other hand, it is vice versa when $\phi = \frac{2}{3}$, the reason being that the higher productivity level would compensate for the reduced working time when $\phi = 2$ whereas it is not sufficient when $\phi = \frac{2}{3}$ as higher IES implies greater substitutability of consumption between the periods which can be achieved by raising the labour supply. The working time of borrowers indirectly affects the debt repayment as the borrowing limit is bound by the labor supply decision; and the debt repayment depends on how much debt is issued via the borrowing limit. Furthermore, the amount of real debt repayment is lowered with an increased inflation by the time of maturity. Therefore, the substitution of inflation against labor supply implies a negative relationship between the two.

[11] Values are based on the social planner problem where $n^b = n^l = \frac{1}{3}$ is aimed to achieve. They differ with respect to ϕ and σ and whether there is homogeneity in productivity levels, which are either $e^b = e^l = 1$ or $e^b = 1 < e^l = 2$.

[12] Remember that, IES= $\frac{1}{\phi}$.

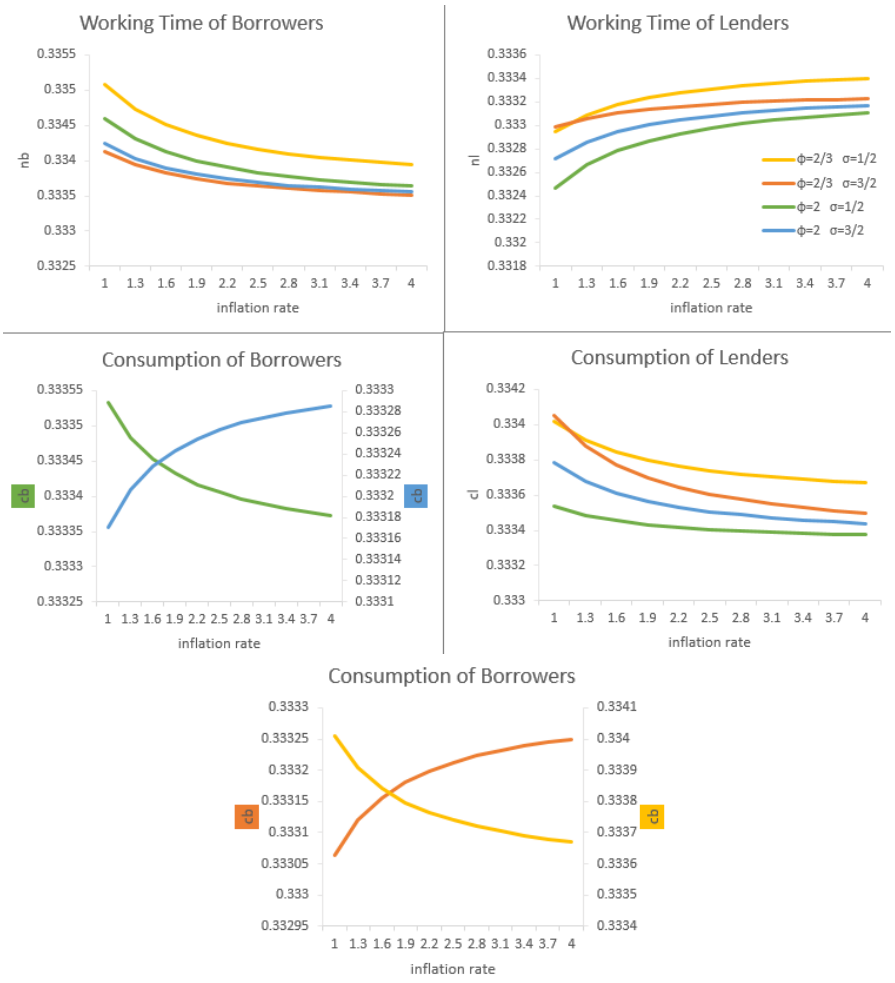


FIGURE 2.1: Cashless Economy with $e^b = e^l$: c and n

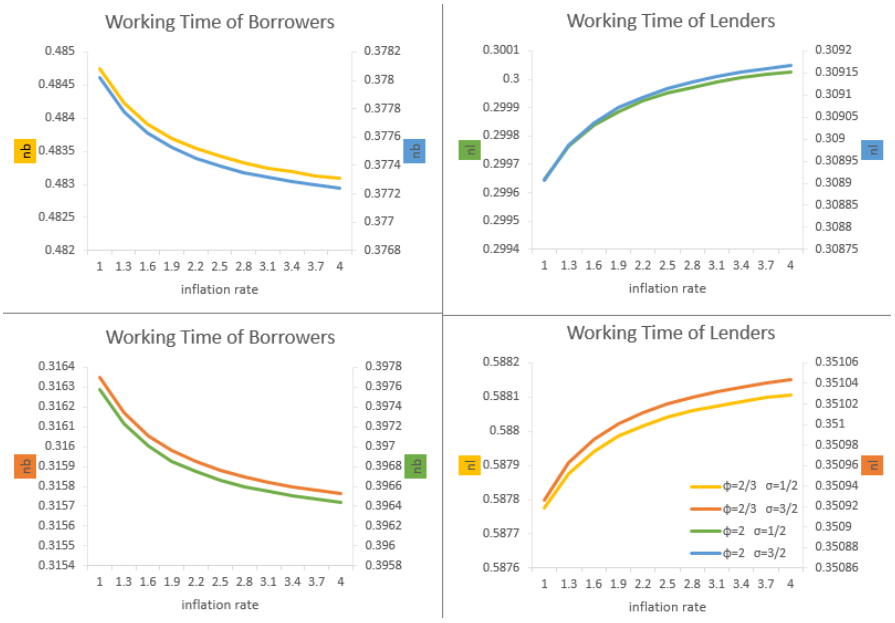


FIGURE 2.2: Cashless Economy with $e^b \neq e^l$: n

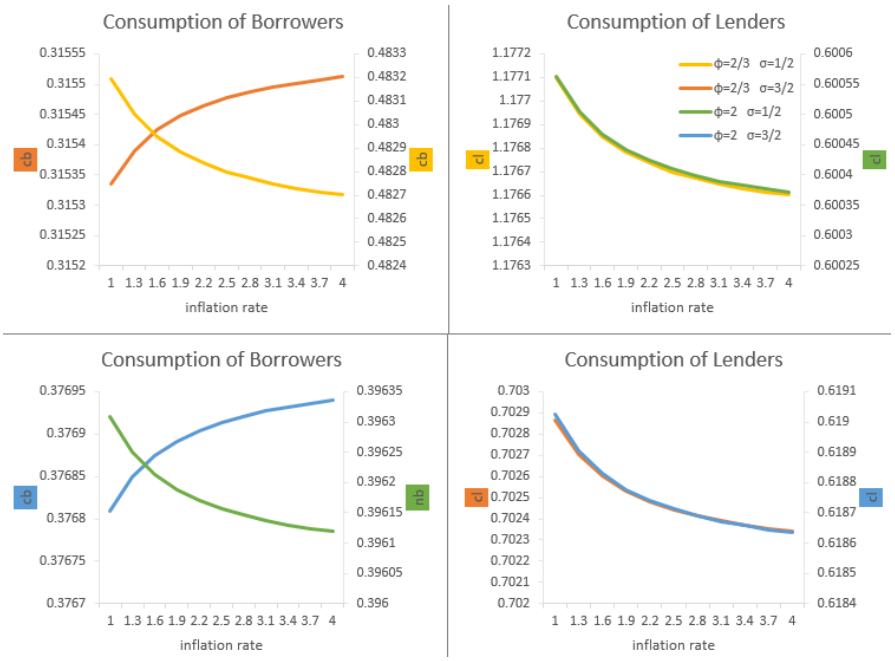


FIGURE 2.3: Cashless Economy with $e^b \neq e^l$: c

The consumption for lenders is a decreasing function of the inflation rate in both homogeneous and heterogeneous productivity levels. In the case of equal productivity, the steady state level of consumption for lenders is always less than the one in a different productivity level as the higher productivity level provides more resources available for consumption spending. For the borrowers, the consumption is increasing in inflation rate when $\sigma = \frac{3}{2}$ and decreasing when $\sigma = \frac{1}{2}$. More specifically, the closed-form equation of the borrower's consumption stresses the following rule; when $\sigma + \beta \geq \delta(1+\sigma)$, $\frac{\partial c^b}{\partial \pi} > 0$. Since the simulations are based upon different values of σ and ϕ, this rule, in turn, boils down to rising consumption for borrowers with higher inflation when $\sigma \geq 1$. Intuitively, lower σ (i.e the inverse of Frisch elasticity of labour supply) entails more volatile working time compared to the lower Frisch elasticity of labor supply. Since the borrowers do not have the compensation opportunity attained by higher productivity level as the lenders have, they need to adjust their consumption accordingly. Hence, when $\sigma = \frac{1}{2}$, they respond to the supply of less working time by reducing their consumption.

The real borrowing limit reduces with increasing inflation rate in all cases implying that the additional resources that could be accommodated by issuing more debt is substituted away by higher inflation rate as the higher inflation cheapens the real repayment of debt burden[13]. The magnitude of direct effect of inflation on cheapening the real value of outstanding debt and the spending on consumption is larger than the indirect effect through slackening the borrowing constraint. Therefore, the borrowers would not need

[13]This effect, in turn, reduces the need for relaxed borrowing constraint. Therefore, the value of relaxing the borrowing constraint is decreasing in inflation.

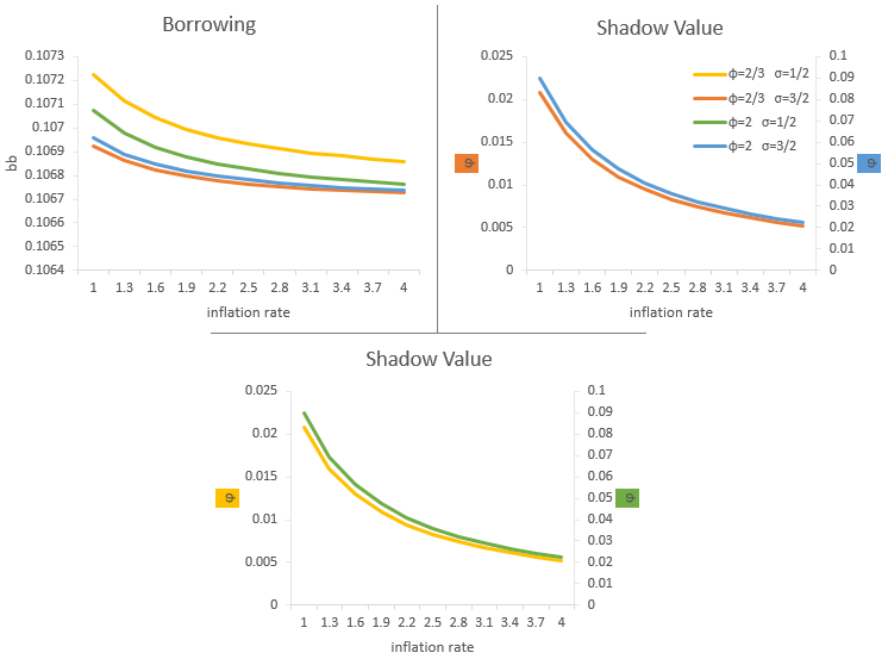


FIGURE 2.4: Cashless Economy with $e^b = e^l$: b and φ

to accumulate more debt. Additionally, increasing inflation rate loosens the borrowing constraint and the shadow value of the constraint (i.e multiplier; φ) converges to zero when the inflation rate gets sufficiently large.[14] In other words, the marginal benefit of supplying an additional unit of working time that allows to expand borrowing gets lower as the inflation rate rises. This is also the complementary reason for decreasing real borrowing as less labor supply translates into less borrowing. Since there is not much to gain by relaxing the constraint as the inflation rate rises, the working time of borrowers decreases with inflation. On the other hand, since the labour income is the resource that is available to the lenders for consumption spending, they increase their working time with inflation. However, this does not manifest itself as rising consumption levels with inflation rate since the amount of debt they agreed to provide the borrowers values less with the increasing inflation rate at the time of repayment.[15] Therefore, the monetary authority can redistribute the resources from lenders to borrowers via debt by generating inflation, the reason being that the debt contracts are predetermined in nominal terms in the budget constraint.

The individual behaviours of the two types give rise to the depicted utility trends towards increasing inflation rates as in Figure 2.6 and 2.7. The utility of borrowers rises whereas that of lenders decays in all cases revealing that the inflation has differing impacts on the utilities of the two types. Thereby, the borrower prefers higher inflation rates than the lender as they benefit from inflation contrary to the lenders, rendering a conflict of

[14] It gets below 0.001 from $\pi = 10$ onward in general.

[15] Remember that, the amount they receive back from the borrowers is $\frac{b^l_{t-1}}{\pi_t}$.

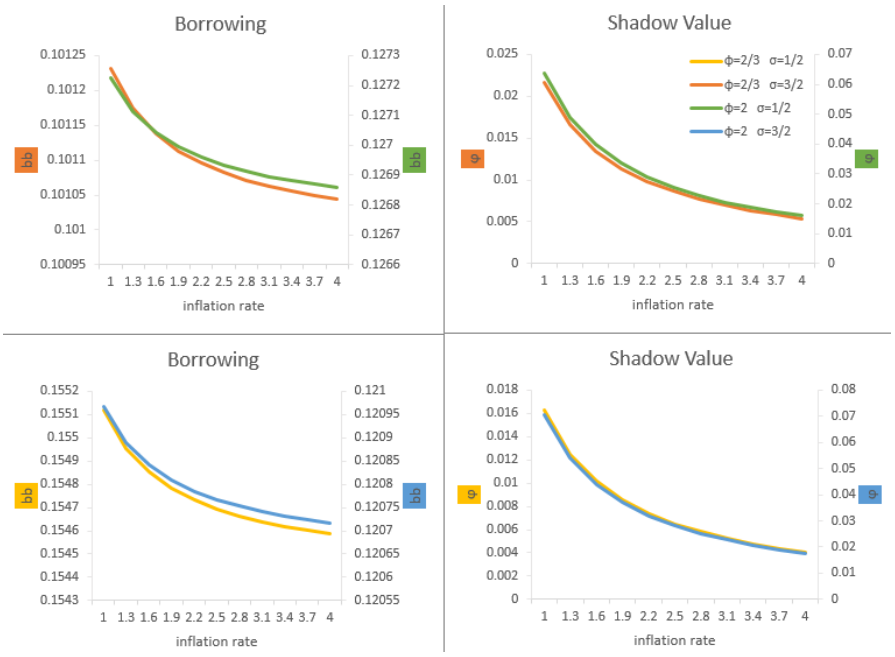


FIGURE 2.5: Cashless Economy with $e^b \neq e^l$: b and φ

interests between the types. Hence, this would cause a corner solution at either of the extremes in determination of inflation rate unless there is a social planner.

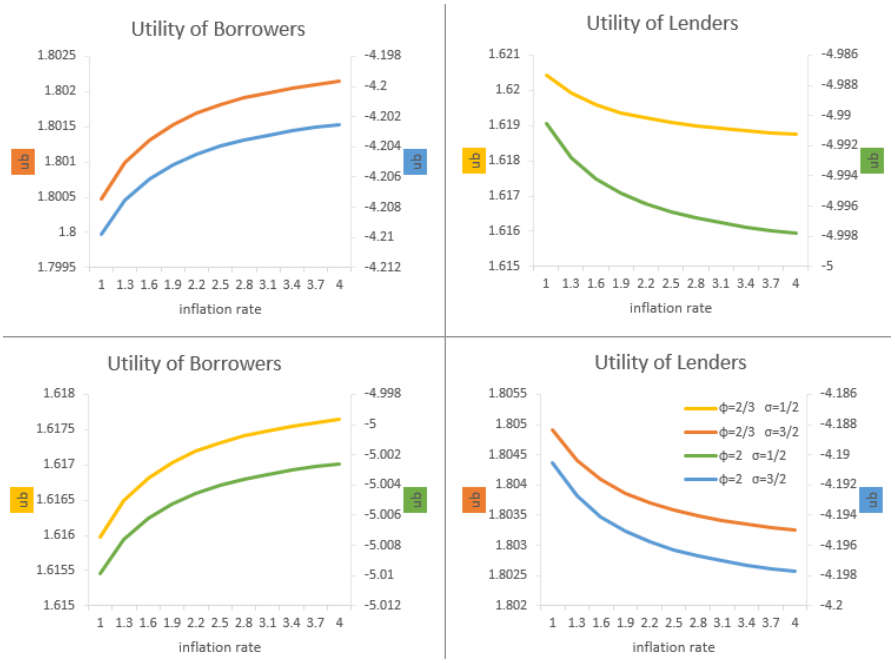


FIGURE 2.6: Cashless Economy with $e^b = e^l$: U

A simple calculation of utilitarian welfare[16] with different weights attached to two types

[16]Utilitarian welfare functions are computed with different weights on the two types of households for comparison. For the scope of the analysis, the ones that are decreasing and increasing with their associated weights are depicted. Specifically, s is the preference weight associated with the borrower. For instance, for $s = 0.4$, utilitarian welfare is as follows: $UW = [\frac{1}{1-(\beta^{0.5})(\delta^{0.5})}][(0.4u^b) + (0.6u^l)]$.

FIGURE 2.7: Cashless Economy with $e^b \neq e^l$: U

shows that the importance that is given to the borrower in the utilitarian welfare function by the hypothetical social planner matters. In particular, utilitarian welfare can be decreasing with low weights (i.e $s < 0.5$) attached to the borrower depending on the parameterizations, which reveals that the negative impact of inflation on the lenders outweighs the positive impact on the borrowers when the social planner has the pro-lender bias. In principle, a benevolent social planner would who aims to maximize utilitarian welfare would act in favor of the constrained household as more gain can be obtained by balancing the constrained household with the unconstrained one. In this vein, since the borrowing constraint is the only distortion in the economy, the social planner would set the inflation rate such that this friction is minimized. However, the utilitarian welfare highlights that even without favoring the borrowers (i.e $s = 0.5$), increasing welfare is achieved. Since this result is attained regardless of the assumption on the productivity levels, it can be said that the monetary policy redistributes resources from lenders to borrowers by generating inflation.

Finally, the comparison regarding the productivity levels reflects that, when heterogeneous productivity levels are assumed, the utilitarian welfare gain is larger in both magnitude and level than the gain in the equal productivity case. For instance, when $\phi = \frac{2}{3}$ and $\sigma = 1.5$, the utilitarian welfare under heterogeneous productivity levels fosters around 12.5% higher welfare than homogeneous case; and when $\phi = \frac{2}{3}$ and $\sigma = 0.5$, the welfare gain is 31% more in heterogeneous case than its homogeneous counterpart. As a result, it can be concluded that the heterogeneous productivity levels are the second channel for redistribution. In this regard, this finding can also be accounted for a further

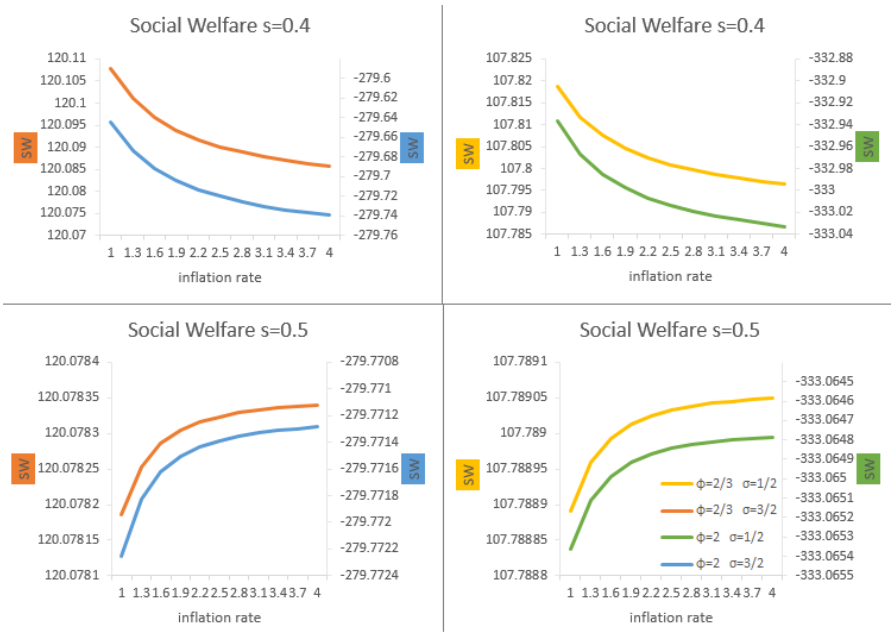


FIGURE 2.8: Cashless Economy with $e^b = e^l$: W

support to the existing empirical and theoretical literature for the positive relationship between the income inequality and the inflation rate. In particular, the different labor productivity levels here, creates income inequality among the types and the welfare gain from generating inflation is higher when heterogeneous labor productivities (i.e income inequality) are present, thereby suggesting that the policy planner can achieve more welfare gain by generating higher inflation when there is income inequality.

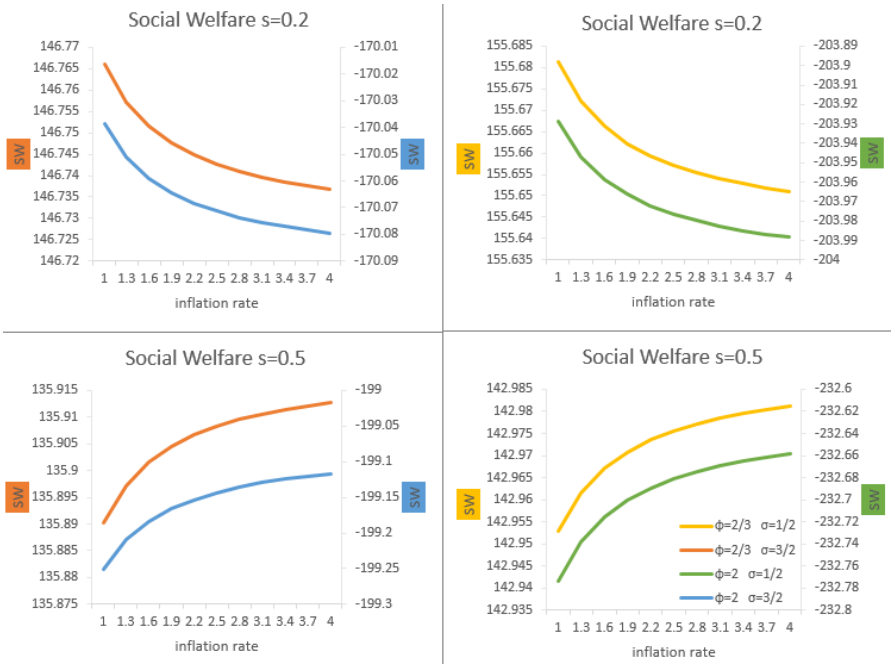


FIGURE 2.9: Cashless Economy with $e^b \neq e^l$: W

2.3 Theoretical Model: Money-in-Utility Setting

Investigating the effects of monetary policy requires a model with cash as the money demand is affected by the changes in inflation as well. Without accounting for money holding decisions, benevolent social planner can set an implausibly high inflation rate, because doing so would hurt only one type of household, namely the lender, by redistributing away from them. However, the introduction of money demand incurs the same distortion that is generated in the form of inflation tax on both types, preventing the social planner from choosing a high inflation rate. Hence, the aim in this analysis is to distinguish the effects of inflation under the presence of money demand motive and compare the welfare consequences of inflation tax in this economy with the cashless economy so as to provide a guideline to the policy planner in setting the inflation rate.

In order to facilitate the comparison with the cashless economy, additive separable utility is assumed and the maximization problems are expressed in real terms. The borrowers maximize a lifetime utility subject to a budget and a borrowing constraint while the lenders are subject to only a budget constraint respectively:

$$\begin{aligned} \max_{\{c_t^b, b_t^b, n_t^b, m_t^b\}} \quad & \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t^b)^{1-\phi}}{1-\phi} - \nu \frac{(n_t^b)^{1+\sigma}}{1+\sigma} + \omega \frac{(m_t^b)^{1-\alpha}}{1-\alpha} \right) \\ \text{subject to} \quad & c_t^b + \frac{b_{t-1}^b}{\pi_t} + m_t^b \leq e^b w_t n_t^b + \frac{b_t^b}{R_t} + \frac{T_t}{2} + \frac{m_{t-1}^b}{\pi_t} \\ & b_t^b \leq \gamma e^b w_t n_t^b \end{aligned}$$

$$\begin{aligned} \max_{\{c_t^l, b_t^l, n_t^l, m_t^l\}} \quad & \sum_{t=0}^{\infty} \delta^t \left(\frac{(c_t^l)^{1-\phi}}{1-\phi} - \nu \frac{(n_t^l)^{1+\sigma}}{1+\sigma} + \omega \frac{(m_t^l)^{1-\alpha}}{1-\alpha} \right) \\ \text{subject to} \quad & c_t^l + \frac{b_t^l}{R_t} + m_t^l \leq e^l w_t n_t^l + \frac{b_{t-1}^l}{\pi_t} + \frac{T_t}{2} + \frac{m_{t-1}^l}{\pi_t} \end{aligned}$$

where ω assigns the weight attached to money holdings (i.e a positive scale parameter) and α is the inverse of the elasticity of money holdings. $m_t^i = \frac{M_t^i}{P_t^i}$ denotes real money balances for $i = \{b, l\}$; and the seignorage revenue is redistributed equally to both types of households as lump-sum transfers, T_t.

The competitive equilibrium of this economy is described by the following set of equations:

$$\frac{\nu({n_t}^b)^\sigma}{e^b w_t} = ({c_t}^b)^{-\phi} + \gamma\varphi_t \tag{2.20}$$

$$\left(\frac{\nu({n_t}^b)^\sigma}{e^b w_t} - \gamma\varphi_t\right)\frac{1}{R_t} = \beta\mathbb{E}_t\left(\frac{\nu(n_{t+1}^b)^\sigma}{e^b w_{t+1}} - \gamma\varphi_{t+1}\right)\left(\frac{1}{\pi_{t+1}}\right) + \varphi_t \tag{2.21}$$

$$\omega(m_t^b)^{-\alpha} = ({c_t}^b)^{-\phi} - \beta\mathbb{E}_t(c_{t+1}^b)^{-\phi}\left(\frac{1}{\pi_{t+1}}\right) \tag{2.22}$$

$$b_t^b = \gamma e^b w_t n_t^b \tag{2.23}$$

$$c_t^b + \frac{b_{t-1}^b}{\pi_t} + m_t^b \leq e^b w_t n_t^b + \frac{b_t^b}{R_t} + \frac{T_t}{2} + \frac{m_{t-1}^b}{\pi_t} \tag{2.24}$$

$$\frac{\nu(n_t^l)^\sigma}{e^l w_t} = (c_t^l)^{-\phi} \tag{2.25}$$

$$\frac{({n_t}^l)^\sigma}{w_t}\frac{1}{R_t} = \delta\mathbb{E}_t\left(\frac{(n_{t+1}^l)^\sigma}{w_{t+1}}\frac{1}{\pi_{t+1}}\right) \tag{2.26}$$

$$\omega(m_t^l)^{-\alpha} = ({c_t}^l)^{-\phi} - \delta\mathbb{E}_t(c_{t+1}^l)^{-\phi}\left(\frac{1}{\pi_{t+1}}\right) \tag{2.27}$$

$$c_t^b + c_t^l = y_t \tag{2.28}$$

$$e^b n_t^b + e^l n_t^l = n_t \tag{2.29}$$

$$b_t^b + b_t^l = 0 \tag{2.30}$$

$$y_t = e^{z_t} n_t \tag{2.31}$$

$$z_t = \rho z_{t-1} + e_t \tag{2.32}$$

$$w_t = \frac{y_t}{n_t} \tag{2.33}$$

$$m_t^b + m_t^l = m_t \tag{2.34}$$

$$T_t = m_t - \frac{m_{t-1}}{\pi_t} \tag{2.35}$$

The simulation exercise of MIU model depends on the previous parameter values together with the reciprocal of the intertemporal elasticity of substitution of real money balances,

$\alpha = 0.83$ following Kremer et al. (2003)[17] and $\omega = 0.006$.[18] Throughout the analysis, homogeneous productivity levels (i.e $e^b = e^l = 1$) are assumed among the household types in order to isolate the presented second redistributional channel of heterogeneous productivities in the cashless economy; and focus on the consequences of the changes in inflation when it has distortionary effects via money demand motive. Inflation varies between [1.3;4] due to the fact that at the steady state, when there is zero inflation, there is no transfers whereas transfers are positive when there is positive inflation. Transfers are important tools for alleviating the negative effect of inflation tax through money holding in the budget constraint. Hence, the simulation, here, starts with the case where the transfers have impact on the budget constraint.

Comparison of MIU model with the cashless setting demonstrates that the trends of the labor, consumption, borrowing, shadow value of the borrowing constraint and the utility of lenders are the same. The decisions are made almost at the same level as the cashless economy except the utilities; and this difference stems from the augmentation of the real money balances into the utility. Although households derive utility from real money balances, since its value diminishes with rising inflation, both the borrowers and the lenders mitigate their money holdings which approaches to zero with increasing inflation.

Both types hold almost the same amount of real money balances with respect to changes in inflation[19]. Transfers amount to a negligible value and are decreasing in inflation. Disentangling the effects of inflation on transfers entails the comparison between the direct and the indirect effects of inflation. The direct effect of inflation on transfers is positive, while the indirect effect (i.e $\frac{\partial T}{\partial m}\frac{\partial m}{\partial \pi}$) is negative, as the first term is positive by nature whenever there is positive inflation and the second one is negative. Figure 2.11 depicts that the indirect effect dominates the direct one, resulting descending transfers when positive inflation is present. Notice that the transfers are endogenous in the sense that it does not follow an exogenously given growth path via money growth; instead, it arises from the decisions of the households towards real money balances. In other words, its trend is generated by the downward trend of the real money holdings.

[17]One of the widely used value of IES of money balances is from Chari et al. (2000) where the calibration is based on the U.S data. Other papers which study the calibrated values in Europe are in the range between 1 and 1.5. To the best of my knowledge, there is no paper that suggests a calibrated value for developing countries. Therefore, abstaining from its developed country counterparts, the simulations in this chapter rely on $\alpha = 0.83$ with the aim to shed light on the effects of inflation in developing country economies.

[18]The scale parameter is calibrated from the steady state money demand equation by using the value of α and velocity data of low&middle income country averages taken from IMF data for the years between 1985-2015. Yet, other parameter values are also checked and the results are found to be insensitive to the changes in the value.

[19]The holdings of real money balances by the lenders are negligibly more than the borrowers which differ in the fourth or fifth decimal.

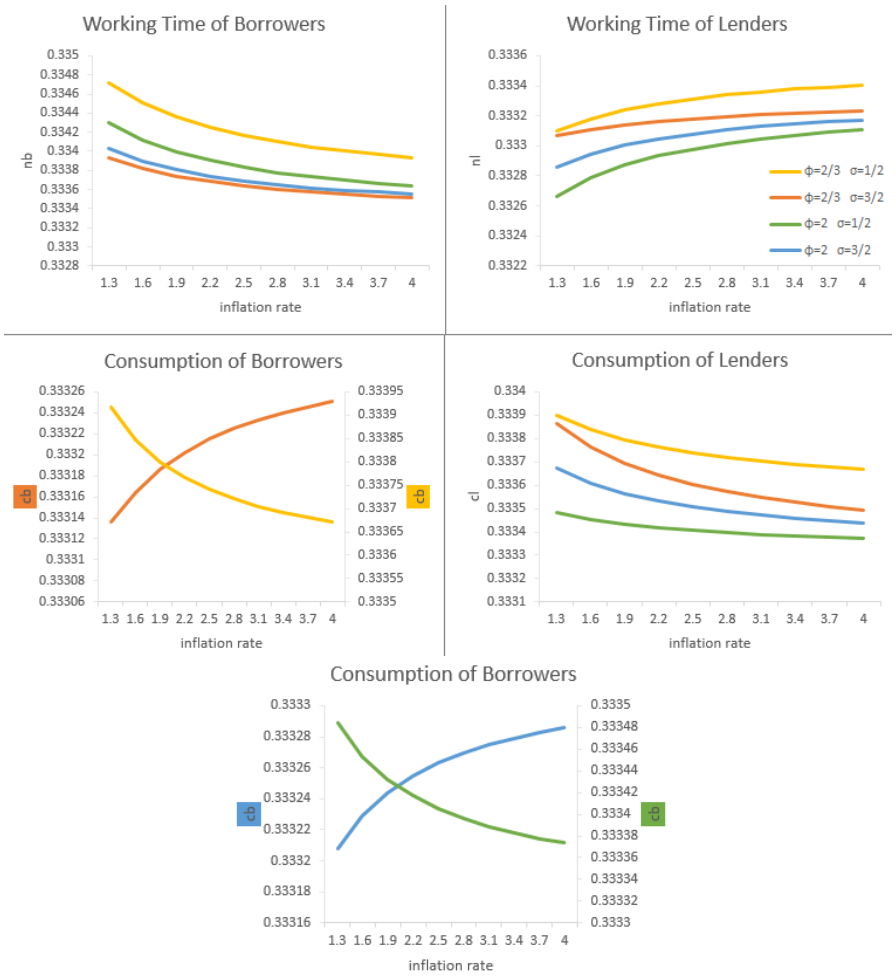


FIGURE 2.10: MIU with $e^b = e^l$: c and n

As Figure 2.13 illustrates, the utility for borrowers rises with inflation for the following parameterizations; $\phi = 2$ and $\sigma = 0.5$, $\phi = 2$ and $\sigma = 1.5$; and $\phi = \frac{2}{3}$ and $\sigma = 0.5$; and that of lenders always decreases. Due to the utility gain from holding real money balances, the levels of the utilities of both types for given inflation rates are slightly higher than the cashless economy. The cashless economy states that the utility for borrowers are increasing in inflation in all parametrizations as either, both decisions are in favor of the utility (i.e $\phi = \frac{2}{3}$ and $\sigma = 1.5$; and $\phi = 2$ and $\sigma = 1.5$) or the positive effect of declining working time in utility overweighs the negative effect of decaying consumption (i.e $\phi = \frac{2}{3}$ and $\sigma = 0.5$; and $\phi = 2$ and $\sigma = 0.5$). However, a contrary result occurs in MIU model compared to the cashless economy due to the utility of borrowers being decreasing in inflation when $\phi = \frac{2}{3}$ and $\sigma = 1.5$. From the point of view of the borrowers, this can only occur because of the downward trend of money holding by alleviating the intensifier effects of decreasing labour supply and increasing consumption on the utility, which gives way to the explanation that the different responses of the utility of borrowers

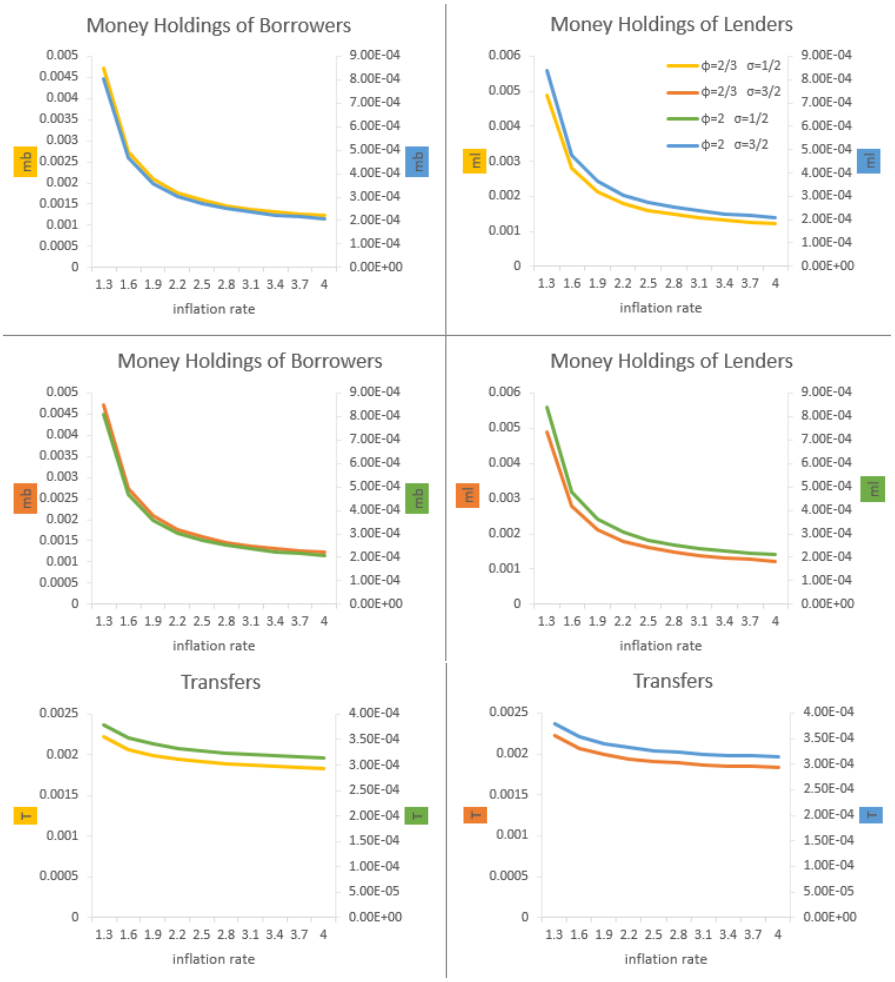


FIGURE 2.11: MIU with $e^b = e^l$: m and T

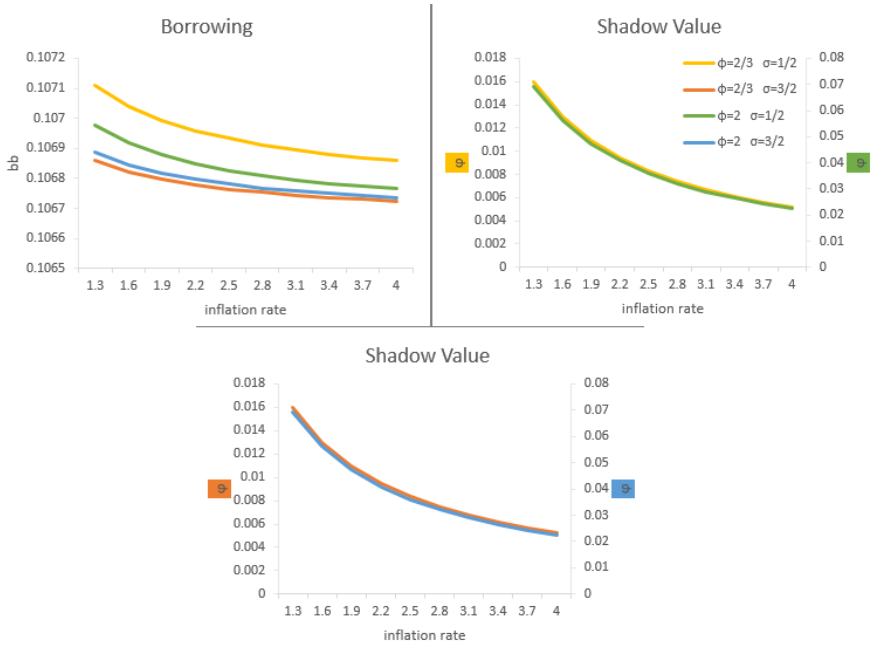


FIGURE 2.12: MIU with $e^b = e^l$: b and φ

are generated by the IESs[20]. In particular, the utility of borrowers is increasing when $\phi = 2$ regardless of the value for the inverse of IES for labour supply; and vice versa when $\phi = \frac{2}{3}$ and $\sigma = 1.5$. In Figure 2.13, top left panel demonstrates the parametrizations to facilitate the comparison where only the inverse of IES in consumption (ϕ) differs ceteris paribus in order to understand the different behaviours of borrower utility. The lower the ϕ is, the easier the substitutability of consumption over time which translates into less need for the allocation of resources that can be used for consumption spending. At the same time, lower ϕ (i.e $\phi = \frac{2}{3}$ and $\sigma = 1.5$ case) leads to having relatively easier substitutability of consumption than money demand compared to the case where $\phi = 2$ and $\sigma = 1.5$, making it relatively more important to smooth money holdings over time. Therefore, the shift from the desire to smooth consumption towards money holding smoothing engenders worsening off of borrowers, imitating the effect of inflation on their real money holdings. Therefore, the key finding here is that the trend of the utility of the borrowers is responsive to the parameterization. In cashless setting, there are two IESs that require to be accounted for; however, in MIU model, there are three IESs. When ϕ and σ are both higher/lower than α, the combination of the effects from labor and consumption decisions of the cashless economy is mirrored on the utility of borrowers[21]. On the other hand, when only one is lower than α and if it is the case for $\phi < \alpha$, the effect of real money balances designates the outcome on the utility of the borrowers[22]. Elasticity of marginal utility (i.e inverse of IES) allows for a comparison of marginal utilities. For instance, the elasticity of marginal utility with respect to consumption being equal to 2 means that the utility changes 2 percent when consumption changes 1 percent. Intuitively, these results follow from the fact that the elasticity of marginal utility with respect to consumption has the largest impact on the utility of borrowers even when it is lower than real money balances and labor supply as there is no scale parameter that restricts its effect on the utility.

When the social planner treats the types equally, as in Figure 2.14, the positive effect of inflation on constrained households projects itself on the utilitarian welfare, fostering welfare gain when $\phi = 2$ and $\sigma = 0.5$. On the other hand, with equal weighing, the utilitarian welfare reduces with inflation when $\phi = 2$ and $\sigma = 1.5$; and $\phi = \frac{2}{3}$ and $\sigma = 0.5$, which stresses that the introduction of money demand into the setting accounts for the domination of the negative effect of inflation rate. When $\phi = \frac{2}{3}$ and $\sigma = 1.5$, since both types of households suffer from higher inflation in this parametrization, generating inflation yields welfare loss. If equal treatments are considered, even though the borrowers are gaining from higher inflation, the utilitarian welfare is decreasing when

[20]Remember that the money demand-consumption optimality conditions (i.e equations (2.22) and (2.27)) indicate that the marginal utility from current consumption exceeds the marginal utility from holding money.

[21]In other words, the utility of the borrowers will be increasing in inflation rate.

[22]In other words, the utility of the borrowers will be decreasing in inflation rate.

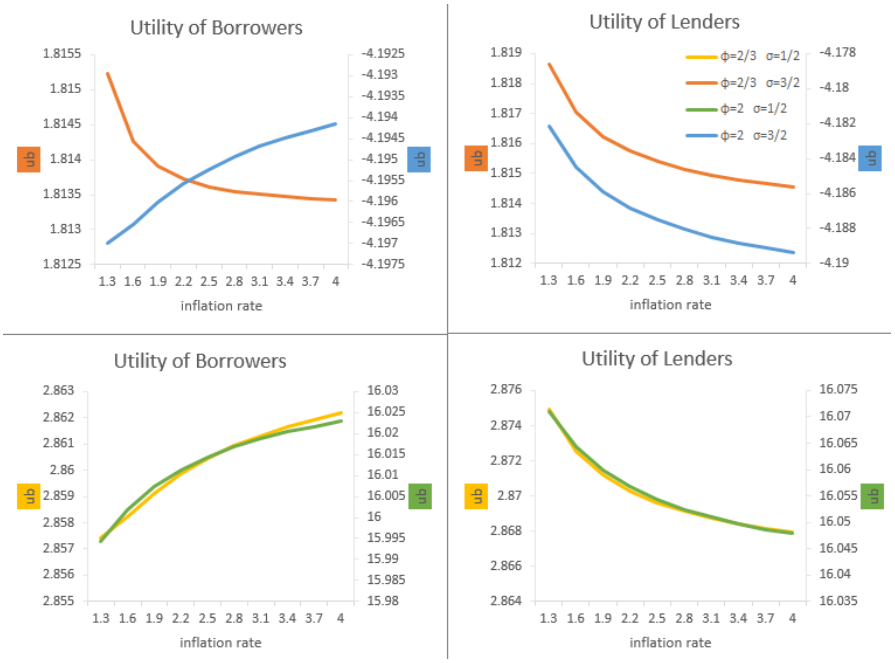


FIGURE 2.13: MIU with $e^b = e^l$: U

$\phi = \frac{2}{3}$ and $\sigma = 0.5$; and it necessitates pro-borrower bias (i.e, $s = 0.8$) in order to achieve welfare gain from generating inflation.

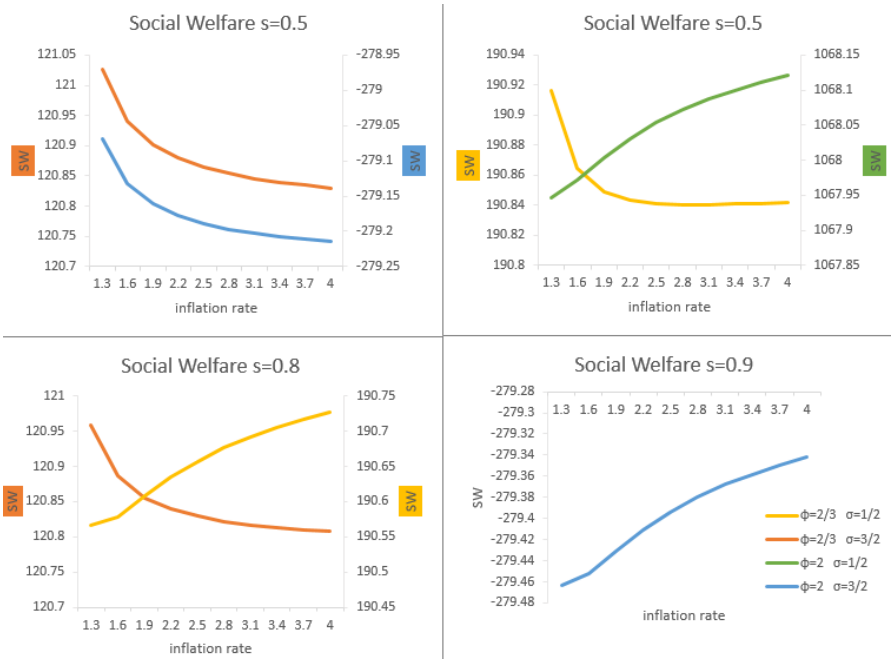


FIGURE 2.14: MIU with $e^b = e^l$: W

It is important to note that both types of households hold almost the same amount of money. This would justify the choice of equally distributed transfers. If there were to be uneven or various trends of money holding decisions by heterogeneous households, this would have brought about a distortion among types per se, requiring a correction via

uneven transfers. In general, the borrowers are still better off in most cases even under the presence of an additional distortion, in the form of inflation tax; and the lenders are always loosing due to higher inflation. Yet, the augmentation of money demand motive into the economy requires favoring the borrowers to be able to achieve welfare gains. On the other hand, the social planner is able to mute the welfare loss by generating inflation without caring for one type more than the other in the cashless economy.

2.4 Conclusion

This chapter proposes a theoretical model with heterogeneous households who differ in their time preferences. Lenders are more patient; hence value future more while impatient households value the consumption of today more than the patient households. Thus, impatient households derive a higher marginal utility from consuming today, leading to borrowing in order to increase their current consumption. On the other hand, patient households indulge in consumption smoothing by saving today. In this setting, the distributional effects of inflation is explored and the non-neutrality of money is assessed without aggregate and idiosyncratic risks, distortionary taxes and generation differences. Finally, money demand motive is introduced to the cashless economy where the decisions regarding to money holding generate another distortion in addition to the borrowing constraint. The aim in this analysis is to distinguish the effects of inflation under the presence of money demand motive; and compare the welfare consequences of inflation tax in this economy with the cashless economy so as to provide a guideline to the policy planner in setting inflation rate.

The cashless economy argues that the structure of the borrowing constraint results in a nominal friction, as higher inflation reduces the real value of debt in terms of commodities at maturity, which tends to benefit borrowers. Therefore, even anticipated inflation becomes non-neutral where the borrowing constraint causes non-neutral effects in employing monetary policy. Additionally, since the debt contracts are predetermined in nominal terms, inflation has an impact on the net worth of borrowers. In other words, an increase in inflation rate lowers the real debt repayments for given outstanding debt; thereby redistributing resources from lenders to borrowers. The introduction of heterogeneous productivity levels illustrates that the amplification of the redistributional effects from monetary policy is observed, suggesting that the different productivity levels between the lenders and the borrowers provides a second channel for redistribution brought by higher inflation. In other words, income inequality facilitates the redistribution of generating inflation as the welfare gain from generating inflation is higher when income inequality (i.e heterogeneous labor productivities) is present.

The cashless economy suggests that the borrowers always benefit while the lenders always suffer from higher inflation. Nevertheless, the utilitarian welfare can be decreasing in inflation when pro-lender bias is assumed. On the other hand, the utilitarian welfare also highlights that even without favoring the borrowers, welfare gain is achieved by generating inflation. In contrast, MIU model demonstrates that the additional distortion in the form of inflation tax can affect even the constrained households negatively, resulting in a welfare loss from generating inflation. Nevertheless, the cases where the borrowers are better off due to higher inflation do not translate into welfare gain when the types are equally treated in the utilitarian welfare function, suggesting that the loss of the lenders are larger than the gain of borrowers from higher inflation. Furthermore, when the households take multiple decisions in addition to money holding, the relative magnitudes of IESs of these choices have to be taken into account when setting inflation rate. In particular, when both inverse IES of labor and consumption are higher/lower than that of real money balances, the combination of effects from labor and consumption decisions is pictured in the utility of borrowers. On the other hand, when only one of them is higher than real money balances together with the smaller one being inverse IES of consumption, the effect of real money balances designates the outcome on the utility of the borrowers.

The optimal monetary policy in the sense of a specific inflation rate offer is beyond the scope of this analysis. Instead, this chapter is concerned with the long-run role of the monetary policy, how it influences patient and impatient households; and hence, affects utilitarian welfare. In turn, it attempts to provide a prescription to a policy planner in setting inflation rates. In this regard, this study shows that the inflation rate has long-run real impacts, it disproportionately affects heterogeneous households by redistributing from lenders to borrowers with anticipated inflation; and whether the inflation rate can be used as an instrument to improve utilitarian welfare relies on the presence of money demand in the form of the MIU model, the concern with pro-lender/borrower bias, the relationship between IESs and the heterogeneous productivity levels. In other words, the policy planner should be concerned about these features when targeting an inflation rate to account for the welfare effects of that policy implication. This is especially the case for the policy planners in developing countries as the calibration for the MIU model is calculated by taking into consideration the low and middle income countries.

Chapter 3

The Determinants of Inflation in Emerging Markets and Developing Countries: Survey and Empirical Analysis

3.1 Introduction

Achieving price stability is the main objective of most central banks. Although they share the same aim, each central bank requires to consider the structure and the characteristics of the economy of the relevant country, yielding a unique optimal inflation rate for each. Hence, to be able to better pin point the optimal inflation rate, it is important to take into account these differences and investigate the determinants of inflation. In this chapter, the sources of inflation in emerging and developing countries are studied focusing particularly first on *proximate* determinants of inflation that attract attention via the suggestion of popular theories; and next, augmenting the political and institutional features of the countries.

This chapter incorporates different theories to facilitate explaining, first, the *proximate* determinants of inflation in emerging and developing countries. The widely accepted school of thought on inflation is the monetarist argument which relies on the quantity theory of money. In this school of thought, inflation is treated as a monetary phenomenon where it is determined by the changes in money supply. This view has found immense support from the existing literature[1]. In addition to the monetarist view, a role

[1]See, such as Grauwe and Polan (2005).

for exploring inflation has been given to the exchange rate, output gap, budget balance and so on. Montiel (1989) suggests that inflation is often associated with budget deficit in developing countries. It is argued that when governments have large fiscal deficits, they may need to finance it via money creation (i.e seigniorage). In this case, as in Sargent and Wallace (1981), budget deficit causes an increase in inflation due to higher money growth. The relationship between the inflation and exchange rate originates from the countries' with higher productivity having higher exchange rates. Through Balassa-Samuelson effect, the rise in productivity pushes up the wages, which in turn will raise costs and prices, thereby leading to an increase in inflation. Coe and McDermott (1997) find that the output gap affects inflation in developing countries. A negative output gap occurs when actual GDP is less than potential GDP and is initiated by a fall in aggregate demand. In response to a lower aggregate demand, the good prices and labor costs fall; and in turn inflationary pressures decrease. Hence, a positive output gap impacts the inflation. Another determinant of inflation reveals from the supply-side as examined by Ball and Mankiw (1995). The changes in oil prices (i.e cost shocks) spur the movements in inflation. Finally, inflation may have been influenced by its past realizations (i.e inertial component) due to the staggered wage contracts or the adjustment process of inflation expectations.

Following the literature, this chapter, also, introduces the political and institutional features of the economies in an attempt to have a better understanding of inflation in emerging and developing countries. The empirical papers do not solved the debate on the determinants of inflation in emerging and developing countries, in-particular when the inflation is low. The controversial results from monetary causes of inflation have led to the search for other sources of inflation, revealing the idea that inflation is also influenced by non-monetary factors. In this line of research, studies indicate that the non-monetary factors tend to complicate the monetary transmission mechanism by interacting with the demand side factors so that they introduce uncertainty regarding the impacts of monetary determinants on inflation. Hence, they suggest that to have a more transparent understanding of inflation, non-monetary factors should be considered as well. For instance, the idea that the government authorities plan to implement less-restrictive policies in order to make use of short-run output increase via inflationary bias roots the presumption that the central bank is relatively not independent. The central bank independence is determined by several factors; and indices of it is formed on the basis of political and economic independence by Grilli, Masciandaro and Tabellini (1991), goal and instrument independence by Debelle and Fischer (1994), legal independence as turnover of central bank governors by Cukierman (1992). For industrialized countries, average inflation is found to be negatively correlated with the degree of central bank independence while little correlation is found for developing countries in the existing

literature[2]. Several empirical papers have found a positive correlation between inflation and income inequality (such as Beetsma and Van Der Ploeg (1996), Al-Marhubi (1997)) that is attributed to the distributional conflicts, political instability and inequality on populist ideologies. Recent evidence reveals that the positive correlation persists in more democratic political systems whereas opposite correlation prevails in non-democratic systems[3].

The empirical strategies for examining the determinants of inflation can be divided into two. First, the pattern of inflation in a single country over a long period of time can be studied. Over time periods, such as 50 or 100 years, there may be sufficient changes in inflation and institutions so that meaningful tests on different theories of inflation determinants can be checked; and robust results can be claimed. Secondly, the experiences in several different countries over a shorter time span can be compared since the differences in economical and political drivers among countries serve for understanding the inflation dynamics. The literature review of this chapter presents both strands of the empirical strategies. Yet, in the empirical analysis section, it follows the second strategy where the empirical methodology utilizes the panel vector-autoregression (PVAR) estimation. Focusing on the emerging and developing countries, the analysis regarding the proximate determinants of inflation suggests that inflation is mainly driven by money growth and inflation persistence. Specifically, money growth accounts for more than one-third of the variance of inflation both in the short and long run; and the inertial component of inflation explains over 40% of the variation in inflation. The unemployment rate and the changes in oil price are the next important sources of inflation with the government debt and the exchange rate movements playing a relatively small role in explaining inflation. The analysis concentrating on the socio-economical and political determinants of inflation argues that the relationship between inflation and income inequality is contingent on the political structure where the positive relationship prevails in democracies; and *de jure* central bank independence has no explanatory power on inflation. Finally, the positive impact of the inflation inertia on inflation, in terms of both magnitude and significance, in each specification regardless of the focus for the determinants of interest suggest that inflationary expectations and indexations schemes in price and wage are the most critical determinants of inflation dynamics in emerging markets and developing economies.

The remainder of the chapter is as follows. Section 3.2 presents the survey for the determinants of inflation in emerging and developing countries. Section 3.3 introduces PVAR estimations for the proximate; and socio-economical and political determinants of inflation. Finally, Section 3.4 concludes with suggestions.

[2]See Fischer(1995).
[3]See Desai, Olofsgard and Yousef (2005).

3.2 Literature Review

Throughout their history, many emerging markets and developing countries have experienced a moderate to high inflation. Inflation began to increase in the 1950s and accelerated immensely in the 1970s and early 1980s; and hyperinflations were experienced in the late 1980s and early 1990s. In the second half of the 1990s, most of these countries managed to lower their inflation rates; and at the beginning of the 21st century, reduced inflation is sustained. However, since mid-2000s, the inflation pressures rose again, mostly because of food and energy prices[4]. Inflation had been reduced to double-figure levels in the mid-1990s and by 2000 to single figure levels. This disinflation performance of the 1990s is generally attributed to fiscal consolidation. External developments such as the decline in global inflation and oil prices contributed to descending inflation, as well as the institutional reforms in the form of improved central bank independence, access to global capital markets; and structural reforms in product, trade and labor markets provided the support to lower rates of inflation[5].

Inflation rates in these countries have been responsive to various external and internal shocks. In order to explain the effects of these shocks on inflation, many approaches have been developed. In Phillips-curve approach, the reasonings behind the inflation are the real factors, shocks to aggregate supply and demand. The negative relationship between unemployment rate and inflation rate claimed by this approach requires an accurate measurement for the unemployment rate. However, pursuing Phillips-curve approach in analyzing inflation dynamics may not be an adequate approach for countries with large informal economy or highly populated by self-employed people[6].[7] Hence, the focus of the existing literature on explaining inflation for emerging markets has turned to the nominal factors. To this end, many studies, for instance, concentrate on the explanation brought by the quantity theory of money suggesting a significant positive relationship between money growth and inflation. The classical view suggested by Sargent and Wallace (1981) which is based on the quantity theory of money implies that fiscal deficit causes inflation because governments with large fiscal deficits tend to resort to money creation to finance its debt. This monetization of debt makes inflation a monetary phenomenon. In contrast, inflation becomes a fiscal phenomenon when fiscal theory of price level prevails, where the increase in nominal public debt to finance persistent

[4]IMF (2008), European Central Bank (2008).

[5]IMF (2001).

[6]To overcome this inadequacy or due to limited availability of unemployment data, some studies constructed output gap data as a proxy for unemployment.

[7]In the analysis of inflation dynamics in both industrial and developing countries between 1960 and 1995, IMF (1996) finds that the output gap is the major factor for the changes in inflation in the medium- and long-run for industrial countries while it is found to explain little of the changes in inflation for developing countries. The difference in the results, for instance, may be attributed to the degree of informality in the economy, quality of the data or the number of self-employed.

budget deficits will be perceived as an increase in nominal wealth as the government bonds are considered as net wealth, when fiscal policy is not sustainable (see, Woodford (1998)). With this debt deflation, increases in price will, in turn, reduce the real value of financial wealth until demand and supply equalize, leading to fiscally driven explanation for inflation.

While monetarists focus on the demand-side factors led by expansionary fiscal and monetary policies, in the structuralist approach, supply-side sources of inflation stemming from rising production costs, such as rising labour cost and input prices (see Bernanke (2005)), are emphasized. Some studies also incorporated exchange rates and global prices in order to account for exchange rate regimes and imported inflation as the food and energy prices have large shares in the inflation baskets of these countries. With the globally interlinked economies, such variables have increasingly attracted more attention as important determinants of inflation. In short, the existing literature incorporates various numbers of variables in order to foster a better understanding of inflation dynamics regarding their approaches. Below is a survey of inflation determinants for panel data analysis of a group of countries; as well as a time-series analysis of individual countries in emerging markets and developing countries is presented.

The causes of inflation in transition economies have been explored with a cross-section and panel data analysis. Koen and Marrese (1995) identify whether inflation is a monetary phenomenon for Russia with the monthly data from January 1992 till November 1994 and claim that contemporaneous money is weak in determining inflation while money growth has the largest impact on inflation two to four lags (i.e months) later. The similar analysis is conducted by Hoggarth (1996) and Korhonen (1998), concluding that inflation in Russia is a monetary phenomenon. Corey, Mecagni and Offerdal (1996) estimate an equation for inflation from an analytic model for the pool of 21 countries and focus on the effects of the relative price changes. They suggest that money and wage growth have a substantial impact in explaining inflation while real appreciation does not have a significant impact on inflation. The effect of relative price variability is found to be sensitive to the region and sample period with a sizable effect during high inflation and a small impact during modest inflation. Inertia and downward price rigidity are argued to be important in explaining inflation when it is at moderate levels. Fischer, Sahay, and Vegh (1998) undertake a panel data analysis with 25 transition countries with the sample period of 1992-1996. They use exchange rate regime in the form of dummy variable for flexible and floating regime, fiscal balance, structural reforms measured as economic liberalization index for trade and foreign exchange regime; for price and competition; for privatization and baking reform as explanatory variables. They find that lower fiscal deficit, fixed exchange rate regime and structural reforms help stabilizing high inflation in these countries.

Kutan and Brada (1999) explore the moderation of inflation in the Czech Republic, Poland and Hungary at the end of the 1990s. As determinants of inflation, they gather data on money supply, nominal wages, past inflation behavior and import prices for the years between 1990 and 1998. Their results indicate that past inflation and import price movements are dominant contributors to inflation in these countries while the money supply and wage growth are unimportant contributors in the short run. The role of foreign prices demonstrate that the moderation of inflation in these countries are driven exogenously, stemming from a general global deflation and from a decline in both global energy and commodity prices. Nikolic (2000) quantifies the impact of changes in growth of money on the response of prices with the data from January 1992 till August 1998. In his time series analysis with an inclusion of lagged dependent variable, his results support the existing literature, claiming that the money growth is a strong determinant explaining inflation in post-communist Russia and suggest the considerable influence of inflation inertia. Lissovolik (2003) captures the sources of inflation in Ukraine during 1993-2002 relying on a markup and a money market model in a cointegrating setting. Exchange rate and wages are found to be the strong long-term determinants of inflation while money has a short-term link with inflation; and the role of relative price variability in inflation processes is supported. Siliverstovs and Bilan (2005) explore the interrelationship among inflation, wage growth, money growth and devaluation expectation by means of variance decompositions and impulse response functions for Ukraine. Using monthly data spanning from January 1996 to November 2003, they show that the changes in devaluation expectations are the main driving source of price changes while money supply has negligible effects on inflation; and find an evidence for substantial inflation inertia.

There are several studies that investigate the drivers of inflation in Asian economies. Lim and Papi (1997) model multi-sector macroeconomic model containing the goods, labor, money and external sectors to analyze the determinants of inflation in Turkey during 1970-1995. In their analysis, the goods market inclines the equilibrium condition for the prices in the long-run while short-run dynamics of prices are affected by the disequilibria in labor, money and external markets. Turkish inflation is found to be driven by monetary variables, namely money and exchange rate; inertial factors are quantitatively significant and public deficit has an important effect on inflation. Cheng and Tan (2002) identify the factors that contribute to inflation for Malaysia applying VECM analysis with a quarterly data covering 1973-1997. They consider eleven variables, such as money supply, interest rate, exchange rate, trade balance, capital inflows, external prices and so on and conclude that external causes have predominant effects on inflation in Malaysia, highlighting the strong effect of the rest of the ASEAN's inflation and exchange rate. Among the domestic factors, private consumption and government

expenditure are found to be the most important determinants of inflation with a less significant impact than that of external causes. Grigorian et al. (2004) explore the presence and the relative importance of monetary transmission channels in Armenia under three interrelated markets; particularly money, labor and foreign exchange, where inflation is assumed to be caused by imported inflation (i.e inflation in trading partners), excessive money growth and wage pressures. Covering the period from January 1996 to June 2003 and using the equilibrium conditions from three markets, cointegration relationships are checked for long-run implications; and ECM framework is utilized for short-run dynamics. Prices are found to respond strongly to the disequilibria in the exchange rate market while the pass-through of excess money and wage pressures in excess of labor productivity are found to be insignificant.

Khan and Schimmelpfennig (2006) evaluate the relative contributions of structuralist and monetarist factors of inflation in Pakistan over the period January 1998 to June 2005. They consider money supply, credit to the private sector, exchange rate and wheat support price as the determinants under investigation, focusing on the claim that the recent increase in inflation is due to the increases in the wheat support price, leading to a monetarist against structuralist-driven inflation explanation for Pakistan. Incorporating the wheat support price into the general open-economy monetary model, the estimation of VECM suggests that the monetary factors, namely broad money growth and private sector credit growth, determine inflation while the wheat support price impacts inflation in the short run, not in the long run. Bonato (2007) studies the determinants of inflation in Islamic Republic of Iran concentrating on the relationship between inflation and nominal variables. Estimated error correction model, based on a small open economy IS-LM model for the quarterly period of 1988-2006, indicates that money growth has a predominant role in determining inflation both in the short- and long-run; and there exists a long-run relationship between the price level and money, its rate of return, the exchange rate and the real output.

Duma (2008) investigates the sources of inflation in Sri Lanka concentrating on the effects of external shocks, i.e exchange rate, oil and import prices. In order to estimate the pass through of these shocks, VAR approach is used including output gap for demand shock; oil price inflation to proxy international supply shocks; and change in the nominal exchange rate as an exchange rate shock. Using monthly data covering 2003-2007, the results suggest that while depreciation of the local currency and import price shocks affect inflation immediately and positively, oil price shocks have an immediate but negative effect on inflation. Additionally, pass-through from exchange rate and import price shocks to prices are found to be positive whereas that of oil price shocks are found to be negative and small. Since the analysis checks for both consumer and wholesale prices, the comparison of the resulting effects on these indices implies that the pass-through of

external shocks to wholesale prices is more severe compared to that of consumer prices. Using annual time series data covering 1971-2006, Pavlavani and Rahimi (2009) study the domestic and external determinants of inflation in Iran. They assume that inflation is determined by endogenous factors such as expected inflation, imported inflation, liquidity, GDP and exchange rate. Their estimations, relying on ARDL approach, suggest that inflation expectation is the most significant determinant of inflation, with exchange rate, imported inflation and liquidity being other effective factors both in the short- and long-run. Jongwanich and Park (2009) examine the importance of the determinants of inflation for 9 Asian countries covering the quarterly period of 1996-2009 with a VAR model. They conclude that excess aggregate demand with the proxy of output gap and inflation expectations account for 15%-30% and 30%-60% of the variability in inflation respectively. External food and oil price shocks are found to explain less than 30% of CPI inflation in these countries.

In their analysis, Khan and Gill (2010) identify the sources of inflation in Pakistan focusing on four different price indicators, namely CPI, WPI, SPI and GDP Deflator. Their study covers the period of 1971-2006 and investigates money supply, budget deficit, exchange rate, inflationary expectations, interest rate, value of imports, wheat support price; and support prices of sugarcane, cotton, rice and wheat together as causes of inflation. Inflation is found to be not affected by fiscal deficit, money supply and wheat support price while exchange rate depreciation, increase in the value of imports and inflation expectations surge inflation in the long run with inflation inertia being the strongest contributor. The impact of interest rate on inflation is negative, yet insignificant whereas that of support prices of sugarcane, rice, wheat and cotton together is positive and significant. In a VAR framework with quarterly data spanning 1991-2008, Patnaik (2010) utilizes impulse response functions and variance decomposition methods to study the causes of inflation in India. This paper indicates that the drivers of inflation is a mix of demand and supply side factors for India. Specifically, volume of demand, money supply and external influences on domestic prices are showed to be the main drivers of inflation with the last two determinants having short run impact; and aggregate demand having the most significant effect on inflation.

Osorio and Unsal (2011) present an analysis of drivers of inflation for Asia[8] using Global VAR (GVAR) model. In order to disentangle the contributions of domestic, regional, and global factors to inflation, they first estimate a GVAR model for 33 countries from Asia and Pacific region covering the years from 1986 to 2010. To see how the inflationary processes of Asia have altered, they estimate SVAR model for each country in two subsamples, in particular, 1986-99 and 2000-09. They indicate that supply (i.e commodity

[8]This paper incorporates the countries such as New Zealand, Australia with the countries, for instance Malaysia and Thailand in the analysis.

prices) and monetary shocks have been the main sources of inflation in Asia for the last two decades. Specifically, changes in exchange rates explain about 15 percent of fluctuations of inflation in Asia and changes in money supply and interest rates explain about 25 percent. However, the impact of these shocks has faded away, particularly in economies that have flexible exchange rate regimes and relatively clear monetary aims. The role of supply shocks are found to diminish slightly in recent years whereas the role of output gap has risen. Finally, they claim that inflation fluctuations are driven predominantly by domestic factors accounting more than 60 percent while global factors account for about 30 percent.

Bhattacharya (2013) overviews the main causes of inflation in Vietnam focusing on the monetary policy transmission mechanisms in order to provide explanations for the experienced higher inflation compared to other Asian emerging markets. The empirical analysis in this paper follows a price-taking small open economy model where inflation is a weighted average of changes in tradable and non-tradable good prices so that with augmentation of monetary policy transmission mechanism, inflation becomes a function of movements in the key economic variables, namely aggregate demand/real output, money supply, nominal effective exchange rate and nominal interest rate; and of foreign price inflation. Over the period 2004Q1 to 2012Q2, VAR is estimated; and the results suggest that in the short-run, movements in the nominal effective exchange rate are the key factors of inflation whereas over the medium-run, GDP growth and growth in credit to the economy are main drivers of inflation. In order to compare the causes of inflation in Vietnam with other EMEs (China, India, Indonesia, Malaysia, Philippines, Sri Lanka and Thailand), a cross-country dynamic panel model is applied covering the period 2004Q1-2012Q2 where lagged inflation, lagged growth rates of GDP, lagged growth of the money supply, contemporaneous movements in import price deflator, world food and commodity prices and so on are used as determinants of inflation. The results from GMM estimation indicate that contemporaneous movements in import prices and past inflation are important determinants of inflation for all these countries whereas lagged growth rates of GDP or of money supply, lagged nominal interest rates and lagged movements in the nominal effective exchange rate are found to play no role in explaining inflation.

Mohanty and John (2015) identify the determinants of inflation in India using a time varying parameter SVAR model covering the data from Q1: 1996-1997 to Q3: 2013-2014. They conclude that the determinants of inflation, namely crude oil prices, output gap, fiscal policy and monetary policy (i.e call money rate), exhibit significant time variation. Crude oil prices and exchange rate are found to be important in explaining inflation while on average the output gap is showed to be insignificant with an asymmetric effect on

inflation. The fiscal deficit contributes to inflation in 2011-2012 while the monetary policy impacts inflation only after 2005-2006.

African economies are also examined to shed light on the contributors of inflation pressure in these counties. Moser (1995) investigates the main factors influencing inflation in Nigeria with ECM model covering the period of 1962-1993. The results show that money growth that is brought about by fiscal deficit is the main driving force of inflation; and devaluation of the currency together with agroclimatic conditions are the other important determinants of inflationary pressure in Nigeria. In an attempt for explaining inflation in Mozambique, Ubide (1997) decomposes inflation into components, estimates an inflation equation using open economy definition of inflation and explores the transition mechanisms via ARIMA model during 1990-1996. In the long-run, inflation in Mozambique is shown to be driven by monetary expansion, depreciation of exchange rate and unforeseen events in agricultural sectors while inflation inertia is found to be insignificant. Blavy (2004) analyzes the inflation developments for the period September 1991-March 2003 in Guinea. The results, based on quarterly data and applying cointegration and error-correction modeling where inflation is assumed to be determined by the equilibrium in the money market, show that the significant long-run relationship between inflation and money growth has been boosted in recent years; and inflation is found to persist over time in the short-run. Nassar (2005) tries to model the determinants of inflation in Madagascar using quarterly data over the period 1982-2004. Based on a two-sector model (i.e monetary disequilibrium model with an open economy) to explore the relationship between prices, exchange rate and money, the estimated model finds a long-run relationship between domestic prices, real income, broad money and foreign interest rates. However, foreign interest rates are found to be statistically insignificant in long-run while exchange rate movements have significant effects; and inflation inertia is also concluded to be important.

Barnichon and Peiris (2007) examine the causes of inflation in Sub-Saharan Africa (SSA), particularly exploring the relationship among output gap, real money gap and inflation. In order to estimate the expectation-augmented Phillips curve, they first build up measures of ouput gap and real money gap via panel cointegration regressions. With panel GMM estimation of an augmented (closed economy) Phillips curve of seventeen African countries covering the years from 1960 to 2003, they claim that both output gap and real money gap have an important role in inflation with the real money gap having larger impact than the output gap on inflation; and excess money is found to have a larger role than excess output in explaining inflation. Diouf (2007) investigates the drivers of inflation in Mali focusing on monetarist theories, structuralist hypothesis and external theories. The estimation of EC modeling with quarterly time series data over 1979-2006 shows that supply-side constraints proxied by average national rainfall have large and

significant effects on inflation by decreasing it. Since the rainfall represents the cereal production, this result implies that it has a large impact on inflation. Real appreciation of the domestic currency decreases inflation in the long run more significantly than the increasing effect of excess money supply on inflation suggesting the monetary and imported long-run drivers as the main sources of inflation in Mali. Finally, real income growth is suggested to be the short-run determinant of inflation. Thorton (2008) investigates the long-run money-inflation relationship for 36 African countries over 1960-2007 using cross section and panel data analysis based on the quantity theory of money relationship. He demonstrates that there exists a weak (strong) long-run relation between money growth and inflation for the countries with money growth and inflation below 10% (much higher than 10%). The determinants of inflation in Sierra Leone is investigated by Gottschalk et al. (2008). Their structural VAR approach is based on a monthly data from 2001 to 2006 and includes international oil prices, reserve money as a measure for monetary policy and exchange rate as determinants of inflation. Oil prices are found to be the key factor for inflation variation and food-supply shocks are found to dominate price variations in the short run. It is concluded that increasing money growth, higher oil prices and nominal exchange rate depreciation cause an increase in inflation in Sierra Leone[9]. Wolde-Rufael (2008) investigates the causal link among budget deficit, money supply and inflation for the period of 1964-2003 in Ethiopia conducting cointegration tests and variance decomposition. The results indicate that fiscal deficit and money supply contribute to inflation without money supply being interfered by budget deficit.

Evaluating the movements in prices from a quarterly data between 1997 and 2007, Klein and Kyei (2009) identify the factors that contribute to the sharp decline in inflation in the recent years of the analysis in Angola. The estimated results from VECM indicate that there is a significant long run relation between inflation and exchange rate; money growth affects inflation with a lag as it first triggers demand pressure and indirectly affects inflation. Since the large share in inflation basket is devoted to imported food items, international non-fuel commodity prices have a strong impact on inflation in Angola. Baldini and Poplawski-Ribeiro (2011) investigate the importance of fiscal and monetary determinants of inflation in 22 Sub-Saharan countries from 1980 through 2005 with VAR estimation. They find that the nominal public debt, as proxied by money growth or in nominal public debt, plays an important role in inflation and fixed exchange rate is showed to be related with lower inflation. Simpasa et al. (2011) elaborate the underlying reasons of recent high inflation rates in four East African economies (Ethiopia, Kenya, Tanzania and Uganda) spanning 1961-2010 by taking into account the characteristics

[9]They address a problem about an important omitted variable, specifically government financing. Their concern refers to the fact that fiscal policy and monetary policy intervene and sometimes constrain each other. Yet, due to the data limitations, they regard this incompleteness in the effects from monetary policy shocks as a shortcoming, but not crucial.

of each country. The the main source of short-run inflation in Ethiopia and Uganda is found to be money growth while in Kenya and Tanzania, oil prices seem to be the main driver of inflation with an increasing impact coming from money supply in recent years. In general, money supply, world food and oil prices are claimed to be the significant factors in explaining inflation rates in these countries.

Caceres et al. (2011) use VAR model for analyzing the inflation dynamics in four CEMAC members (Cameroon, the Central African Republic, Gabon, the Republic of Congo) and in the CEMAC-4 region from 1996 to 2010. Their analysis argues that inflation is driven mainly by government policies, namely controlled prices which direct the spillover from international market prices into domestic prices, government expenditure and global food and energy commodity prices. Money supply is found to have insignificant effects on inflation in the region; and exchange rate movements are found to have indirect effects on inflation through import prices. With ARDL approach, Adu and Marbuah (2011) identify the main sources of inflation in Ghana from 1960 to 2009, where small open economy definition for inflation is employed as a quantitative model. Their results show that without a shift of the importance of the determinants during the sample period, real output, broad money supply, fiscal deficit, nominal exchange rate and nominal interest rate are the important factors in explaining inflation with output growth having the strongest impact. Using quarterly data over 1983-2009, Kinda (2011) identifies the factors that drive inflation in Chad. The findings from a VECM that relies on a small open economy IS-LM model indicate that the supply-side constraints (i.e rainfall), public spending and external factors (i.e changes in trading partner prices and in exchange rate) are the main causes of inflation. Conducting SVAR approach confirms the effects of rainfall, foreign prices, exchange rate and public spending with an addition of persistence of inflation.

Durevall and Sjö (2012) assess the main determinants of inflation in Ethiopia and Kenya. In order to understand the recent upright trend of inflation, they evaluate excess money supply, domestic agricultural supply shocks, exchange rates, world food, non-food and energy prices using ECM with a monthly data over 1999-2011 for each country. Their results show that while exchange rates and world food prices have a long run impact, agricultural supply shocks and money growth have short and medium run effects on inflation; and inflation is driven substantially by its past realizations. Using a monthly data over 2000-2012, Durevall, Loening, and Birru (2013) explore the inflation dynamics in Ethiopia focusing on the changes in food prices. Their main finding is that the international food and goods prices determine the long-run inflation. Food inflation is affected by agricultural supply shocks in the short run, deviating from long run price trends; and money supply plays a role in driving short run non-food inflation. Alkoum and Agil (2013) trace the main drivers of inflation in the Libya using ARDL approach.

With the data from 1980 to 2011, they consider money supply, real income, exchange rate, output gap, expected inflation and imported inflation as determinants of inflation. Money supply, real income and imported inflation are suggested to be the most significant drivers of inflation rate both in the short- and long-run. Exchange rate, output gap and inflation expectation are also found to contribute to inflation with descending impact on it. Oladipo et al. (2013) examine the sources of inflation for West African countries, namely Guinea Bissau, Ghana, Gambia, Guinea, Nigeria and Sierra Leone. Using the equation for overall price levels as a weighted average of tradable and non-tradable goods and incorporating money market equilibrium to this, they estimate VAR and VECM covering the period between 1970q1 and 2010q4 in order to account for both short- and long-run dynamics. Their results suggest that money supply, income, exchange rate movements and foreign prices play significant role on the inflation rate in the long-run; and except foreign prices, other drivers remain as significant determinants of inflation in the short-run.

Nguyen et al. (2015) explore the dynamics of inflation in Sub-Saharan Africa considering the fact that policy shifts, the integration with the global world may have changed the presumption that the inflation in these countries are led by supply shocks. Their quantitative analysis accounts for global and regional demand pressure, inflation spillovers together with trade and financial links between these countries. They first estimate Global VAR model for 65 countries, including 33 SSA countries, covering quarterly data from 1988 to 2013 in order to investigate the reasons of inflationary pressure. Secondly, they search for an evidence of structural break of how the inflationary process has changed over time in two sub-samples, 1988-98 and 1999-2013. Their results indicate that over the last 25 years, shocks to exchange rate, monetary variables and domestic supply shocks have been the most important determinants of inflation in SSA. Country characteristics, such as vulnerability to weather shocks, economic importance of agriculture, oil and food imports, trade openness and policy regime are also highlighted for driving inflation. However, over the last decade, the shift on the sources of inflation in the area is observed. In particular, the role for global oil and foods shocks, domestic demand shocks, shocks to output as well as inflation spillovers from other countries have increased whereas the role of exchange rate shocks, domestic supply shocks and monetary variables have decreased.

Latin American economies have attracted some attention for analyzing the inflation dynamics reigned in the region. Williams and Adedeji (2004) explore the inflation dynamics in Dominican Republic by jointly investigating the effects of the money market and traded-goods market disequilibria. The results from quarterly observations during the period 1991-2002 indicate that the disequilibrium in the money market plays a significant role on inflation while the disequilibrium in the traded goods market does not.

Furthermore, ECM shows that changes in real output, exchange rate, monetary aggregates and foreign prices drive inflation in the short-run. In their quarterly observation analysis over the period 1983Q1 to 2001Q4, Bailliu et al. (2003) apply three models, namely a mark-up model, a money-gap model and a Phillips curve, to explain the major determinants of inflation in Mexico. A mark-up model treats inflation as a cost-push phenomenon where the price level is determined by a long-term constant mark-up over costs. A money-gap model views inflation as a monetary phenomenon where changes in the aggregate price level occurs due to the attempt for correcting monetary disequilibria. Money gap is defined as the difference between the actual money supply and the estimated long-run money demand; and a positive money gap, in which the stock of money is above the long-run demand for money, suggests rising inflationary pressures. Phillips curve approach claims that inflation arises from real factors, in particular imbalances between aggregate demand and supply where a decrease in unemployment rate suggests a boost in excess demand, which causes an upward pressure on nominal wages affecting inflation expectations; and in turn inflation. Among all, the mark-up model turns out to perform the best for explaining the dynamics of inflation in Mexico and the the exchange rate is found to be the predominant driver of inflation.

Capistrán and Ramos-Francia (2006) gauge the degree of persistence of inflation for the ten largest Latin American economies[10] covering the period 1980-2006. With varying estimated degree of inflation persistence across countries, the region as a whole is found to have very high persistence in inflation. Using mark-up and monetary theory models, Monfort and Peña (2008) study the inflation dynamics of Paraguay. In their mark-up model, prices are modeled as a function of imported prices and domestic costs. More specifically, prices are calculated some weighted average of unit labor cost, other domestic inputs, and foreign prices. In the monetary theory model, they consider currency in circulation and broad money as monetary aggregate explanatory variables. Using quarterly data for 1991-2007 and cointegrated VAR together with VEC model, oil and administered prices are found to be insignificant while the exchange rates of the main trading partners as a proxy for imported inflation and unit labor costs are found to be significant in explaining inflation. Imported inflation, especially the exchange rate with Brazil, is found to matter also in the short-run. Currency in circulation appears to be the predominant monetary aggregate for inflation movements in the long-run; and inflation inertia, either stemming from inflation expectations or wage indexation, is showed to be strong in inflation dynamics in Paraguay. D'Amato and Garegnani (2009) study the short-run dynamics of inflation in Argentina by estimating a hybrid New-Keynesian Phillips curve where both backward- and forward-looking rules of price setting together

[10]The countries under consideration are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay and Venezuela.

with more realistic measure of marginal cost (i.e aggregate labor income share), instead of output gap, are considered. They extend the model by augmenting nominal devaluation and foreign inflation in order to account for small open economy dynamics. Covering the years between 1993 and 2007 and using GMM estimation, their results demonstrate that nominal devaluation and foreign inflation have a significant effect on inflation, with the latter accounting for more impact. Both backward- and forward-looking components are found to be important in determining inflation dynamics in Argentina, with the backward-looking component having larger effects.

The determinants of inflation are studied under specific categorizations of countries as well. Using pooled data VAR estimations for 53 developing countries from Africa, Asia, Mediterranean and South America over the period 1964-1998, Loungani and Swagel (2001) find that inflation persistence plays a predominant role, accounting about 50, 50, 70 percent of variation in inflation in Mediterranean, Asia and Africa respectively. However, its role is smaller for South America (5 percent) and when all the countries are included in the analysis (10 percent). Differences have been made in the inflation inertia between fixed and floating exchange rate regimes, having the coefficient greater for fixed rate countries than for floating rate countries[11]. Money growth is found to be the second most important determinant of inflation in these countries when inflation inertia is the dominant factor. Its contribution to inflation is stressed to be less important in fixed exchange rate regimes than in non-fixed regimes. They find that the variation of inflation explained by the exchange rate changes depends on the order of the shocks, specifically whether it is given before or after the shock of money growth. Both fuel and non-fuel commodity prices are found to have significant impacts on inflation in fixed exchange rate regimes among developing countries.

Mohanty and Klau (2001) study the trends and determinants of inflation in 14 EMEs[12] in the 1970s, 1980s and 1990s. Their empirical analysis comprises both demand and supply side factors combining a wage and a mark-up price equation together with Phillips curve, concentrating 1990s because of the data limitations. They find that exogenous supply shocks, especially shocks to food prices, are the most common driver of inflation in all these countries, with exchange rate being the next. Food prices are also suggested to be significant in variability of inflation. The demand factors, represented by output gap and excess money; and wage growth as supply side factor play significant role in affecting inflation, though they argue that it is hard to grasp the precise impact. Other supply side factors, however, namely the exchange rate or import prices and agriculture shocks, are presented as the significant main drivers of price movements in EMEs whereas oil price

[11]Contrary to the result of Crowley (2010), see below.

[12]The countries considered by the study: Brazil, Chile, the Czech Republic, Hungary, India, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, South Africa, Taiwan (China) and Thailand.

shocks are found to have a weak effect on inflation. Finally, they point that persistence of inflation explains a large proportion of both the average inflation and the variation in inflation in all countries.

IMF (2001) finds a significant long-run relationship between the size of government deficit and inflation in 23 EMEs using dynamic panel regression analysis over 1970-1999, suggesting that inflation is positively associated with fiscal deficit and negatively with the size of inflation tax base. This relationship is tested by the inclusion of other drivers of inflation, namely openness, exchange rate regime, political instability, changes in oil and non-oil commodity prices and world inflation[13], yielding stable results. Specifically, 1 percentage point of reduction in government deficit leads to a decrease in inflation by 2 to 6 percentage points. Additionally, world inflation and changes in oil prices are found to be significant while no statistical relationship between fixed exchange rate regime and inflation; and negative relationship between openness and inflation that becomes insignificant when fiscal imbalance is introduced are presented in the analysis.

In their paper, Catão and Terrones (2001) search for an evidence of Sargent and Wallace's (1981) "unpleasant monetarist arithmetic" where an increase in public debt is associated with rising inflation in countries with large public debt for EMEs. For a panel of 23 EMEs during 1970-2000, they focus on the long-run relationship between fiscal deficit and inflation. Their long-run relationship is brought by a general equilibrium model that relates fiscal deficit, money demand, money supply and inflation. Nesting the theoretical model in ARDL approach, they find that 1 percentage point decrease in fiscal deficit to GDP ratio decreases inflation by 2 to 7 percentage point. They check the robustness of this result by excluding the countries that experienced very high and hyperinflation from the sample[14] and the result remains the same; thereby concluding that the fiscal deficit has a positive statistically significant relationship with inflation. Oil price changes and world inflation are found to be important and significant in determining inflation while openness to trade and the exchange rate regime movements provide no evidence for affecting inflation.

Domaç and Yücel (2005) investigate the factors contributing to the starts of inflationary episodes in 15 EMEs[15] covering 1980-2001 and employing pooled probit analysis to a cross-country data set. In their analysis, they consider the factors that are commonly addressed by the existing literature; and also incorporate political determinants of inflation. From the political perspective, populist view of inflation suggests that polarized and fragmented governments, which have electoral uncertainty and disagreements

[13]They test their analysis by excluding the countries that experienced hyperinflation episodes

[14]Fischer, Sahay and V/egh (2002) argue that the relationship is significant for countries which experience very high inflations.

[15]The countries covered by the paper: Argentina, Brazil, Colombia, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, South Africa, Thailand, Turkey, and Venezuela.

between policymakers, are more prone to levy inflation tax. On the other hand, the state-capture approach argues that wealthy and powerful elite may derive personal benefit from inflation so that the price instability is due to the will of incumbent politicians or the elite, contrary to the demand by the public for inflationary financing. While this view suggests that price stability can be achieved by promoting democratic accountability, the former conjecture argues that for price stability, autonomous and consolidated governments are needed. Their results indicate that the inflation episodes are triggered by output gap, change in food production index and change in oil prices. From the political stance, institutional democracy and durability of the regime measures are found to be negatively correlated with inflation starts, supporting state-capture view; yet with significant impact from the former. Specifically, an increase in GDP growth above trend, negative agricultural shocks and decrease in budget surplus raise the probability of inflation starts while an increase in capital flow relative to GDP and a more democratic environment decrease the probability of inflation starts in these EMEs.

Fanizza and Söderling (2006) argue that many MENA countries follow monetary policies such that fiscal position of a country becomes a key determinant for inflation. Instead of the prediction based on Fiscal Theory of the Price Level that suggests eliminating seigniorage revenue is not sufficient to avoid moderate to high inflation, they claim that a sound fiscal position is a necessary condition for macroeconomic stability. Kwon et al. (2006) search for an evidence for the implications of "unpleasant monetarist arithmetic" from a large cross-country analysis. To account for this specific focus, their model relies on forward looking fiscal-monetary models of inflation. They consider particularly the role of public debt rather than the budget deficit on inflation for two reasons. First, monetization expectations and wealth effects of public debt can arise regardless of the size of the budget deficit. Secondly, the size of the budget deficit can be quite different from the public debt due to debt-indexation, non-debt financing and exchange rate movements (see, IMF 2003). Their empirical analysis utilizes GMM estimation over 71 countries including developing and developed countries spanning 1963-2004. They find a strong and positive impact of debt growth on inflation in developing and non-major advanced economies, with greater impact for indebted developing countries. Furthermore, the significant link between debt and inflation is found to exist even when money growth, real output growth, currency depreciation and output gap are controlled. Finally, exchange rate regime is suggested to contribute to this link. In particular, the response of inflation to debt is larger and significant under a floating regime than a fixed exchange rate regime. As an application, they also confirm the significance of public debt-inflation link in Jamaica with a VAR approach.

Borio and Filardo (2007) put forward a complementary explanation for determinants of inflation where they pose a more "globe-centric" approach considering the changes in

the trend of inflation and in the sensitivity of inflation responses to traditional determinants, especially since 1990s. Their country-centric approach assumes that inflation is determined by excess demand, wage, exchange rate and import prices which captures international effects whereas the globe-centric approach considers foreign prices, global excess demand pressures and factor mobility. In their methodology, they use backward-looking Phillips curve specification by extending it with a global measure of economic slack where it is calculated as weighted average of international output gaps. The data of this paper covers both industrial and emerging market countries over the sample period of 1985-2005. The results suggest that global factors have become more important relative to domestic ones; and in some countries, the explanatory powers of global factors have dominated that of domestic output gaps as one of the key determinants of domestic inflation. The inclusion of import and oil prices, as traditional indicators of external influences, are checked for robustness and their findings are not overturn.

Habermeier et al. (2009) analyzes the inflation pressures and monetary policy responses to rising inflation due to the food and oil price shocks using several estimation methods varying from pooled OLS to GMM for 49 EMEs and developing countries covering monthly data during January 2005-June 2008. As explanatory variables of inflation, they consider inflation inertia, measures of aggregate demand pressure, such as GDP growth, output gap, unemployment, wages, fiscal deficit; food inflation and oil inflation as external factors and central bank credibility. Monetary policy tightening is found to be related with a decrease in inflation while aggregate demand pressures and higher commodity prices increase inflation. Observed surge in inflation is attributed to aggregate demand pressures proxied by credit growth and rise in food and energy prices while food inflation and oil inflation are found to be insignificant affecting inflation even considering their large share in CPI basket. A negative relationship between rise in inflation and exchange rate appreciation is observed. Currency appreciations under more flexible exchange rate regimes, greater degree of central bank independence and credibility are found to be associated with lower inflation. Increasing capacity constraint, inflation persistence and tighter labour markets are found to contribute to inflationary pressures with second round effects.

Crowley (2010) reports an analysis on the factors determining the inflation in the Middle East, North Africa, and Central Asia (MENACA) region[16]. In the MENACA region, regional inflation had a downward trend from 1996 until 2000 which was reversed since 2000. This paper aims to understand the reasons behind this shift by considering the

[16]It is important to approach these conclusions with caution as Kuwait, Qatar, Saudi Arabia, United Arab Emirates are also included in the sample. Yet, it is noted that regrouping the countries into subgroups as major oil exporter, moderate oil exporter, and countries that export little or no oil does not change the pattern of inflation in the region.

factors that have been accounted for explaining inflation dynamics in the existing literature. Using annual data, this paper tests the importance of past inflation, nominal exchange rate, commodity prices, import prices and GDP growth proxied for output gap as the related data is mostly unavailable. Positive and significant correlation between inflation and changes in non-fuel commodity prices is found. Inflation inertia is found to be the most significant factor. The effects of the percent change in the exchange rate and broad money supply are proven to be positive and significant. The strength of US dollar is shown to be related to a lower inflation; with the level of the value of the dollar being more important than the change. However, the effect of change in fuel prices, real economic growth and import prices on inflation are suggested to be insignificant.

Agénor and Bayraktar (2010) estimate contracting models of the Phillips curve for eight middle-income developing countries, namely Chile, Colombia, Korea, Malaysia, Mexico, Morocco, Tunisia, and Turkey. The analytic foundations of this type of models rest on the fact that backward-looking Phillips curves put too much emphasis on inertia while forward-looking Phillips curves have difficulties in explaining the persistence of inflation and in responsiveness of inflation to monetary policy shocks; and New Keynesian models are not plausible to account for open-economy considerations, such as trade openness' affecting price setting behaviours of firms through marginal production costs. To solve this problem, they specify many open-economy inflation specifications, with different assumptions on the formation of expectations; and focus on the impact of openness, the role of marginal production costs, the effect of borrowing costs and the role of factor substitution between labor and imported inputs. In all specifications, they include the real exchange rate, the relative price of imported intermediate goods in terms of wage (i.e a measure for the degree of factor substitution), imported oil prices and lending costs to account for the possibility that firms may need to borrow. Based on two-step GMM techniques, their results indicate that one lagged and one lead inflation rates are highly statistically significant and have a positive effect on the current inflation in all countries with backward-looking behavior being a more important component in explaining inflation. The lending rate and output gap appear to positively affect inflation. World oil prices and relative input prices are found to have a limited impact on inflation while bank borrowing costs are significant for Korea and Mexico.

Parker (2017) studies the relevance of global inflation on national inflation using the dataset of 223 countries covering advanced, middle and low income countries over 1980-2012. Along with global inflation, 9 country-specific characteristics, such as trade openness, financial development, exchange rate regime and central bank independence, are considered in the analysis as they intervene with the effect of global inflation on domestic inflation to a greater or lesser extend. The results suggest that while global factors can account for around 70 percent of the variance of inflation in advanced economies,

in other words, for those with greater financial development, higher GDP per capita and more central bank transparency, but not in middle and low income countries. It is also indicated that the global inflation factors are more important in affecting the national inflation rate in countries with fixed exchange rates. Finally, the impact of global inflation on domestic inflation rates is found to be much lower for less developed countries.

3.3 Empirical Analysis

This section presents the quantitative analyses regarding to the determinants of inflation by utilizing two different dataset[17]. First, panel vector-autoregressive (VAR) model is introduced together with data explanations, specification features and results in order to understand the 'proximate' drivers of inflation; next, to those of the socio-political influences.

Panel VAR models have become increasingly popular especially among applied macroeconomists and policymakers as they permit to account for interdependencies in order to capture global transmission mechanisms, treat the relationships across macroeconomic units without imposing a priori constraint on these links, incorporate cross sectional dynamic heterogeneities; and allow for heterogeneity in coefficients. These features of Panel VARs enable them to become used to analyzing the dynamics of business cycles in a region, to forecast some economic variables by taking into account cross unit spill-over effects, to study the transmission of idiosyncratic shocks and so on.[18]

In this chapter, IRFs obtained from PVAR estimation are used in order to examine the relative importance of the determinants of inflation in emerging and developing countries; and brief comments are given with reference to VDCs. As the determinants of inflation, *proximate* drivers of inflation suggested by traditional approaches are considered.[19] Specifically, annual data on 41 countries[20] for the years from 1990 to 2015 are gathered. Data on inflation rate, exchange rate, unemployment rate, money growth and oil price are from the IMF International Financial Statistics while debt data is from Historical Public Debt Database of IMF. Inflation is the consumer price index calculated as percentage change in corresponding period of the previous year. The exchange rate is the national currency per U.S. dollar, end of period rate. The nominal exchange rate is used in the analysis as the real exchange rates account of the inflation, that the aim

[17]The data are different as it is obligated by the availability of the choice of inflation determinants.
[18]See, Canova and Ciccarelli (2013) for a survey on PVAR models and their topics.
[19]Following one of the first papers on developing countries by Loungani and Swagel (2001), similar variables are studied.
[20]See Table 3.15 in Appendix for the full list of countries.

is to understand the underlying drivers of. From the data, year-on-year depreciations and appreciations are calculated so that any effects on inflation will be attributed to movements in the exchange rate. The unemployment rate is given in percentage units. Money growth is the annual percentage change in broad money. The oil price is given in the form of U.S. dollars per barrel as a rate. Since this is a world-wide price, it is the same for each country. The debt data comprises of the gross government debt-to-GDP ratios. As the fiscal imbalance data is limited for the countries under consideration, government debt data is used instead. Table 3.1 provides the summary of the data, according to which inflation and money growth vary widely across countries followed by government debt-to-GDP ratio and oil price rate. According to Table 3.2, that provides the pairwise correlations between the variables, the relationship suggested by the quantity theory is supported by the strong and significant correlation between money growth and inflation. Another strong correlation between money growth and debt points to the use of seignorage by the government for financing its debt. Together with significant correlation between inflation and government debt, the monetarist view becomes more evident.

Table 3.1: Summary Statistics for Proximate Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
oilp	1066	46.65077	32.30113	13.07	105.01
unemp	960	9.84392	6.514569	.1743948	37.3
debt	1004	54.50466	76.17525	1.02666	2092.92
money	1016	50.37192	348.7702	-85.00267	7677.834
cpi	1025	57.42178	428.2769	-7.113768	7485.492
excg	1043	.059948	.2373355	-.1485432	4.566732

Table 3.2: Pairwise Correlation Matrix for Proximate Variables

	oilp	*unemp*	*debt*	*money*	*cpi*	*excg*
oilp	1.0000					
unemp	-0.0900	1.0000				
debt	-0.1095*	0.0748	1.0000			
money	-0.0853	-0.0402	0.5994*	1.0000		
cpi	-0.1018	-0.0491	0.4811*	0.9121*	1.0000	
excg	-0.1572*	-0.0974	0.2408*	0.5499*	0.6046*	1.0000

* demonstrates $p < 0.001$ significance.

The analysis starts by conducting several panel unit root tests. Having unbalanced dataset due to unavailability of the data narrows down the number of alternative stationarity tests that can be applied. Cross-sectionally augmented Dickey-Fuller (CADF)

test is used, as suggested by Pesaran (2007), in order to take into account the cross-sectional dependencies (CD). Alternatively, Im-Pesaran-Shin (IPS) test of panel unit root is utilized as it allows for heterogeneous panels, serially correlated errors and unbalanced dataset. Model selection procedure is calculated by using first- to third-order panel VARs and the first four lags of the interest variables under consideration as the instruments suggests various results. According to the model selection criteria by Andrews and Lu (2001), BIC is the best procedure except the case with the smallest sample size. Considering that they use the sample size of 250 in their Monte Carlo simulation and in this paper $N = 41$, the model fit, namely PVAR(1), offered by BIC is ruled out. Following Abrigo and Love (2015), the preferred model of PVAR(3) by Hansen's J statistic is also dismissed as it does not correct for the degrees of freedom. On the other hand, MAIC and MQIC are at their smallest values when the preferred model is second-order panel VAR. Lag selection of the model also facilitates the selection of serial correlation in individual variables by restraining the number of included lags for the calculation of the unit root tests.

Table 3.3: Results of Panel Unit Root Tests for Proximate Variables, IPS

Variable	Wout trend		W trend	
	test stat.	p-value	test stat.	p-value
oilp	1.9722	0.9757	1.7894	0.9632
unemp	-3.4278	0.0003	-1.4937	0.0676
debt	-4.6253	0.0000	-1.9531	0.0254
money	-36.0851	0.0000	-16.5742	0.0000
cpi	-2.10	0.0000	-2.30	0.0000
D.unemp	-19.1637	0.0000	-14.6497	0.0000
D.oilp	-16.7712	0.0000	-11.3996	0.0000

2 lags are used for level and 1 lag for first-difference variables.

In Table 3.3 and 3.4, the results of IPS and CADF unit root tests are presented. Following the result of the model selection procedure, the decisions on the stationarity of the variables are made according to the two-lag inclusion of variables for specifying the lag structure for ADF regressions[21]. In the IPS stationarity test, there is no result regarding the movements of the exchange rate due to the insufficient number of observations per panel while there is no test result in CADF for the oil price as this is the world price. Furthermore, having the same prices for all countries inevitably leads to cross-dependence for each of the panels. Hence, the test results from IPS are relied on for the oil price while for the changes in exchange rate, the decision is based on the results of the CADF test. The presence of cross-section dependence causes a failure in the judgment

[21]The unit root tests of IPS and CADF are also conducted for the case where only 1 lag is included to correct the serial correlation. The results point to the same conclusions.

of the 'first generation' panel unit root tests as they are likely to reject the null hypothesis of nonstationarity excessively. CADF test eliminates CD by augmenting the ADF regression with the lagged cross-sectional mean and its first differences of the individual series to account for the CD. In this procedure, it is important to carefully determine the number of lags to include as the results are affected by the lag length. Too many lags to insert results in a loss of degrees of freedom leading to over-parameterization whereas too few lags fail to capture the dynamics of the system causing omitted variable bias. To overcome these problems, the tests for inclusion of 0- and 1-lag are also checked, which suggest the same conclusions as 2-lag case. When trend is included, oil price and unemployment are found to be I(1) in IPS whereas the rest of the variables are found to be stationary. According to CADF test, unemployment and debt are I(1) for only constant; and constant and trend cases while the null hypothesis of nonstationarity is rejected for other variables. Hence, it is concluded to fit a second-order panel VAR with oil price, unemployment and debt in first-difference and the rest in level.

TABLE 3.4: Results of Panel Unit Root Tests for Proximate Variables, CADF

Variable	W constant		W cons. & trend	
	test stat.	p-value	test stat.	p-value
unemp	-0.799	0.212	0.348	0.636
debt	-0.126	0.45	1.548	0.939
money	-5.28	0.000	-2.513	0.006
cpi	-6.604	0.000	-4.333	0.000
excg	-5.395	0.000	-2.044	0.02
D.unemp	-8.33	0.000	-5.6	0.000
D.debt	-8.458	0.000	-6.069	0.000

2 lags are used for level and 1 lag for first-difference variables.

In general, panel-data vector autoregression methodology incorporates the panel-data approach, that allows for unobserved individual heterogeneity, with the traditional VAR approach, which assumes all the variables in the system endogenous. A PVAR model can be defined as follows:

$$X_{i,t} = \Gamma(L)X_{i,t-1} + \theta_i + \epsilon_{i,t}$$

where t denotes time and i indexes countries, $X_{i,t}$ is the vector of endogenous stationary variables, $\Gamma(L)$ expresses the one-sided matrix polynomial in the lag operator L, θ_i is the set of country-specific fixed effects and $\epsilon_{i,t}$ indicates the vector of errors. Under the presence of both lagged dependent variables and fixed effects, the least square estimates

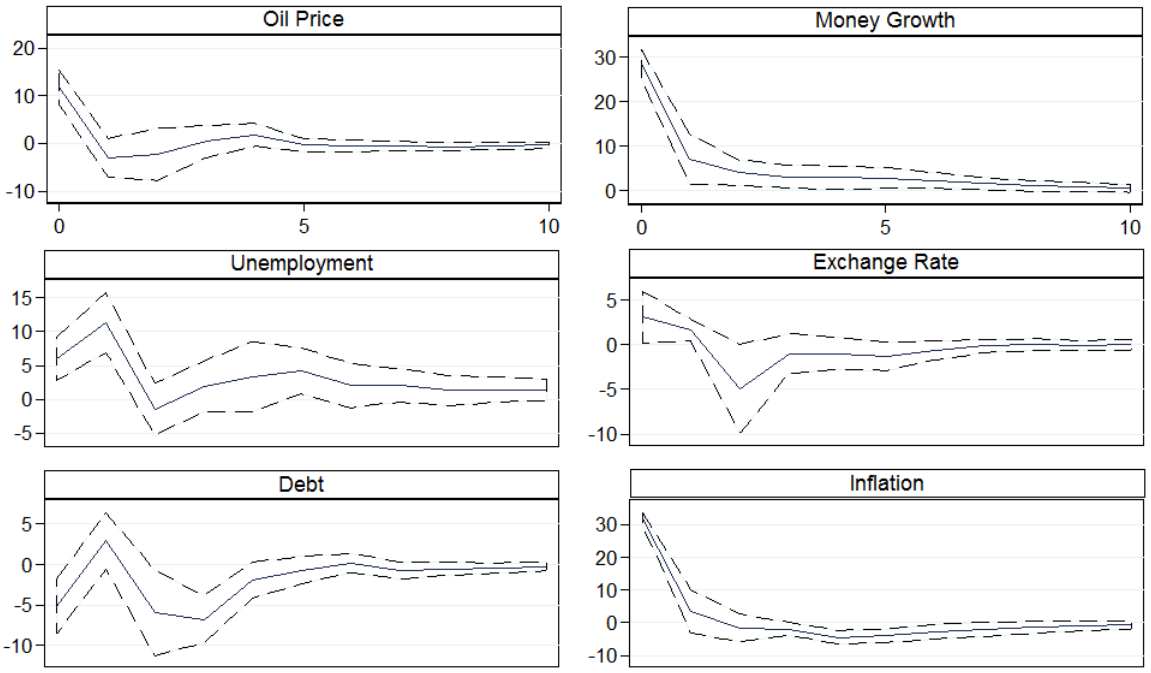
are biased. However, as suggested by Nickell (1981), the bias is inversely proportional to the number of periods, (T). In this analysis, $T = 26$, so that the size of the bias is expected to be small[22]. Methodologically, utilizing VAR procedure on panel data imposes restrictions on the estimated coefficients of each cross-sectional country. The augmentation of fixed-effects (FE) overcomes this assumption of the same structure for each country and captures country-specific influences. Specifically, FEs, here, account for individual heterogeneities on inflation due to the differences, such as in institutional factors, which potentially drive the changes in inflation, yet the data is not available. Since the FEs are correlated with the regressors due to the introduction of the lags of dependent variable, FE estimator in VAR is inconsistent. Hence, the GMM is proposed for the calculation of consistent estimates; and in order to remove the FEs, the Helmert procedure is used, following Love and Zicchino (2006), which preserves the orthogonality between lagged regressors and transformed variables, so that the lagged regressors can be used as instruments and the coefficients can be estimated by system GMM.

The estimation procedure is, then, followed by the computation of IRFs and VDCs using Cholesky decomposition. The orthogonalized IRFs simulate the response of one interest variable to an orthogonal shock in another interest variable by holding other shocks constant, rendering a better understanding of the isolated effects of individual drivers of inflation. To achieve this orthogonality, ordering of the variables is important as the variables that appear earlier in the ordering are assumed to be more exogenous than the later ones. To this end, it is assumed that the oil price movements are exogenously driven that cannot be affected by other factors contemporaneously. Considering the fact that they are, in general, affected by OPEC-related supply shocks, changes in the oil prices are ranked first. The rest of the variables are ordered accounting for the size of the correlations between them and the causality analysis. Although Granger-causality analysis yields two-way causation between the two, it is assumed that causation runs from money growth to inflation, placing money growth in front of inflation. As there is only a one-way causality from the exchange rate movements to inflation rate, the feedback effect from inflation to exchange rate is ruled out, hence justifying to rank inflation at the bottom as it is supposedly the most endogenous variable among all. The large correlations between money and inflation; money and debt; and finally debt and unemployment in a descending order together with two-way causality between the pairs suggest to place debt and money together. The unemployment rate is a proxy that is used by the literature for the output gap where a negative output gap is represented by a rise in the unemployment rate. By distinguishing the real demand shock from the

[22] Yet, keep in mind that the simulations of Judson and Owen (1999) conclude that the bias is significant when $T = 30$. Nickell (1981) argues that the estimates would be biased even with large N with the presence of lagged dependent variables on the right-hand side of the system of equations. However, there is no rule-of-thump value for T and N.

nominal variables, thus, the unemployment rate is aligned before money, debt and the exchange rate; leading to the following order: changes in oil price, unemployment rate, government debt, money growth, exchange rate movements and the inflation rate[23].[24]

FIGURE 3.1: Response of Inflation to Proximate Variable Shocks



Orthogonalized IRF with 95% confidence interval by dashed lines.

Figure 3.1 focuses on the response of inflation to each shock of the other variables including itself.[25] The solid lines in the figures show point estimates while the dashed lines capture the 95% confidence interval. To estimate the confidence intervals of IRFs, the Monte Carlo method with 1000 draws is computed. As shown, the positive oil price innovations increase inflation in the short run and the impact becomes insignificant in the long run. An increase in the unemployment rate, first, raises inflation; and after one or two lags, it decreases inflation. This result seemingly contradicts with the Phillips-curve approach. However, since the magnitude of impacts are modest and borderline statistically significant, the response of inflation can be attributed to the case where due to lower aggregate demand and higher unemployment, the revenues of the government fall leading to a surge in fiscal deficit causing inflation. The response of inflation to government debt innovations is hump-shaped, with the impact being small. The possible explanation for this outcome is that the fiscal deficit exerts significant inflationary pressures for countries that experience very high and hyperinflation, as also

[23] This is a similar order to that of Loungani and Swagel (2001).

[24] Alternative orderings of the variables are found to have no affect on the results.

[25] The responses of other variables to each shock are not presented as the main aim is to understand the dynamics of inflation.

suggested by the existing literature. Yet, there is no sub-sampling according to inflation categories in this analysis. Expansionary policies, namely faster growth in money and depreciation of exchange rate, lead to higher inflation immediately; and the response is statistically significant. Finally, inflation inertia is statistically significant and accelerates inflation. These results are robust to the changes in the ordering of the variables with small changes in magnitudes, yet, no changes in significance and trend.

Table 3.5 shows the results of variance decomposition. The key finding is that inflation is mainly driven by money growth and inflation persistence. Specifically, money growth accounts for more than one-third of the variance of inflation both in the short and long run. The inertial component of inflation explains over 40% of the variation in inflation. The unemployment rate and the changes in oil price are the next important sources of inflation with the government debt and the exchange rate movements playing a relatively small role in explaining inflation. The results suggest that inflationary expectations and indexations schemes in price and wage are the most critical determinants of inflation dynamics in emerging markets and developing economies.

TABLE 3.5: Variance Decomposition of Inflation to Proximate Variable Shocks

Horizon	Impulse Variables					
	oilp	*unemp*	*debt*	*money*	*excg*	*cpi*
0	0	0	0	0	0	0
1	.068	.017	.013	.4	.005	.497
2	.066	.073	.016	.385	.005	.456
3	.065	.071	.03	.378	.016	.44
4	.064	.071	.049	.372	.016	.43
5	.064	.074	.049	.368	.016	.43
10	.062	.084	.048	.363	.016	.427

The horizon is presented sequentially given that 4 lags are used as instruments in the estimation of PVAR. Next, the variances for the mid and end of the horizon are displayed.

In order to investigate the determinants of inflation with a specific focus on an institutional factor and socio-economical characteristics in emerging markets and developing countries, three variables are considered, namely political structure index, income inequality and central bank independence index. Democracy and inflation are linked because democratic systems are regarded as political infrastructures that are grounded on organized labor who can translate their demands into wage-push inflation, making deflationary policies inappropriate[26]. Democratic governments can finance itself through taxation, debt and monetization, which, except the last, would make the governments undesirable. On the other hand, a dictatorship does not follow the demands of the working class as it is not confined by electoral concerns. However, this may still lead

[26]See Goldthorpe (1987).

to money supply increase as in democracies, as well as excessive use of other means. Inflation can also be a consequence of a political uncertainty. Alesina and Tabellini (1990); and Cukierman, Edwards, and Tabellini (1992) suggest that governments would use seigniorage to finance its operations under political instability. Many autocracies are prone to political instability and tend to use the redistribution of income as an instrument to be supported by the median voter. Hence, inflation can occur in autocracies to redistribute income. On the contrary, Roemer (1995) argues that a democracy implicates political turnover, leading to uncertainty from the point of view of the voters whereas a dictatorship rules out the political instability, indicating that inflation is innate to democracy, which is the essence of partisan theories. In short, political theories of inflation can be categorized into two. In particular, the populist approach suggests that democratic governments use inflation to generate revenues as it is demanded by the public for redistribution purposes while the state-capture approach argues that incumbent parties and the elite benefit from money creation, causing price instability. The former implies that features of democracy, such as the urge for being elected again, increase pressures on the political parties to use inflation[27] whereas the latter suggests that democratic accountability promotes price stability. Since households differ in their income sources, inflation affects these sources, thereby households heterogeneously, leading to transformed income distribution.

On the one hand, Albanesi (2007) demonstrates a strong positive correlation between inflation and income inequality, where the rationale stems from the differences in transaction patterns between household types; specifically, low income households's holding more cash and hence being more vulnerable to inflation. However, in their paper, Coibion et al. (2012) indicate that a permanent increase in the inflation target decreases income inequality. Hence, it can be said that the relationship between inflation and income inequality in terms of correlation and causation has been controversial. From the empirical perspective, for instance, Bulir (2001) suggests that the reduction of inflation from hyperinflationary levels reduces income inequality whereas Al-Marhubi (1997) finds that income inequality is associated with higher inflation. Such contrary results have led to rigorous analysis on this relationship by augmenting more complex interaction between the two. For instance, Galli and Hoeven (2001) conclude a non-monotonic relationship between income inequality and inflation where inequality decreases as inflation changes from high to low rates; and increases as inflation is further reduced from low to lower rates, similar to Bulir (2001). Alternatively, by combining all these variables, Desai, Olofsgard and Yousef (2003) argue that democracy reduces inflation in low-inequality countries; but raises it in high-inequality countries, suggesting that the relationship between inflation and democracy is contingent on inequality.

[27] Dictatorial governments can avoid these pressures.

In theory, countries with more independent central banks can achieve lower inflation as suggested by Loungani and Sheets (1997) because such central banks as the institution for monetary policy planners are able to take action without concerning the agenda of the government when they are freed from the pressures of the government[28]. However, Cukierman's indicators claim that the established negative and statistically significant relationship between *de jure* independence and inflation in developed countries is not followed by developing countries.[29] To shed light on these controversial results, annual data for 31 countries[30] covering the period 1980-2010 is obtained. Inflation is gathered from Reinhart and Rogoff data. Although the data they archive has many resources, the period this chapter covers is from WEO and IFS data in IMF; and refers to CPI annual percentage change. Income inequality (i.e gini) is from Standardized World Income Inequality Database (SWIID)[31] that collects the data by the Luxembourg Income Study fostering better cross-national research than the other resources as other data-set require additional correction for cross-national comparison. The polity variable is gathered from Polity IV Project where it has a range from -10 to 10 referring to a scale from strongly autocratic to strongly democratic respectively, to measure the regime characteristics of the countries. In the analysis, it is rescaled between 0 and 1 as suggested by many papers. Central bank independence data is gathered from new dataset of Garriga (2016) where she built it up on the Cukierman, Webb, and Neyapti (1992) index of CBI. The descriptive statistics of the variables in Table 3.6 indicate that inflation has the largest variability followed by income inequality index. In pairwise correlation table, a positive association between gini and inflation, and negative relationship between inflation and democracy; and central bank independence are salient. Although these correlations are small in magnitude and statistically insignificant, this has been encountered in empirical analyses as well, as stated above.

TABLE 3.6: Summary Statistics for Socio-economical Variables

Table 3.6: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
inf	960	90.83126	933.1045	-9.497	24410.98
gini	812	43.67427	7.892907	19.52696	61.89418
cbi	938	.4752702	.2071159	.1345	.904
polity	961	.5871488	.3394293	.05	1

[28] Among many others, Mishkin (2007).
[29] Cukierman (1992).
[30] See Table 3.16 in Appendix for the full list of countries.
[31] Solt (2016).

TABLE 3.7: Pairwise Correlation Matrix for Socio-economical Variables

	inf	*gini*	*cbi*	*polity*	*ginpol*
inf	1.0000				
gini	0.0804	1.0000			
cbi	-0.0372	0.0319	1.0000		
polity	-0.0392	0.1761*	0.2453*	1.0000	
ginpol	-0.0048	0.4611*	0.1445*	0.9396*	1.0000

* demonstrates $p < 0.001$ significance.

IPS stationarity tests could not be obtained for *cbi* and *polity* due to the insufficient number of time periods in order to calculate the test statistics. Hence, for those variables, CADF test results are taken into account. According to the results of the non-stationarity tests and lag length selection criteria, the model for the variables in their individual form is fit for PVAR(2) where *gini* and *cbi* are estimated in level; and *inf* and *polity* in first-differences. The ordering of the variables are chosen assuming that *polity*, *cbi*, *gini* affect *inf* both contemporaneously and with a lag while *inf* affects the others only with a lag so that the relative importance of these variables on; and the relationships of these variables with inflation can be revealed. In line with the literature on the presented insignificant relationship between *cbi* and *inf* for developing countries, *cbi* is ranked first followed by *polity* and *gini* in order to employ IRFs.[32]

TABLE 3.8: Results of Panel Unit Root Tests for Socio-economical Variables, IPS

Variable	Wout trend		W trend	
	test stat.	p-value	test stat.	p-value
inf	-7.1851	0.0000	-6.8336	0.0000
gini	-2.3297	0.0099	-2.5210	0.0059
ginpol	-4.9089	0.0000	-5.5621	0.0000

2 lags are used for level and 1 lag for first-difference variables.

In Figure 3.2, the IRFs that are associated with individual impulses from CBI, Gini and Polity are shown. The negative effects from innovation to CBI on inflation is dominated by positive ones. While the initial effect is negative, the prominent effect that occurs with lag is positive and persists in the long run. However, none of the shocks are statistically significant. The response of inflation to democracy index innovations is volatile with a dominant positive impact, supporting populist approach. Yet, this effect is insignificant. The positive impact of income inequality on inflation is negligible and also insignificant. On the other hand, inflation inertia is shown to be significant with an increasing effect

[32]Results are founded to be independent of the order of the interest variables.

TABLE 3.9: Results of Panel Unit Root Tests for Socio-economical Variables, CADF

Variable	W constant		W cons. & trend	
	test stat.	p-value	test stat.	p-value
inf	-1.412	0.079	-0.831	0.203
$gini$	1.187	0.882	-3.437	0.000
cbi	-3.650	0.000	-1.948	0.026
$polity$	0.995	0.840	3.372	1.000
$ginpol$	-3.053	0.001	-0.342	0.366
$D.inf$	-16.511	0.000	-14.554	0.000
$D.gini$	-1.376	0.084	-0.872	0.192
$D2.gini$	-16.177	0.000	-13.289	0.000
$D.polity$	-6.947	0.000	-5.617	0.000
$D.ginpol$	-5.986	0.000	-5.029	0.000

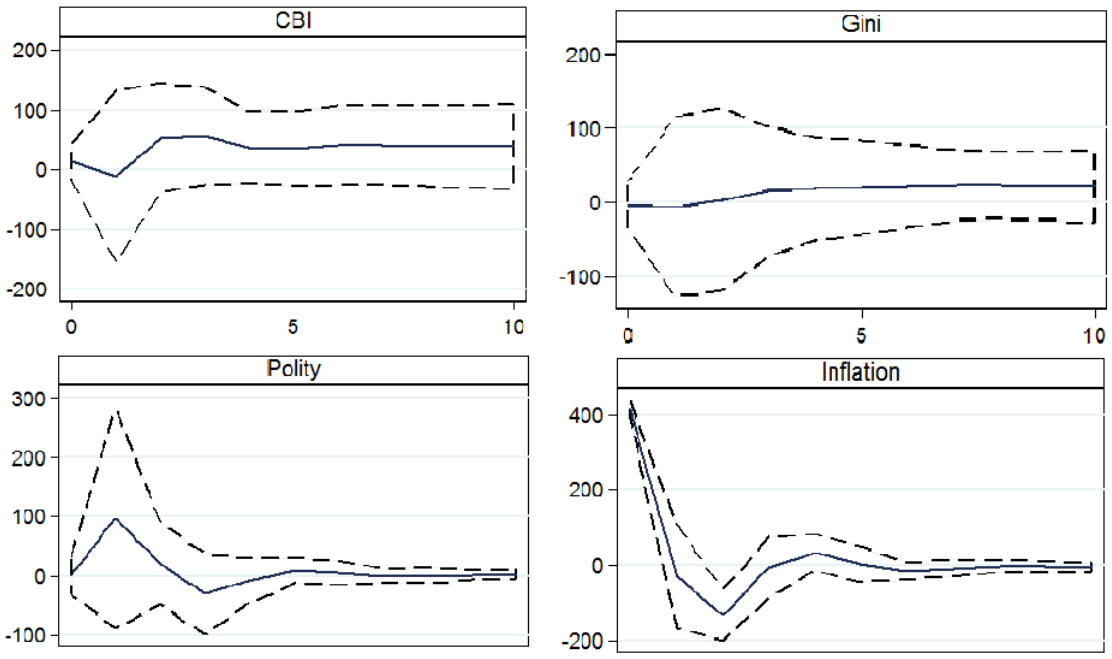
2 lags are used for level, 1 lag for first-difference and 0 lag for second-difference variables.

on contemporaneous inflation. The negative impact of inflation persistence that occurs with lag is a similar result of, for instance, Desai, Olofsgard and Yousef (2003) where the deeper lags of inflation are found to have negative coefficients. This is expected since it is allowed to instrument all variables up to four lags in the estimation. It can be regarded as the decelerating impact of past inflation on current inflation rather than a decreasing effect as the deeper the lags get, the less information they carry on the current variable. The insignificancy of individual impacts of social and political indicators on inflation highlights the importance of inflation inertia. However, considering the fact that the existing literature also agrees that augmenting the variables individually can lead to insignificant or 'wrong' sign results, such as in Desai, Olofsgard and Yousef (2005); and the significance is dependent on the classification of inflation as high and very high as in Aisen and Veiga (2005), the analysis is incorporated with an interaction term.

Following the literature, the interaction variable of *ginpol* that refers to *gini* x *polity* is generated to account for the effect of democracy and inequality together. Since the model selection criteria suggests first-order panel VAR and relying on the unit root test results, a PVAR(1) is modelled with *ginpol* and *gini* in levels while *polity* and inf in first-differences. Taking into account the strength of the correlations, the Cholesky order is set for *ginpol*, *polity*, *gini* and inf[33]. IRFs in Figure 3.3 indicate that the interaction term, inflation and gini affect inflation positively whereas the innovations of democracy have a negative impact on inflation. The effect from the democracy index is only significant when it leads to decrease in inflation, claiming that inflation is more likely in autocratic systems than in democratic ones. The impact of income inequality is also significant only when it is positive where the effect occurs in the short run. Hence,

[33]Alternative orderings of the variables are found to have no effect on the results.

FIGURE 3.2: Response of Inflation to Socio-economical Variable Shocks



Orthogonalized IRF with 95% confidence interval by dashed lines.

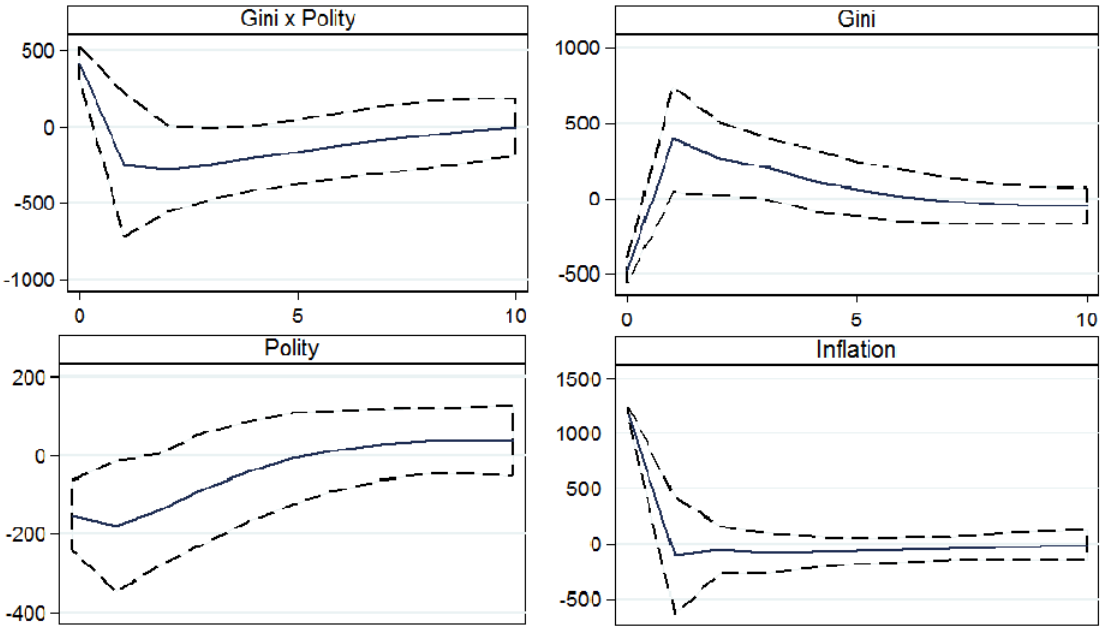
it is evident that when the interaction term is included in the estimation, the individual terms become significant. Furthermore, the negative effect from democracy together with the positive effect of the interaction term on inflation supports the hypothesis that as the inequality gap rises, greater democratization leads to inflation.

Finally, the impact of the central bank independence on inflation is investigated in which the dataset is classified as democratic and non-democratic systems whereby the mean value of the democracy index for the entire period of the analysis that is greater or equal to 0.5 is defined as the democratic system[34]; and an estimation is run for these two sub-samples. PVAR (2) is fit with all the variables, except *gini* which is in its second-difference, are estimated in first-differences for non-democratic countries while for democratic countries, all the variables are estimated in their levels except *cbi*, which is included in its first-difference into the regression[35]. The Cholesky ordering of *ginpol*, *cbi*, *gini* and inf yields the following IRFs depicted in Figure 3.4 where the top panel illustrates the responses of inflation in non-democratic systems whereas the bottom panel demonstrates those for democratic systems.

The response of inflation to interaction term is significant in its initial effect when no sub-sampling is conducted whereas it loses its significance for all possible horizons in

[34]See, marked countries in Table 3.16 in Appendix.
[35]The results of the stationarity tests can be found in Table 3.17-20 in the Appendix.

FIGURE 3.3: Interaction Term: Response of Inflation to Socio-economical Variable Shocks

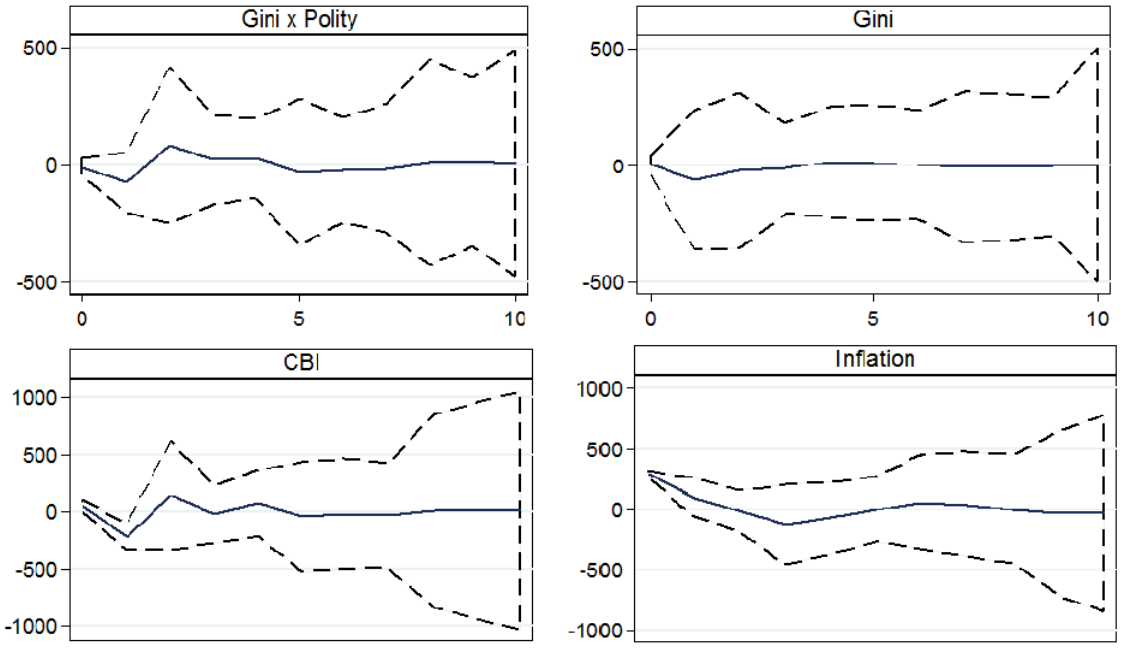


Orthogonalized IRF with 95% confidence interval by dashed lines.

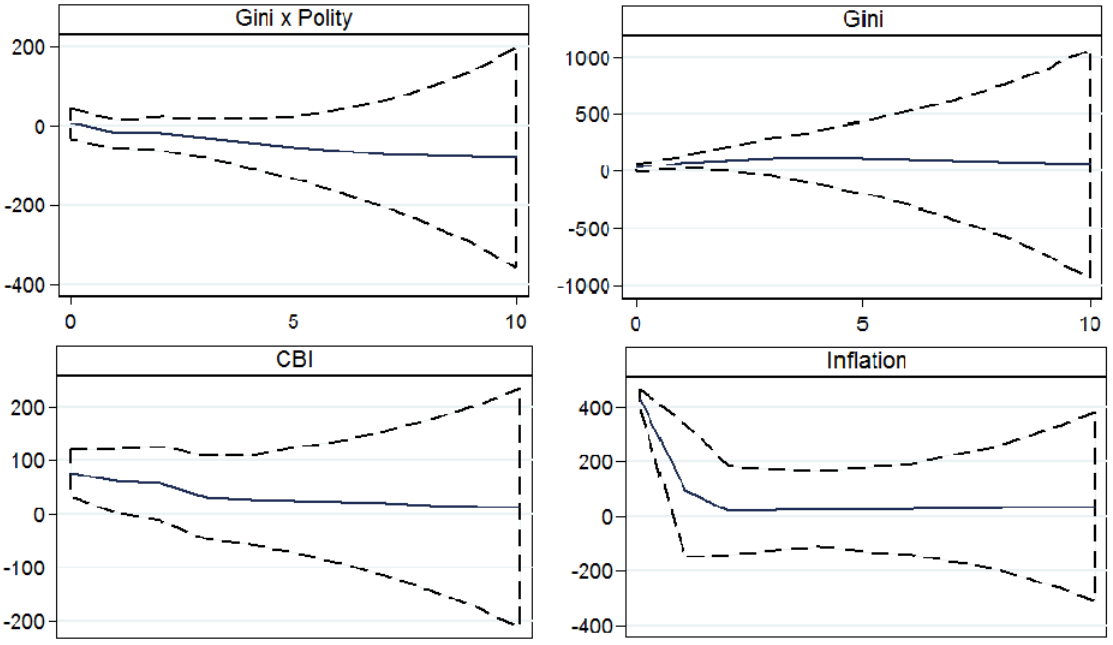
both non-democratic and democratic countries. The innovations to gini immediately influence inflation positively in democracies with the impact being borderline statistically significant. The same effect is insignificant for non-democracies in line with the existing literature. Specifically, Dolmas, Huffman and Wynne (2000) show that economies with high income inequality are prone to have higher inflation which is evident in democracies. Beetsma and van der Ploeg (1996) also find a positive relationship between inflation and inequality for democratic systems, but not for non-democracies.

The effect of central bank independence on inflation is rarely significant where a negative significant impact occurs with a lag in non-democracies while a positive influence occurs immediately in democracies. The former result is in line with various papers such as Cukierman, Webb and Neyapti (1992), Gutierrez (2003) and Arnone et al. (2007) when *de facto* CBI index that based on the turnover of the central bank governors is used. Their results highlight that turnover is negatively correlated with inflation in developing countries but not significantly correlated in developed countries. However, the general insignificance in this relationship has been encountered in the literature as well. The in depth explanations in this regard are as follows: first, it is most likely that the relationship between the central bank and inflation is more complex than what one index can achieve to refer to. In practice, there are several other mechanisms that directly or

FIGURE 3.4: Sub-sample: Response of Inflation to Socio-economical Variable Shocks



(a) Non-democracies



(b) Democracies

Orthogonalized IRF with 95% confidence interval by dashed lines.

indirectly interact with CBI too[36], that influence inflation but are not and may not be covered in a simple regression analysis; thereby providing insignificant results. Secondly, the strong negative relationship commonly found by other authors between CBI and inflation is valid for industrial countries where *de jure* measurement is used as an index

[36]Such as fiscal policy, trade barriers, regulation of financial markets and so on.

for CBI while it is the *de facto* independence that is useful for investigating the relation between inflation and CBI for developing and emerging countries as the aggregated index value relies on the actual institutional norms and practices of central banks instead of written laws of central banks.[37] It may also be ascribed to the fact that institutional changes require long periods of time; and hence the representation of this change in the data and the impact of this change can be observed from a historical dataset. Furthermore, the loss of significance in all variables might be due in part to the reduction in sample size as the sub-sampling divides the dataset into 11 non-democracies and 20 democracies. In short, these results support the positive relationship between inequality and inflation for democratically chosen governments; and the insignificant impact of *de jure* central bank independence on inflation in emerging markets and developing countries. Finally, the significant responses of inflation to innovations in inflation persistence in each specification suggest a more critical role for past inflation than institutional arrangements and socio-political drivers for explaining inflation dynamics.

The analysis so far considers the variables in untransformed form. With this approach, it is aimed to feed the system with as many observations as possible. Since there are either negative or around 0 observations as demonstrated in Table 3.1, log-transformation causes a loss from the information contained in these observations. Natural logarithm of the variables is generally taken in quantitative analyses in order to stabilize the variance of the series. This transformation is also used to linearize the time trend in time series variables and to measure the elasticities among left-hand side variable and right-hand side variables. Below, the analysis is repeated with the series in log-transformed form on the cost of widening the gap in the panel data.

Table 3.10 gives the summary statistics of the transformed variables. The comparison with Table 3.1 shows one of the advantages of this approach with smoothed variances. As illustrated in Table 3.11 and Table 3.2, the loss of the significant correlation between *money*, *cpi* and *excg* with *debt* suggest that outliers on the right-skew dominate their relationships. The appearance of statistically significant correlations originates from the low standard deviations of the variables. The correlation between money growth and inflation is still the largest one among the series supporting the quantity theory of money.

To save space, unit root tests are not given this time. Yet, with the same approach adopted in untransformed model, PVAR(1) where oil price and money growth in first-differences and the rest in levels is estimated. The order for the IRF is as follows: *oilp*, *debt*, *unemp*, *money*, *excg* and *cpi*. However, the results are robust to a change

[37] See, Acemoglu et al. (2008); and Arnoane, Laurens and Segalotto (2009) for the discussion. Moreover, a great number of papers uses turnover of central bank governors data instead of CBI as it refers to actual changes in the central banks.

TABLE 3.10: Transformed: Summary Statistics for Proximate Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
oilp	1066	3.598756	.6999968	2.570319	4.654056
unemp	960	2.05539	.7428962	-1.746433	3.618993
debt	1004	3.763944	.6548476	.0263108	7.646316
money	989	2.813472	1.036439	-1.933768	8.946093
cpi	998	1.988447	1.366202	-2.99537	8.920722
excg	663	-3.401368	1.584431	-12.1323	1.518798

TABLE 3.11: Transformed: Pairwise Correlation Matrix for Proximate Variables

	oilp	*unemp*	*debt*	*money*	*cpi*	*excg*
oilp	1.0000					
unemp	-0.0640	1.0000				
debt	-0.1382*	0.2565*	1.0000			
money	-0.2956*	-0.1098*	-0.0284	1.0000		
cpi	-0.2810*	-0.0873	0.0312	0.6652*	1.0000	
excg	-0.2189*	-0.0228	0.0724	0.4258*	0.5079*	1.0000

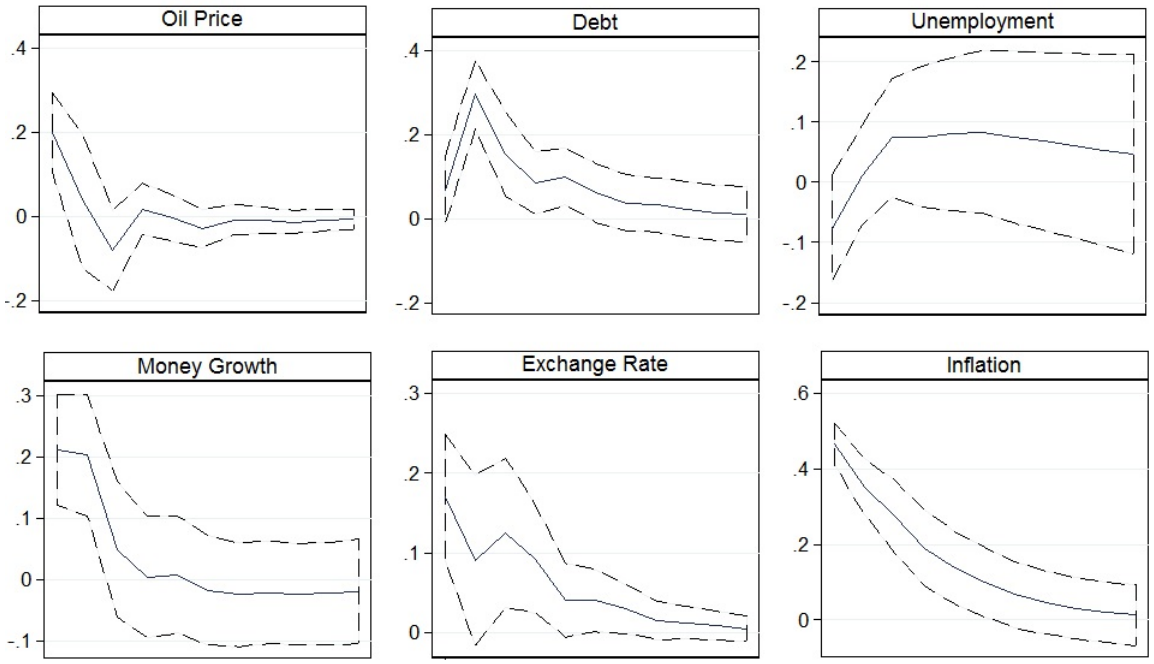
* demonstrates $p < 0.001$ significance.

assumed in the untransformed model. According to the IRF, one standard deviation innovations to oil price increases inflation, but the impact is insignificant from medium-term onward. The negative yet insignificant effect of unemployment to inflation can be explained by Phillips-curve. The significant positive response of inflation to the government debt shock in the short- to medium-run indicates inflationary pressures of the debt financing actions by the government. Faster money growth, depreciation of the currency and inflation inertia increase inflation with the latter having the strongest and longest-lasting effect. Finally, variance decomposition in Table 3.12 suggests that the main sources of inflation are inflation persistence and money growth in which the former accounts for 64% of the variation in inflation.

In the analysis with respect to institutional factors and socio-economical characteristics, only inflation is transformed by taking natural logarithm as the rest of the series are either transformed otherwise or an index. Since only *inf* variable is changed, variation is occurred only in the first column of the correlation matrix in which there is a small but significant negative correlation between inflation and central bank independence.

Due to the expected insignificant results from the fit of the model without interaction term (i.e with *polity*, *cbi*, *gini* and inf), the model with interaction term is presented. The model selection criteria suggests PVAR(1) and unit root tests necessitate

FIGURE 3.5: Transformed: Response of Inflation to Proximate Variable Shocks



Orthogonalized IRF with 95% confidence interval by dashed lines.

TABLE 3.12: Transformed: Variance Decomposition of Inflation to Proximate Variable Shocks

Horizon	Impulse Variables					
	oilp	*debt*	*unemp*	*money*	*excg*	*cpi*
0	0	0	0	0	0	0
1	.116	.013	.017	.131	.085	.638
2	.068	.153	.01	.142	.061	.566
3	.065	.158	.016	.12	.072	.569
4	.061	.156	.022	.111	.077	.573
5	.058	.161	.029	.106	.076	.57
10	.056	.159	.054	.102	.075	.555

The horizon is presented sequentially given that 3 lags are used as instruments in the estimation of PVAR. Next, the variances for the mid and end of the horizon are displayed.

that democracy and income inequality are fit in first-differences while inflation and *ginpol* are in levels. The same ordering in the untransformed model[38] is assumed. IRFs in Figure 3.6 indicate that shocks to *ginpol* and inflation persistence affect inflation positively and those of income inequality and democracy indices influence negatively. While the effects from interaction term and *gini* are borderline significant on impact,

[38]Other variations of the ordering do not change the result.

TABLE 3.13: Transformed: Summary Statistics for Socio-economical Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
inf	939	2.426414	1.35924	-1.857899	10.10279
gini	812	43.67427	7.892907	19.52696	61.89418
cbi	938	.4752702	.2071159	.1345	.904
polity	961	.5871488	.3394293	.05	1

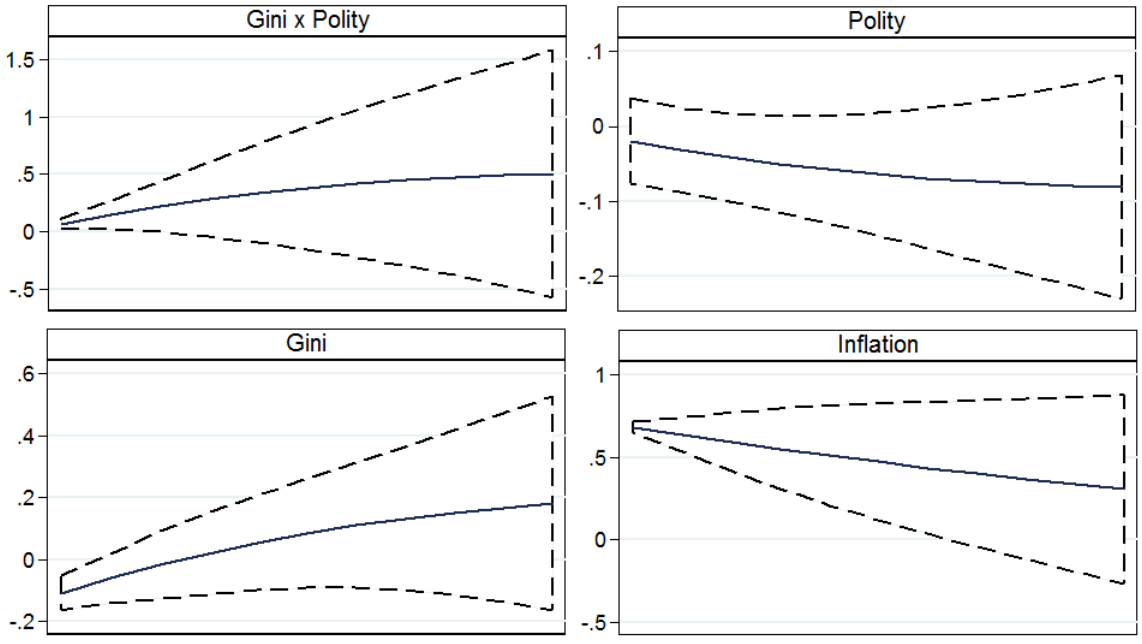
TABLE 3.14: Transformed: Pairwise Correlation Matrix for Socio-economical Variables

	inf	*gini*	*cbi*	*polity*	*ginpol*
inf	1.0000				
gini	0.0915	1.0000			
cbi	-0.1236*	0.0319	1.0000		
polity	0.0039	0.1761*	0.2453*	1.0000	
ginpol	0.0585	0.4611*	0.1445*	0.9396*	1.0000

* demonstrates $p < 0.001$ significance.

the effect of inflation inertia is significant in the medium-run as well. These findings are in line with the untransformed estimation.

FIGURE 3.6: Transformed & Interaction Term: Response of Inflation to Socio-economical Variables Shocks



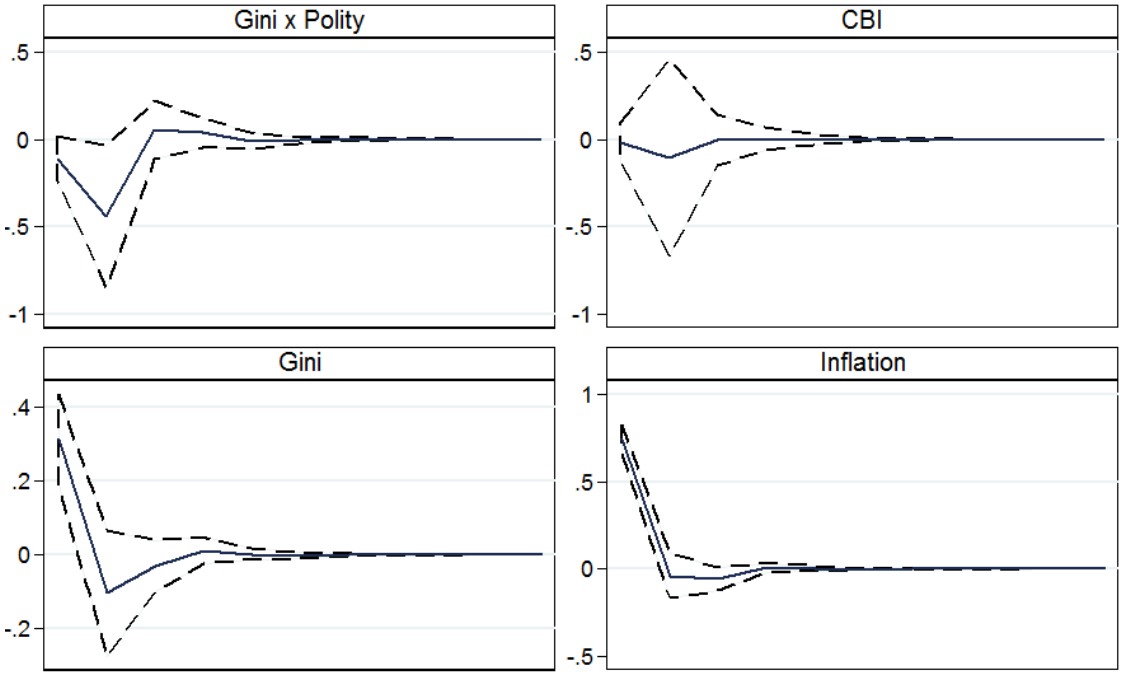
Orthogonalized IRF with 95% confidence interval by dashed lines.

The impact of central bank independence is evaluated again in two sub-samples. PVAR(1) is fit in which *cbi* and *gini* in first-differences and the rest in levels are estimated for democratic countries while *ginpol*, *cbi* and inf in first- and *gini* in second-difference are estimated for non-democratic countries. One of the different results in log-transformed estimation from the untransformed one is the significant positive effect of *gini* in non-democratic systems. Although the response of inflation to income inequality is small and significant only as an initial effect, it can be related to the claim that political instabilities in non-democratic countries are prone to income redistribution. The other distinctive result occurs with the loss of small significant initial effect by central bank independence index in democratic systems. Otherwise, the responses of inflation to one percent innovation by these determinants are compatible with the untransformed estimation.

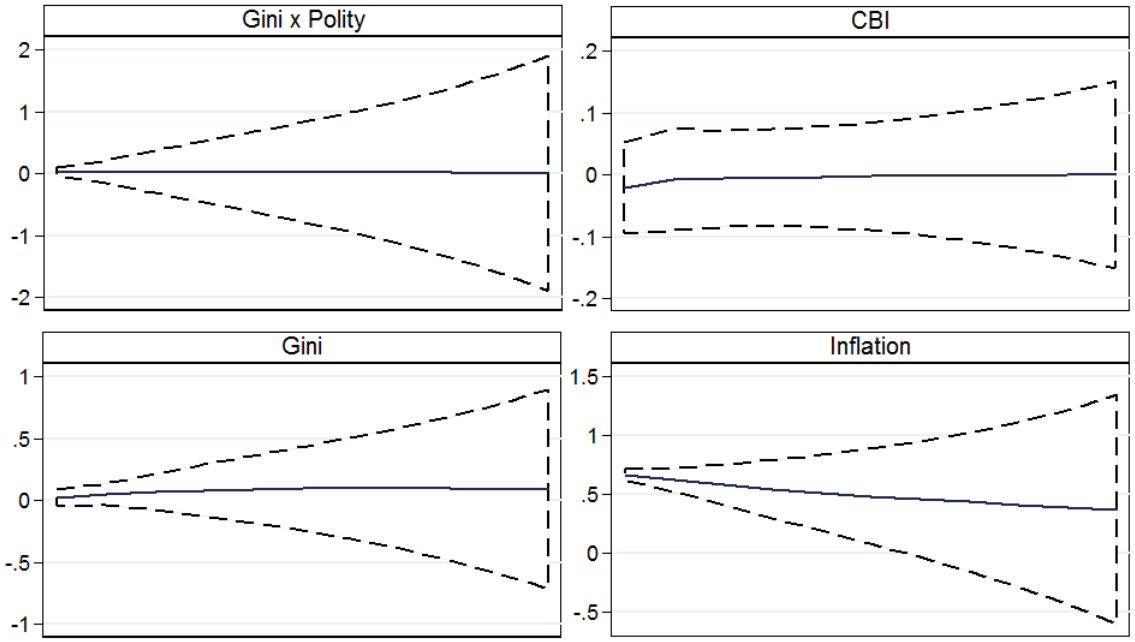
When shocks with Choleski[39] ordering are used, transforming the variable does not influence the interpretation of the shock, rather, it changes that of the response as it is in terms of rescaled data after the transformation. This can be observed from the comparison of the horizontal axes. The insignificant results or differences, however, can be attributed to the following aspects. First, during the sample period, these countries experience mostly hyperinflation or high inflation periods with some relatively low and negative rates as indicated by right-skewness. By taking natural logarithm, hyperinflation periods are smoothed out indicating a small increase rather than a radical spike; and deflation periods are totally removed from the sample, indicating loss of information on those periods. Secondly, when the sample size shrinks, it is more likely to be trapped by over-parametrization problem. Specific to the socio-economic and political analysis, it might be the case that disentangling the effects of left-hand side variables on inflation is harder in semi-logarithm form. Furthermore, when the sample is divided into two groups, the corresponding results of the lost data is less negligible compared to the whole sample; hence creating some shifts with statistical insignificance. Nevertheless, log-transformed estimation conforms to the main results of the untransformed estimation so that it can be regarded as a robustness check.

[39] Alternatively, any other covariance matrix factorization would also suffice.

FIGURE 3.7: Transformed & Sub-sample: Response of Inflation to Socio-economical Variable Shocks



(a) Non-democracies



(b) Democracies

Orthogonalized IRF with 95% confidence interval by dashed lines.

3.4 Conclusion

The empirical strategies for examining the determinants of inflation can be divided into two. First, the pattern of inflation in a single country over a long horizon can be studied. Second, the experiences of inflation in several different countries over a shorter time span can be compared as the differences in economical and political drivers among countries serve for understanding the inflation dynamics. The empirical analysis in this chapter follows the second strategy by utilizing PVAR estimation.

The analysis regarding the proximate determinants of inflation suggests that inflation is mainly driven by money growth and inflation persistence whereas the analysis concentrating on the socio-economical and political determinants of inflation argues that the relationship between inflation and income inequality is contingent on the political structure where the positive relationship prevails in democracies; and *de jure* central bank independence has no explanatory power on inflation. Finally, the positive impact of the inflation inertia on inflation, in terms of both magnitude and significance, in each specification regardless of the focus for the determinants of interest suggest that inflationary expectations and indexations schemes in price and wage are the most critical determinants of inflation dynamics in emerging market and developing economies.

The results of this positive analysis give rise to the following suggestions. If the dominance of inflation inertia is claimed to be backward-looking wage settlements, wage negotiations should be arranged on productivity instead of past realizations of inflation in the future. Since the first round effects of adverse supply shocks could be amplified in a volatile environment affecting inflation expectations and credibility of the monetary authorities in applying policy regime, structural reforms should be considered. If the inertia is proven to arise from inflationary expectations with slow adjustment, price controls, such as controlled levels of exchange rate, wage and prices, may accelerate the adjustment of the expectations breaking the inflation inertia.[40] Inflationary inertia can also be broken when the monetary authority would be forward-looking and more responsive to the deviations of expected inflation from the inflation target. It tends to be reduced with credible disinflationary policies and plans. To maintain the downward pressure on prices when considering that inflation persistence is due to the staggering of price-setting and price-indexation especially accompanied by high public sector deficit, control over the price of consumer goods and public services; and cuts in subsidies can also be utilized.

[40]It is important to note that these choices may lead to unemployment, shortages and speculative effects on exchange rate.

Chapter 4

Foreign Aid: Lurking or Spilling Over?

4.1 Introduction

What is the main instrument of a central bank? Which rule should a central bank follow as a function of macroeconomic conditions? As observed, inflation targeting, output gap targeting, exchange rate and money targeting are among the policies adopted by the central banks in strict or flexible forms according to the main concerns of the countries. Although there is an extensive research in response to these questions, the resulting disagreement gives a way for further studies in designing optimal monetary policy. The novelty of the current analysis, however, arises from the question regarding what the best response of the monetary policy authority is specifically in foreign aid recipient developing countries.

The Millennium Development Goals (MDG)[1] together with escalating resource transfers have entailed numerous studies on the effects of foreign aid. Despite the number of papers, most of the contributions in the literature are predominantly empirical; and concentrate on the growth effect of foreign aid[2], leaving a scope for a theoretical analysis that focuses on the optimal targeting rule of the monetary authority in aid-receiving countries. Furthermore, considering the fact that foreign aid in some less developed countries is quite substantial[3], its positive (negative) effects can be amplified (lessened)

[1] MDGs emerged from the September 2000 Millennium Declaration at the United Nations and include measurable targets for halving world poverty between 1990 and 2015.

[2] See, such as, Arndt et al. (2011), Burnside and Dollar (2000), Easterly et al. (2004), De Haan (2009) and Rajan and Subramanian (2005) for positive, negative or insignificant results.

[3] In 2015, Tuvalu has received %89.2, Liberia %62.4 and Central African Republic %30.6 net official development assistance (ODA) of their GNI.

with respect to the size of the incoming resources via the conduct of optimal monetary policy. In fact, there are many theories that illustrate the relationship between the incoming foreign aid and the corresponding changes in macroeconomic indicators with the intervention of monetary policy. For instance, Berg et al. (2010) note that foreign aid that is used in financing government spending affects the economy as if it were a domestically-financed fiscal expansion which causes an increase in money supply leading to inflationary pressures. Alternatively, due to the fear of inflationary pressures, monetary policymakers may raise the interest rate in order to secure the aid which result in a crowding-out of the private investment inducing a reallocation of the resources towards public sector[4]. Hence, monetary authorities should not neglect these inflows in setting their monetary policies because the policy regime they follow has an impact on not only prices but also the allocation of resources.

In this vein, a New Keynesian model with sticky prices and capital accumulation that features a capital adjustment cost is proposed. The analysis roots in the evaluation of the Taylor rule based on a welfare assessment under alternative stochastic processes when the monetary authority accounts for the incoming foreign aid. In particular, given the calibrated values of the structural parameters of the model, policy parameters of the Taylor rule, namely interest rate smoothing, inflation targeting and output growth targeting, are optimized in order to maximize unconditional welfare under three cases: (i) only cost-push shock (CP), (ii) only foreign aid shock (FA); and (iii) cost-push and foreign aid shocks $(CP + FA)$ in which total factor productivity shock is always muted. The theoretical framework for foreign aid is distinct from the most of the previous studies in two ways. First, foreign aid is modelled in the form of untied transfers. Secondly, both temporary and permanent changes of it are considered[5]. Initially, a theoretical model where the government receives the foreign aid and directs it to the representative household as a lump-sum monetary transfer is constructed. Next, foreign aid is designed to be entirely spent on consumption goods that the household has no control over the decision on; yet, still derives utility from.

Despite the conflicting results on the effects of foreign aid on macroeconomic conditions, conventional wisdom among the development economists follows that an effective redistribution of resources from rich industrialized countries to poor developing countries is necessary in order for the latter to catch the former. However, models that allow for intertemporal optimization by the agents would point out that in response to an increase in the available resources, agents would marginally reallocate those resources to current

[4]As suggested by Hussain et al. (2009)

[5]For instance, Chatterjee and Turnovsky (2007) and Agenor, Bayraktar and Aynaoui (2008) study only the permanent changes of aid while Arellano et al. (2005) and Chatterjee and Turnovsky (2005) analyze the effects of temporary changes of it.

and future consumption together with those of investment. Hence, these additional resources in the form of foreign aid could be lurking towards an inefficient reallocation or have positive spillover effects in the economy. The results from the welfare-optimized Taylor rules in this chapter indicate that the presence of foreign aid shocks serves to the monetary authority in anchoring output growth, suggesting that the foreign aid is not merely a shock that creates reallocation in this setting, but it can become an unconventional policy tool as well.

To identify how the foreign aid is spent creates a misallocation or not, the same model is modified such that foreign aid shock directs to the household via a consumption transfer resulting in a reallocated consumption bundle instead of a monetary transfer. Specifically, after receiving the foreign aid, government devotes the entire foreign aid on consumption that the representative household has no control over yet still derives utility from it. The results show that monetary authority adopts the similar optimal monetary policy regimes with monetary transfer setting indicating that the way foreign aid spent with or without the intermediacy of government does not affect the optimal monetary policy response of the central banks as long as foreign aid shocks are transferred to the household in such a way that the additional resources are absorbed in her bundles of choice.

Theoretical models investigating the monetary policy response in favor of the effectiveness of the foreign aid generally center their analysis on an open economy model in order to account for Dutch Disease mechanism[6]. For instance, Prati and Tressel (2006) propose a two-period open economy model with tradable and non-tradable goods where aid affects them via their productivity parameters. An expansionary monetary policy is found to be welfare-improving by offsetting the undesirable consequences of foreign aid. Berg et al. (2010) offer a small open economy model with tradable and non-tradable goods where the former has learning-by-doing effects that incur cost to this sector through its productivity. They find that accumulating aid in reserves as a form of partial absorption policy can hinder the effects of Dutch Disease. Mwabutwa, Bittencourt and Viegi (2013) assess the existence of Dutch Disease in Malawi and identify the response of the Reserve Bank of Malawi in the form of policy rule. The Bayesian Dynamic Stochastic General Equilibrium model in their paper suggests that Dutch Disease mechanism is not present in Malawi and the response of the central bank to the incoming aid follows a Taylor rule. In short, the limited number of theoretical papers that combines monetary policy and

[6]See, Michaely (1981) and Van Wijnbergen (1986). According to this mechanism, the effect of foreign aid on demand worsens the external competitiveness of the traded sector while strengthening the internal competitiveness of non-traded production against the former when aid results in an increase in demand for non-traded goods leading to an increase in domestic price. Hence, the downturn in trade performance caused by real exchange rate overvaluation damages export industries and productivity growth as the traded sector is crucial to the productivity growth.

foreign aid concentrates either on the role of monetary policy in limiting (boosting) the negative (potential positive) impacts of foreign aid ignoring the Keynesian ingredients or in a positive analysis. However, this chapter aims to fulfill the normative analysis gap on this topic by comparing the optimal monetary policy responses.

The New Keynesian approach has been prevalently used among central banks for monetary policy analysis in recent years as it synthesizes the framework of Real Business Cycle with Keynesian theory allowing for explicit theoretical microfoundations together with well-captured real world data. In a New Keynesian model with an efficient steady state without real rigidities, the optimal monetary policy rule prefers zero inflation and zero output gap in all periods by responding aggressively to any price change in order to keep zero inflation. In doing so, output would be equal to its natural level, which is also the efficient level. Under this setting, thus, the central bank does not face a policy trade-off; and strict inflation targeting is dictated as the optimal policy within the model. Hence, in a simple benchmark New Keynesian model with only nominal price rigidities, the first best[7] can be restored as replicating the flexible price equilibrium which translates into stabilizing the output gap. In other words, as Blanchard and Gali (2007) call it, when only prices are sticky, the "Divine Coincidence" emerges because stabilizing inflation also stabilizes the output gap. However, the setting with cost push shocks[8] constitutes a short run trade-off between zero inflation and zero output gap as stabilizing one comes at the cost of more volatility in the other due to the fact that they move in opposite directions with respect to cost-push shock. In this case, the central bank prefers to allow for only partial accommodation of inflationary pressures in order to avoid large instability of output, leaving the inflation targeting still as the easily implementable and desirable policy rule[9]. The results demonstrate that aid recipient developing countries also face a trade-off between stabilizing the inflation rate and output growth in the presence of cost push shock. The reason behind this finding is that the cost push shocks directly affect prices whereas foreign aid has no direct impact on prices, yet influences the allocations through which affecting prices. Hence, the trade-off between two monetary targets does not vanish, making the inflation targeting still more desirable compared to the output growth targeting in these countries.

In this line of research, many studies assume that interest rates are appointed as a function of inflation and the output gap, resting on the justification that it is the output gap that affects welfare instead of output. Nominal GDP targeting has also gained attention among policy planners as it enables the monetary authority to simultaneously target both nominal and real variables. This chapter, however, considers a Taylor-type

[7] Woodford (2001).

[8] Another case where the Divine Coincidence does not hold is a model with both price and nominal wage stickiness as in Erceg et al. (2000).

[9] Garin, Lester and Sims (2015).

rule that allows for inflation and output growth targeting. The justification for this type of specification is that the output growth is easily observable in real time compared to the output gap which relies on a hypothetical flexible wage and price level of output (i.e natural level of output). While this type of specification is common in the literature[10], it can be also treated as an extreme case of nominal GDP targeting where zero inflation targeting is assumed.

The studies on the optimal monetary policy in the form of Taylor rule agree that while price stability is the main concern, output should be fixed to its flexible price level. For instance, Fisher (1994) and Svensson (1998) summarize the optimal monetary policy in a New Keynesian theory by having price stability as the primary concern compared to output stability. The results in this chapter suggest that the optimized rule features a high amount of inertia, a strong response to inflation and a moderate response to output growth, supporting both the findings of the previous studies even when foreign aid is considered; and the switch in monetary policy that has been experienced in developing countries. In fact, many industrial countries (e.g., Australia, Canada, Great Britain and Sweden) adopted inflation targeting in the 1990s. In return, they have experienced stable and low inflation rates, without a sacrifice in the growth of the economy. After the success of this regime, inflation targeting gained attention among developing countries as well. In essence, following this policy by developing countries has emerged in protest to the difficulties in conducting monetary policy via the exchange rate peg or money supply target. Adopting inflation targeting provides, first and foremost, increased accountability of the monetary authority and transparency of the procedures which enhance the credibility of the monetary authority and the policy. It facilitates the clear communication of the overriding objective of the monetary policy enabling a better anchor for inflation expectations, price and wage setting. Hence, inflation targeting became not only a monetary policy strategy for developed countries but also for developing countries[11]. The findings also indicate that central banks exhibit non-desirability of responding to the output growth in the presence of foreign aid shock. The qualitative effects of a foreign aid shock are very similar to those of a positive productivity shock and preference shock in the wealth transfer setting and the consumption transfer setting respectively. By increasing output and consumption in the former and latter settings respectively, the foreign aid shock reduces the distortion introduced by cost-push shock, hence, facilitating the stabilization of the output growth. In other words, as an extra income or consumption, foreign aid supports the monetary policymakers by eliminating

[10]See, among others, Ireland (2004), Coibion and Gorodnichenko (2011) and Fernandez-Villaverde (2010).

[11]For instance, for Brazil, Chile, South Africa and Thailand. See, also, Gonçalvez and Salles (2008) as the advocates of inflation targeting regime following their empirical analysis in developing countries.

the trade-off that they are facing by mitigating the effects of the nominal rigidity in the economy.

This chapter studies a closed economy model in order to find the optimal monetary policy response in aid receiving countries. On the other hand, open economy models account for the effects of the real exchange rate on inflation on the ground that the exchange rate influences, first, the price of imported goods and, in return, the inflation rate; and second, the competitiveness of domestic goods and, in return, aggregate demand which will also affect inflation rate through Phillips curve. In return, extensions of Taylor rule incorporating exchange rates have been considered[12]. In this case, central banks can achieve their inflation targets by frequently adjusting their exchange rates. However, these adjustments cause output responses producing instability in unemployment and growth. Accounting for these problems, a great deal of discussions has been made in the literature on whether to use open economy models, to incorporate the exchange rate into the Taylor rule especially in inflation targeting less developed countries. Ball (1999) and Svensson (2000) argue that monetary authorities in open economies should target a long-run inflation rate removing the temporary effects of exchange rate. Laxton and Pesenti (2003), Cespedes et al. (2004), Cavoli and Rajan (2006), and Batini et al. (2007) conclude that the coefficient on the exchange rate target should be small or zero. According to Taylor (2001) and Clarida et al. (2001) augmenting the Taylor rule with exchange rate creates a confusion in the minds of the public about the main objective of the central bank. Benes et al. (2013) and Ostry et al. (2012) argue that the main instrument for managing the exchange rate is sterilized sales and purchases of foreign exchange. Taking into account these findings and keeping in mind that the developing countries are generally small open economies, exchange rate is removed from the Taylor rule by considering a closed economy model; and a steady state inflation target is imposed as a long-run target. However, the consumption transfer setting can be thought of as a model where trade openness is acknowledged. In particular, foreign aid financed consumption goods can be regarded as imported goods in which the Law of One Price holds for the entire non-durable consumption (i.e both private and imported goods consumption) in the inflation basket.

The remainder of the chapter is organized as follows. Section 4.2 presents the New Keynesian model where the foreign aid is in the form of wealth transfers. Section 4.3 describes the calibration and solution strategy; computes and analyzes the optimal policy. Section 4.4 introduces the same model with foreign aid as consumption good transfers. Section 4.5 concludes with a discussion.

[12]Ball (1999) and Svensson (2000).

4.2 Model: Wealth Transfer

A New Keynesian model that features sticky prices, capital accumulation and foreign aid in discrete time is constructed. The economy consists of a representative household, a continuum of intermediate goods producing firms, a representative final goods producing firm, a government and a monetary authority.

The infinitely lived representative household has preference over consumption and labor supply; and is endowed with money, M, bonds, B, and physical capital, K. The household has the following sources of nominal income: nominal wage income, previous period money holdings, previous period bond holding together with nominal interest, rent net of depreciation from capital and lump-sum transfers from the government, V, that is originated from seignorage revenue and foreign aid. Since there is no tax, the household can spend this disposable income on purchasing more goods, holding more bonds, more money and accumulating capital. Thus, the household chooses the sequence for consumption c_t, working time n_t, bond holdings b_t, capital k_{t+1} and cash m_t in order to maximize the expected utility function

$$\max_{\{c_t,n_t,b_t,k_{t+1},m_t\}} \quad \mathbb{E}\sum_{t=0}^{\infty}\beta^t\left(\frac{c_t^{1-\phi}}{1-\phi}-\nu\frac{n_t^{1+\sigma}}{1+\sigma}\right)$$

subject to the budget and cash in advance constraints in real terms

$$c_t + k_{t+1} + b_t + m_t \leq w_t n_t + r_t k_t + (1-\delta)k_t + \frac{(1+i_{t-1})b_{t-1}}{\pi_t} + \frac{m_{t-1}}{\pi_t} + v_t$$
$$c_t \leq m_t + v_t$$

where $b_{t-1} = \frac{B_{t-1}}{P_t}$ and $m_{t-1} = \frac{M_{t-1}}{P_t}$ represent real bond and money holdings held between period $t-1$ and t respectively, with i_{t-1} being the nominal interest rate on real bond holdings. w_t denotes the real wage earned from supplying labor to the intermediate goods producing firms, r_t is the real rental rate earned from the intermediate goods producing firms; and inflation is defined as a gross rate, i.e. $\pi_t = \frac{P_t}{P_{t-1}}$. The utility is assumed to be well-behaved with a rate of time discount satisfying $0 < \beta < 1$ and ν is the disutility weight on labor supply. According to the cash-in-advance constraint, the household must have enough cash or transfer payments to afford the current consumption expenditures.

The characterization of the household's problem implies

$$c_t^{-\phi} = \lambda_t + \mu_t \tag{4.1}$$

$$\nu n_t^{\sigma} = \lambda_t w_t \tag{4.2}$$

$$\lambda_t = \beta \mathbb{E}_t \lambda_{t+1} \frac{1 + i_t}{\pi_{t+1}} \tag{4.3}$$

$$\lambda_t = \beta \mathbb{E}_t \lambda_{t+1} [r_{t+1} + (1 - \delta)] \tag{4.4}$$

$$\lambda_t = \beta \mathbb{E}_t \frac{\lambda_{t+1}}{\pi_{t+1}} + \mu_t \tag{4.5}$$

where λ_t and μ_t denotes the Lagrange multipliers associated with budget and cash-in-advance constraints respectively. The first order condition on consumption (4.1) reveals that the binding cash in advance constraint (i.e $\frac{i_t}{1+i_t} > 0$)[13] drives a wedge between the marginal utility of consumption and the marginal utility of wealth. The first order condition on labor (4.2) indicates the optimality condition between the marginal utility of leisure[14] and its price. The first order conditions with respect to bonds (4.3) and capital (4.4) equate the profits and costs associated with investing one marginal unit of wealth in bonds and capital respectively. The first order condition on real balances (4.5) denotes the equation for pricing money that is defined in terms of the liquidity services it offers.

The role of the government is to receive foreign aid, FA, which it transfers to the representative household in a lump-sum fashion and print money. Hence, the budget constraint of the government is

$$m_t - \frac{m_{t-1}}{\pi_t} + fa_t = v_t$$

The perfectly competitive final goods firm uses a continuum of differentiated intermediate goods, $y_{i,t}$, indexed on the interval $i \in [0, 1]$ in each period $t = 0, 1, 2, \ldots$ to produce a final good, y_t. The final output is assembled from the individual goods with Dixit-Stiglitz (1977) technology

$$y_t = \left(\int_0^1 y_{i,t}^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}}$$

[13] Combining first order conditions with respect to money, bond and labor yields an equation for the marginal utility from real balances and transfers: $\mu_t = \left(\frac{i_t}{1+i_t} \right) \left(\frac{\nu n_t^{\sigma}}{w_t} \right)$.

[14] Keep in mind that $n_t + l_t = 1$ where l denotes leisure.

where ϵ measures the elasticity of demand for each of intermediate goods. The final goods producing firm maximizes its profit by choosing

$$y_{i,t} = \left(\frac{P_{i,t}}{P_t}\right)^{-\epsilon} y_t$$

for all $i \in [0, 1]$ and $t = 0,\ 1,\ 2,....$ This equation gives the corresponding demand for each of the intermediate good i in which $P_{i,t}$ is the price of the intermediate goods that is taken as given by the final goods sector; and P_t is the price of the final goods. In equilibrium, zero profit of the perfectly competitive final goods sector determines the P_t as

$$P_t = \left(\int_0^1 P_{i,t}^{1-\epsilon} di\right)^{\frac{1}{1-\epsilon}}$$

for all $t = 0,\ 1,\ 2,....$

The intermediate goods producer i hires labor and rents capital from the household to produce $y_{i,t}$ according to the following technology

$$y_{i,t} = e^{z_t} k_{i,t}^{\alpha} n_{i,t}^{1-\alpha}$$

with the share of capital income satisfying $0 < \alpha < 1$. The technology shock follows an AR(1) process

$$z_t = \rho_z z_{t-1} + e_{zt}$$

with where e_{zt} is the independent, serially uncorrelated innovation and normally distributed with zero-mean and standard deviation σ_z.

The cost minimization problem of the intermediate firm implies the following first order conditions for its input prices

$$r_t = \alpha mc_{i,t} \frac{y_{i,t}}{k_{i,t}} \tag{4.6}$$

$$w_t = (1-\alpha) mc_{i,t} \frac{y_{i,t}}{n_{i,t}} \tag{4.7}$$

where $mc_{i,t}$ is the marginal cost of production. The intermediate good sector is monopolistically competitive and the intermediate goods producer, hence, has market power. It faces a quadratic cost of nominal price adjustment, measured in terms of the final

goods and given by

$$\frac{\chi}{2}\left(\frac{P_{i,t}}{P_{i,t-1}}-1\right)^2 y_t$$

where $\chi > 0$ determines the degree of nominal price rigidity as it governs the magnitude of the price adjustment cost. The higher is χ, the more sluggish is the adjustment of nominal prices; and when $\chi = 0$, prices are fully flexible. This price adjustment mechanism is, first, proposed by Rotemberg (1982) allowing the intermediate goods producing firms to have a dynamic problem in setting the price $P_{i,t}$ of their output. The literature on the characterization regarding to the price setting mechanisms, namely time-dependent, such as Taylor (1980) and Calvo (1983); or state-dependent, such as Rotemberg (1982), Dotsey, King, and Wolman (1999) and Golosov and Lucas (2007), of countries has been concentrating on the industrialized countries. While developed countries are found to have time-dependent or a combination of time- and state-dependent price setting behaviors, recent studies[15] identify the developing and emerging market countries as having state-dependent price setting mechanism. In time-dependent models, the decision of changing prices is exogenous. In other words, prices change according to a stochastic or deterministic rule regardless of the state of the economy. In contrast to the time-dependent models, the decision of changing prices is endogenous in state-dependent models, allowing the agents to decide whether or not to change their prices. Due to the differences in the nature of the price changes in these models, the implications of the macro models based on them can also differ. Hence, following the evidences in developing and emerging market countries and the criticism by Caplin and Leahy (1991), arguing that the exogenous price adjustments in time-dependent models complicate to know whether the effects of money are the consequences of the type of the price adjustment mechanism or of the nominal rigidities per se; the model utilizes a state-dependent price adjustment.

The intermediate goods producer i sets its prices to maximize

$$\max_{\{P_{i,t}\}_{t=0}^{\infty}} \quad \mathbb{E}_t \sum_{j=0}^{\infty} \Delta_{t,t+j}\left[\left((1+\tau^s)\frac{P_{i,t+j}}{P_{t+j}} - mc_{i,t+j}\right)y_{i,t+j} - \frac{\chi}{2}\left(\frac{P_{i,t+j}}{P_{i,t+j-1}}-1\right)^2 y_{t+j}\right]$$

$$\text{subject to} \quad y_{i,t+j} = \left(\frac{P_{i,t+j}}{P_{t+j}}\right)^{-\epsilon} y_{t+j}$$

where $\Delta_{t,t+j} = \beta^j\left(\frac{\frac{U_n(t+j)}{w(t+j)}}{\frac{U_n(t)}{w(t)}}\right)$ is the stochastic discount factor. Firms are assumed to

[15]Such as, Kovanen (2006), Gagnon (2009), Gábriel and Reiff (2010), Cavallo (2012), Feltrin and Guimaraes (2014) and Choudhary et al. (2016).

receive a sale subsidy, τ^s, in order to remove the distortions associated with monopolistic competition, leading to a simplification at the steady state analysis. Since all the firms face the same maximization problem, they will choose the same price, producing the same quantity. Thus, symmetric equilibrium implies $P_{i,t} = P_t$, $y_{i,t} = y_t$, $n_{i,t} = n_t$, $k_{i,t} = k_t$ and $mc_{i,t} = mc_t$ $\forall i$ leading to the following first-order-condition[16]

$$P_t = \frac{1}{\frac{(\epsilon-1)(1+\tau^s)}{\epsilon} + \frac{\chi}{\epsilon}\left[(\pi_t - 1)\pi_t - \beta\mathbb{E}_t\left(\frac{\frac{(n_{t+1})^\sigma}{w_{t+1}}}{\frac{(n_t)^\sigma}{w_t}}\right)\left((\pi_{t+1} - 1)\pi_{t+1}\frac{y_{t+1}}{y_t}\right)\right]} W_t \frac{n_t}{k_t}\left(\frac{1}{1-\alpha}\right)$$
$$= \eta_t W_t \frac{n_t}{k_t}\left(\frac{1}{1-\alpha}\right)$$

implying that the intermediate goods producing firms set their price as a mark-up, η_t, over the marginal cost. The New Keynesian Phillips curve with cost-push shock is

$$(\pi_t - 1)\pi_t = \beta\mathbb{E}_t\left(\frac{\frac{(n_{t+1})^\sigma}{w_{t+1}}}{\frac{(n_t)^\sigma}{w_t}}\right)\left((\pi_{t+1} - 1)\pi_{t+1}\frac{y_{t+1}}{y_t}\right) + \frac{\epsilon}{\chi}\left(mc_t - \frac{(1+\tau^s)(\epsilon-1)}{\epsilon}\right) + e_{p_t} \quad (4.8)$$

where e_{p_t} is a cost-push shock as a deterministic shock impulse. Instead of appearing in the firm's maximization problem, it is contemplated as a reduced-form cost-push shock following Sims (2013). The cost-push shocks can have different interpretations and representations. As in Smets and Wouters (2002)[17] and Steinsson (2002), the time-varying elasticity of demand for each of the intermediate goods, i.e. ϵ_t instead of ϵ, shows up as a cost-push shock in the Phillips curve associating the more elastic demand and correspondingly reduced desired markup with the mitigated inflationary pressures. Erceg, Henderson and Levin (2000) generate the cost-push shocks as the endogenous fluctuations in wage markups caused by the sluggish adjustment of nominal wages. Clarida, Galí, and Gertler (2000) consider the rises in oil price as cost-push shock. Instead, Leith and Liu (2016) model the fluctuations of the revenue tax rate as cost-push shock due to the fact that the time-varying elasticity of demand in nonlinear models influences the measure of the price dispersion in such a way that is not regarded to be ingrained in cost-push shock models. Other alternative interpretations in the literature are any effects that cause a time-varying wedge between the flexible price and the efficient levels of output, such as net worth shocks proposed by Gilchrist and Leahy (2002) and Carlstrom, Fuerst, and Paustian (2010); or housing productivity and housing demand shocks by Adam and Woodford (2013).

[16] In order to get this expression, use equation (4.7) to replace mc_t, together with nominal representation of wage, i.e. $W_t = w_t P_t$.

[17] They also regard the shocks to the markup in the labor market and in the required risk premium on capital as cost-push shocks.

The above equation forms a non-linear forward-looking New-Keynesian Phillips curve, where the deviations of the real marginal cost from its desired steady-state value, i.e. desired markup, are the driving force of inflation together with cost-push shocks. Notice that, in the absence of the cost-push shock, when there is no price stickiness, $\chi = 0$, and $1 + \tau^s = \frac{\epsilon}{\epsilon - 1}$, $mc = 1$ at the steady state, implying Pareto optimality at the steady state.

The law of motion for capital is given by

$$k_{t+1} = (1 - \delta)k_t + I_t$$

where δ is the depreciation rate of capital and I_t is the investment.

Foreign aid evolves following a stochastic component

$$fa_t = x_t y_t$$

where the law of motion for the stochastic component is

$$x_t = \bar{x} + \rho_x(x_{t-1} - \bar{x}) + e_{xt} \tag{4.9}$$

so that $\bar{x}$ represents the steady state foreign aid level, ρ_x denotes the degree of persistence and e_{xt} is an iid shock.

The equilibrium in the final goods market necessitates that the all available final goods are allocated to consumption, investment and costs that results from the price adjustment

$$fa_t + y_t = c_t + I_t + \frac{\chi}{2}(\pi_t - 1)^2 y_t$$

The aggregate resource constraint reveals that the foreign aid operates as a wealth transfer[18]. Foreign aid may also be modelled such that it has productivity enhancing effects or learning-by-doing effects by appearing in total factor productivity in the production function as in Dutch disease literature. Alternatively, it can be tied to particular activities, such as health, infrastructure[19], education or provision of some public goods[20]; or given in specific forms such that it leads to the transfer of knowledge as in technical assistance[21] allowing for improvement in the level of skills and technical know-how in the recipient country. Note that, for the model to be well-defined, the aggregate resource

[18]For similar treatment of foreign aid, see, Annen and Kosempel (2012) and Annen, Batu and Kosempel (2016).

[19]See, Adam and Bevan (2003).

[20]For instance, Chatterjee et al. (2012).

[21]See, Annen and Kosempel (2009).

constraint implicitly necessitates the following condition $0.817 < \pi < 1.182$ at the steady state.[22]

Following Taylor (1993), a simple inflation targeting rule implies that the central bank manages the short-run nominal interest rate in response to the fluctuations in inflation and output growth

$$\ln\left(\frac{1+i_t}{1+\bar{i}}\right) = \rho_i \ln\left(\frac{1+i_{t-1}}{1+\bar{i}}\right) + (1-\rho_i)\left\{\rho_\pi \ln\left(\frac{1+\pi_t}{1+\overline{\pi}}\right) + \rho_y \ln\left(\frac{GRI_t}{\overline{RI}}\right)\right\}$$

Here $\bar{i}$, $\overline{\pi}$ and $\overline{RI}$ correspond to the steady state values of nominal interest rate, inflation rate and total available growth rate of income respectively, where the latter is defined as $GRI_t = \frac{(1+x_t)y_t}{(1+x_{t-1})y_{t-1}}$. $\rho_i \in [0,1)$ is a smoothing parameter; and $\rho_\pi \in [0,10]$ and $\rho_y \in [0,10]$ are the weights assigned by the central bank to the deviations of inflation and output from their steady states. As in Schmitt-Grohé and Uribe (2007), the monetary policy is, here, modelled such that the central bank sets the short-run nominal interest rate in response to observable variables only. This is why output growth in deviations from steady state is included in the targeting rule rather than output gap, allowing to gauge the effects of monetary policy when changes in the foreign aid is also accounted for. This Taylor rule can be mapped into targeting rules as well. Specifically, strict inflation targeting rule requires $\rho_y = \rho_i = 0$ and $0 < \rho_\pi \leq 10$ while flexible inflation targeting rule allows for $0 < \rho_\pi, \rho_y \leq 10$ and $\rho_i \in [0,1)$.

4.3 Optimizing Monetary Policy

The critical feature of this analysis roots in the evaluation of the Taylor rule based on a welfare assessment under alternative stochastic processes when the monetary authority accounts for the incoming foreign aid. In particular, given the calibrated values of the structural parameters of the model, three coefficients of the Taylor rule are optimized in order to maximize unconditional welfare under three cases: (i) only cost-push shock (CP), (ii) only foreign aid shock (FA); and (iii) cost-push and foreign aid shocks $(CP + FA)$ in which total factor productivity shock is always muted[23]. The novelty of this analysis arises from the question regarding what the best response of the monetary policy authority is in aid recipient developing countries.

[22] The goods market equilibrium can be written as $y_t = \frac{c_t + I_t}{1 + x_t - \frac{\chi}{2}(\pi_t - 1)^2}$.

[23] By doing so, the interpretation of how to treat the incoming foreign aid is facilitated. Furthermore, for the comparison of only foreign aid shock and only technology shock, see Figure 1 and Figure 2.

4.3.1 Calibration and Solution Strategy

The selection of parameter values for developing countries is challenging as the literature has been investigating mostly the micro data from developed countries. The value for the discount factor in developing countries varies from 0.95 to 0.99. For instance Arellano et al. (2005) assumes 0.95 for general calibration of developing countries, Annen and Kosempel (2012) and Bhattacharya and Ila Patnaik (2016) use approximately 0.97 while Berg, Portillo and Zanna (2014) calibrate it to be 0.99 for Uganda. Here, a more conventional value $\beta = 0.98$ is adopted.[24] The inverse of intertemporal elasticity of substitution is set to 2 as the most widespread value in the literature for developing economies[25]. The value for the inverse of Frisch elasticity of labor supply is quite controversial ranging from 0.2 to 10.[26] Yet, the estimates for Frisch elasticity is in general $\frac{1}{\sigma} \in [0.25, 1]$. Following the suggestion by Prasad and Zhang (2015) pointing to the high informality of the labor market in developing countries, σ is set to a slightly higher value than its developed country counterparts. The weight on the disutility of supplying labor, ν, is calibrated from the first best choice of the economy such that the steady state labor supply is equal to 0.3. The value assigned to the rate of capital depreciation, δ, implies an average investment ratio of 27 percent. This value is attained from low&middle income countries data of capital formation percentage of GDP between 1960 and 2015 in World Bank data. While Prescott (1986) estimated the capital share of income in the U.S 36%, Kraay and Raddatz (2006) argue that the values ranging between 0.5 and 0.6 are more appropriate for poor countries. On the other hand, Gollin (2002) and Caselli and Feyrer (2007) identify sizeable cross-country variation in capital share. Following the standard value in macroeconomics, α is assumed to be $\frac{1}{3}$[27].

The elasticity of substitution between differentiated goods is set to 11[28]. Sale subsidy is calculated so as to remove the monopolistic power at the steady state, i.e $\tau^s = \frac{1}{\epsilon - 1}$. The probability that a price does not adjust in a given period, i.e Calvo probability, is set to 0.66 following Rotemberg and Woodford (1997). Since the standard way of calculating the degree of nominal price rigidity, χ, is to equate the slope coefficients of Calvo and Rotemberg Phillips curves, this value is required. It follows that $\chi = \frac{(\epsilon-1)(1+\tau^s)0.66}{(1-0.66)(1-0.66\beta)}$.

[24] For the papers which use similar or same value for this parameter, see, for instance, Aoki, Benigno and Kiyotaki (2016); Shen, Yang and Zanna (2015).

[25] Agenor and Montiel (1999); Devereux et al. (2006); Aguiar and Gopinath (2007); García-Cicco et al. (2010).

[26] Aoki, Benigno and Kiyotaki (2016) uses 0.2, Berg et al. (2012) uses 10 for CEMAC region, Prasad and Zhang (2015) set it into 1.5.

[27] This value is in line with the following papers spesifically Arellano et al. (2005) and García-Cicco, Pancrazi Uribe (2010).

[28] Many papers use $\theta = 9$, 11 or 12. Here, Anand et al. (2015); Prasad and Zhang (2015); and Clarida, Galí and Gertler (1999) are followed.

The stochastic process for aid is calibrated from the Official Development Assistance (ODA) data of World Bank. The available data of net ODA constant prices for low&middle income countries is normalized by GDP constant prices for the period of 1960-2015. This standard measure in the literature yields the following persistence and long-run values respectively, $\rho_x = 0.92$ and $\bar{x} = 0.01$[29]. The parameter values for technology process are set such that they match the output volatility in the data that is used for normalization of foreign aid data. The autocorrelation coefficient is $\rho_z = 0.93$ per annum and $\sigma_z = 0.02$ which are values in line with the literature.[30] Since the cost-push shock is introduced in reduced-form, 1% standard deviation is assumed for its volatility. The monetary policy parameters follows the values from Gali et al. (2004) and Mohanty and Klau (2005). Calculating these values from the long-run responses suggests $\rho_i = 0.7$, $\rho_\pi = 2.05$[31] and $\rho_y = 0.125$. Finally, zero inflation and real output growth are targeted. Table 4.1 presents the quick overview of the parameter values.

The approach, here, consists of finding the policy specification $\{\rho_i, \rho_\pi, \rho_y\}$ that maximizes the welfare of the households. More formally, the policy parameters that maximize $\mathbb{E}[V_t]$ are analyzed:

$$\max_{\{\rho_i,\rho_\pi,\rho_y\}} \quad V_t \equiv \mathbb{E}\sum_{k=0}^{\infty}\beta^k\left(\frac{c_{t+k}^{1-\phi}}{1-\phi} - \nu\frac{n_{t+k}^{1+\sigma}}{1+\sigma}\right) \tag{4.10}$$

where $\mathbb{E}$ represents the unconditional expectations operator. The first-order approximations of the equilibrium conditions are independent of the monetary policy since the expected value of a variable is equal to its non-stochastic steady state. Hence, the first-order approximation of all policies coincide with the same level of welfare[32]. To avoid this problem, the second-order approximation of the welfare is computed for a recursive representation of the problem in equation (4.10)

$$V_t \equiv \left(\frac{c_t^{1-\phi}}{1-\phi} - \nu\frac{n_t^{1+\sigma}}{1+\sigma}\right) + \beta^t\,\mathbb{E}\,V_{t+1}$$

4.3.2 Comparing Monetary Policy Rules

The comparison of the rules, first, involves policy evaluations of the three stochastic cases of the model economy on the condition that each stochastic process has a volatility of

[29]This value is low compared to highly foreign aid dependent countries as in Arellano (2005). However, Buffie et al. (2004) summarize similar values for some selected countries from Africa.

[30]See, for instance, Aguiar and Gopinath (2007), Anand (2015), Prasad and Zhang (2015), Annen (2016)and Aoki et al. (2016).

[31]Although for an active monetary policy, the literature often uses $\rho_\pi = 1.5$ or $\rho_\pi = 2$, the weight for inflation targeting is required to be equated to 2.05 in order to ensure the Blanchard-Khan determinacy. Yet, these values are only necessary for the start of the guess.

[32]For a discussion, see Schmitt-Grohé and Uribe (2007) and Kim and Kim (2003).

TABLE 4.1: Baseline Parameter Values

Parameter	Description	Value
Households		
β	discount rate	0.98
ϕ	inverse IES	2
σ	inverse Frisch elasticity of labor	1.5
ν	weight of disutility from working	44.69
Firms		
δ	depretiation rate	0.08
α	capital share	0.33
θ	elasticity of substitution btw goods	11
τ^s	sale subsidy	0.1
probability	Calvo probability	0.66
χ	adjustment cost	60.46
ρ_z	AR(1) for technology	0.93
σ_z	st. dev. of technology	0.02
Foreign Aid		
ρ_x	AR(1) for foreign aid	0.92
$\bar{x}$	steady state foreign aid	0.01
σ_x	st. dev. of foreign aid shock	0.003
Monetary Policy		
σ_e	st. dev. of cost-push shock	0.01
ρ_i	smoothing parameter of interest rate	0.7
ρ_π	coefficient of inflation targeting	2.05
ρ_y	coefficient of output growth targeting	0.125
γ_π	inflation target	1
γ_y	output growth target	1

1% standard deviation. Next, the volatilities from the baseline calibration is used for the same analysis. Following this kind of procedure enables to get clear results and simplifies the interpretations of these results.

For only cost-push shock case, cost-push shock follows from equation (4.8) while foreign aid is considered to be a deterministic process:

$$x_t = \bar{x} \tag{4.11}$$

instead of equation (4.9). On the other hand, only foreign aid shock case necessitates the equation (4.9) for foreign aid; and equation (4.8) without reduced-form cost-push term:

$$(\pi_t - 1)\pi_t = \beta \mathbb{E}_t \left(\frac{\frac{(n_{t+1})^\sigma}{w_{t+1}}}{\frac{(n_t)^\sigma}{w_t}} \right) \left((\pi_{t+1} - 1)\pi_{t+1} \frac{y_{t+1}}{y_t} \right) + \frac{\epsilon}{\chi} \left(mc_t - \frac{(1+\tau^s)(\epsilon - 1)}{\epsilon} \right) \tag{4.12}$$

Finally, the baseline economy without any variation is followed for both shocks case.

Table 4.2 reports the parameter configuration that characterizes the each shock case when $\sigma_e = \sigma_x = 0.01$.

TABLE 4.2: Wealth Transfer: Parameter Values of the Taylor Rules when $\sigma_e = \sigma_x = 0.01$

Shock	Rule		
	ρ_i	ρ_π	ρ_y
CP	0.7	10	0.7842
FA	0.7	10	0
$CP + FA$	0.7	10	0.4831

When the economy is hit only by cost-push shock, all the parameter values are positive, indicating that the cost-push shock generates a trade-off between stabilizing the inflation rate and output growth as in Clarida, Gali and Gertler (1999), Woodford (2001) and Gali (2002)[33]. However, when there is only foreign aid shock, central banks face no short-run trade-off and strict inflation targeting emerges as the sole aim of the monetary policy. In the presence of both cost-push and foreign aid shocks, monetary policymakers, instead, are required to balance the targeting objectives. The comparison of coefficient of output growth targeting in CP and $CP + FA$ shocks indicates that the presence of foreign aid shock in addition to cost-push shock reduces the need to stabilise the output growth. The less desirability of output growth stabilization is originated from the nature of the foreign aid since it acts as a wealth transfer. In other words, foreign aid shock alleviates the distortion that stems from the cost-push shock. As observed in all cases, the coefficient of inertial adjustment of the interest rate is always positive, supporting the claim by Mohanty and Klau (2005) stating that the developing countries put substantial weight on interest rate smoothing. Moreover, it also indicates that the monetary policymaker is backward-looking and fights inflation deviations from the steady state more aggressively in the long-run compared to the short-run[34].

When the magnitudes of the shocks differ, similar monetary policy approaches are derived from the welfare optimization as in Table 4.3. In particular, in the presence of cost-push shock, central banks find it optimal to follow a flexible inflation targeting where they act more in favor of the inflation stabilization compared to that of output growth. When the economy is subject to foreign aid shock, the trade-off between stabilization rules disappears and monetary policymakers strictly fight against inflation deviations from the target rate. However, when the economy features both sources of

[33]The trade-off is between inflation rate and output gap in these papers.
[34]See, Schmitt-Grohé and Uribe (2007).

TABLE 4.3: Wealth Transfer: Parameter Values of the Taylor Rules when $\sigma_e = 0.01$ and $\sigma_x = 0.003$

Shock	Rule		
	ρ_i	ρ_π	ρ_y
CP	0.7	10	0.7842
FA	0.7	10	0
$CP + FA$	0.7	10	0.7459

shocks, monetary policymakers depart from strict inflation targeting by choosing a mitigated response parameter to output growth targeting compared to only cost-push shock case. Note that, when both shocks are present, the weight given to the output growth targeting is higher compared to the same case in equal shocks. In other words, the decrease in ρ_y from CP case to $CP + FA$ case when $\sigma_e = 0.01$ and $\sigma_x = 0.003$ is smaller compared to the one when $\sigma_e = \sigma_x = 0.01$. Intuitively, when the shock to foreign aid is larger, i.e equal shocks, this "helicopter-drop" income is slightly more successful in stabilizing output growth. Although this may sound counter-intuitive, it stresses the importance by the effect of temporary changes in foreign aid rather than the permanent changes[35]. Furthermore, note that output growth stabilization translates into taking actions with respect to foreign aid as well. While this could be viewed as a signal for the rather small importance of the volatility in foreign aid, yet, it hardly matters for the efficient conduct of the monetary policy in total.

The conventional measure of foreign aid percentage of GDP is sometimes criticized on the claim that it tends to be procyclical[36]. Hence, as an alternative measure, ODA per capita is proposed. Furthermore, some of the emerging market and developing countries are characterized as heavily aid dependent[37]. In order to account for these observations and as a robustness check, the same welfare-based optimal monetary policy is solved with a higher mean value of this foreign aid measure; and the results are found to be qualitatively invariant to these changes.

To understand the intuition for why the welfare-optimizing policy rule features no response to output growth, it is important to identify the nature of the foreign aid shock. Is it a further source of *inefficiency* or an instrument that may benefit the monetary policymakers in reducing the distortions which already exist in the economy? To this end, Figure 4.1 and 4.2 display the Impulse Response Functions (IRF) of the optimal monetary policies with respect to only technology shock with equations (4.11) and (4.12)

[35]This result in line with the conclusion by for instance Annen and Kosempel (2012).
[36]Pallage and Robe (2003) find that aid is procyclical in 60% of the recipient countries.
[37]For instance, see Arellano et al. (2005).

and only foreign aid shock with equation (4.12) respectively. Following a positive technology shock, output, consumption and capital rise while labor supply and inflation fall. The qualitative effects of a foreign aid shock are very similar to those of a positive productivity shock. Since the foreign aid enters into the economy as wealth transfer, richer households consume more and supply less labor on impact[38]. This imitation of technology shock by foreign aid suggests that the foreign aid shock can be treated as a productivity shock that generates income effects. In Rotemberg models, the cost of nominal rigidities, i.e., the adjustment cost, causes a wedge between consumption and output as some of the output is devoted to the price adjustment cost. However, at the steady state, assuming zero inflation target discards this rigidity. Therefore, by increasing output, the foreign aid shock reduces the only distortion left in the economy due to the cost-push shock; hence, facilitating the stabilization of the output growth. In other words, as an extra income, foreign aid supports the monetary policymakers by eliminating the trade-off that they are facing by mitigating the effects of the nominal rigidity exists in the economy.

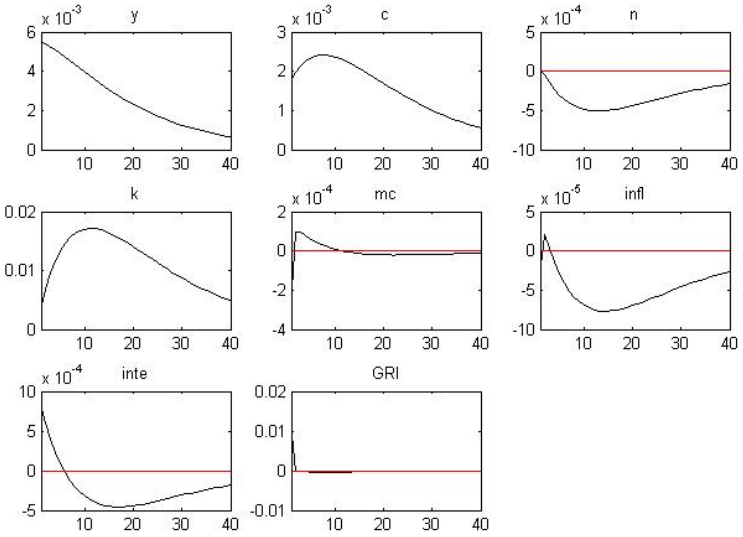


FIGURE 4.1: Impulse Response Function of Optimal Monetary Policy w.r.t. Technology

Having established how the foreign aid acts in the setting, the impacts of cost-push shock can be easily elaborated. Cost-push shocks introduce real imperfections into the New Keynesian model via the variations in desired price markups. In two-shock case, this real imperfection forces the central bank to respond to the output growth as well, contrary to the only foreign aid shock case. This gives rise to the explanation that although foreign aid shock helps to mitigate the nominal rigidity, its effect is not strong enough to cancel out the real imperfection, leading to a shift in the non-desirability of response

[38]Similar results in Asem and Gupta (1999).

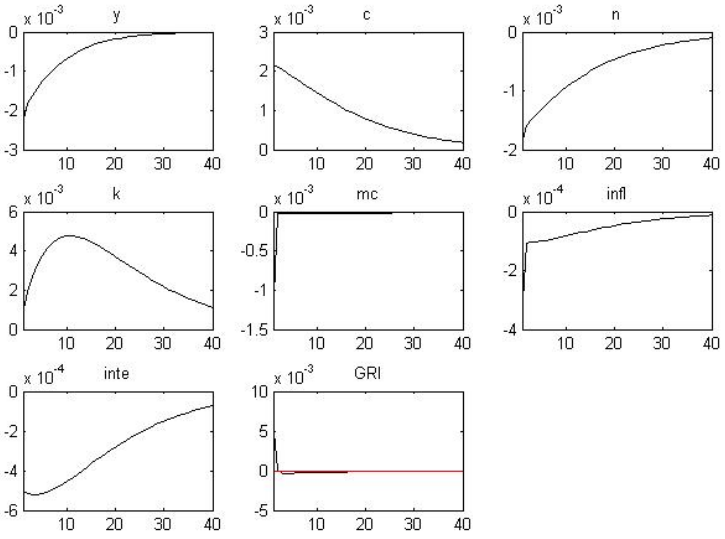


FIGURE 4.2: Impulse Response Function of Optimal Monetary Policy w.r.t. FA

to output growth which is the optimal reaction in only foreign aid shock case. Figure 4.3 depicts the IRF of the interest variables to one percent cost-push shock to better gauge the effects of this shock. The comparison of the changes in output with respect to only cost-push shock and only foreign aid shock reveals that the volatility in output is greater in the former. While both shocks result in alteration of household decisions, only cost-push shock directly affects relative prices. Furthermore, remember that the Phillips curve relates the current inflation to current output growth and expected future inflation. In such a framework, the foreign aid shock allows for a preferred alignment of expected future inflation to current inflation with a policy better anchoring the output growth. Hence, in both-shock case $\rho_y > 0$; yet, it is still smaller than the only cost-push shock economy.

4.4 Model: Consumption Transfer

The model in Section 4.2 claims that foreign aid is efficiently used in a lump-sum way so that there is no reason to stabilize output fluctuations induced by foreign aid shocks. In particular, foreign aid enters into the budget constraint of the representative household via monetary transfers from the aid-receiving government. These additional resources are, then, available for more consumption spending, capital, bond and money holdings. Alternatively, after the intake of foreign aid, the government may decide how the additional resources are spent in the economy. Specifically, the government devotes the entire foreign aid on consumption instead of having the household choice over capital and so on. Hence, in this setting, the household does not receive lump-sum transfers of

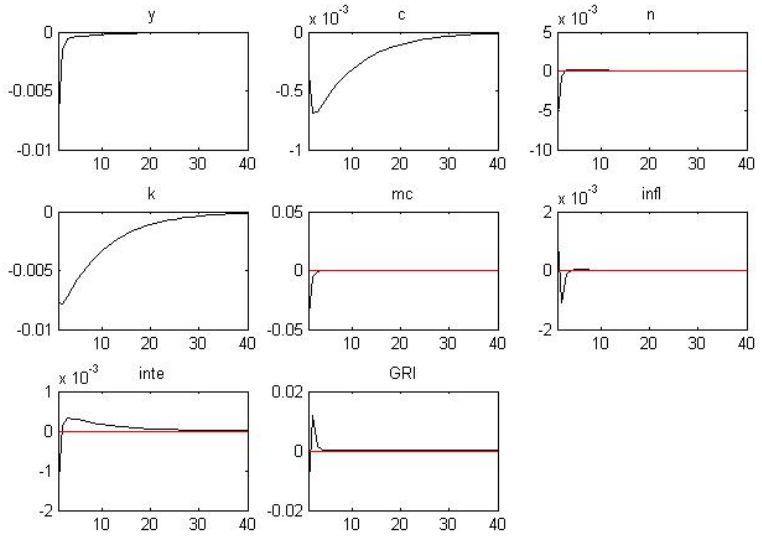


FIGURE 4.3: Impulse Response Function of Optimal Monetary Policy w.r.t. CP

aid; and the resource constraint is not affected by the incoming foreign aid. However, composite consumption that contains non-durable consumption goods implies that the representative household derives utility from both private and foreign aid induced consumption goods rather than only private consumption as in the wealth transfer setting. The reason behind this variation is to analyze this type of setting is to identify whether how the foreign aid is spent creates a misallocation or not; and, in return, check the robustness of the results obtained in the previous framework.

The model has the following different features. The representative household chooses the sequence for private consumption c_t, working time n_t, bond holdings b_t, capital k_{t+1} and cash m_t

$$\max_{\{c_t,n_t,b_t,k_{t+1},m_t\}} \quad \mathbb{E}\sum_{t=0}^{\infty}\beta^t\left(\frac{\hat{c}_t^{1-\phi}}{1-\phi}-\nu\frac{n_t^{1+\sigma}}{1+\sigma}\right)$$

with $\hat{c}_t$ representing composite consumption good (i.e non-durable consumption) and c_t indicating private consumption on home produced goods. $\hat{c}_t = c_t + \theta c_{fa}$ where c_{fa_t} denotes the consumption goods purchased by foreign aid. Among perfect substitute goods, $\theta = 1$ is assumed for simplicity of calculation. The household maximizes the expected utility function subject to the following budget and cash in advance constraints in real terms

$$c_t + k_{t+1} + b_t + m_t \leq w_t n_t + r_t k_t + (1-\delta)k_t + \frac{(1+i_{t-1})b_{t-1}}{\pi_t} + \frac{m_{t-1}}{\pi_t} + v_t$$
$$c_t \leq m_t + v_t$$

The government receives foreign aid and issues money. It spends these resources on foreign aid induced consumption goods and transfers the rest of the resources back to the household.

$$m_t - \frac{m_{t-1}}{\pi_t} + fa_t = c_{fa_t} + v_t$$

where c_{fa} is financed entirely by foreign aid transfers

$$fa_t = c_{fa_t}$$

In other words, foreign aid can also be regarded as a special form of government spending. Correspondingly, the resource constraint is

$$fa_t + y_t = c_t + c_{fa_t} + I_t + \frac{\chi}{2}(\pi_t - 1)^2 y_t$$

The rest of the model follows the previous setting.[39] Parameter values in Table 4.1 are also carried over for the optimization of policy parameters except the standard deviation of the shocks. The shocks are assumed to be equal to 0.001 in order to avoid explosive simulations in second order approximations. Finally, the same magnitude of shocks are analyzed.

TABLE 4.4: Consumption Transfer: Parameter Values of the Taylor Rules when $\sigma_e = \sigma_x = 0.001$

Shock	Rule		
	ρ_i	ρ_π	ρ_y
CP	0.7	10	0.7833
FA	0.7	10	0
$CP + FA$	0.7	10	0.4791

As Table 4.4 illustrates, in the presence of cost-push shock, central banks find it optimal to follow a flexible inflation targeting with a more aggressive response to deviations of inflation from desired levels than those of output growth. However, when the economy is hit by foreign aid shock, monetary policy authorities strictly adopt an inflation targeting regime. When both shocks are present, central banks face a trade off between stabilizing inflation and output growth. Their reaction to inflation targeting is still more aggressive than output growth targeting. Yet, the response to output growth in this case is smaller than only cost-push shock case.

[39]For equilibrium conditions, see Appendix for Chapter 4.

Although it is not possible to compare the optimal rules in terms of weights given to the policy regimes in this and previous settings due to the differences in the magnitudes of the shocks, the results in terms of which regime to adopt are similar to the ones obtained in the wealth transfer setting. In the latter setting where the foreign aid is directed to the household, the household optimally allocates these resources according to her ranking of marginal utilities in those choices. However, here, the representative household is not allowed to choose how to spend the foreign aid. Instead, the household is forced to have more of the consumption goods financed by incoming foreign aid that is purchased by the government. In other words, foreign aid shocks act like preference shocks in consumption transfer setting where the household has no control over; yet enjoys it. Intuitively, although the allocation of foreign aid and how it reaches the household differs, the additional resources are still devoted to the household by affecting the optimal consumption bundles. Since foreign aid is entirely spent for consumption, this type of foreign aid spending does not cause distortions creating any misallocation of the additional resources. As a consequence, this fact suggests the way foreign aid is spent with or without the intermediacy of government does not affect the optimal monetary policy response of the central banks as long as foreign aid shocks are transferred to the household in such a way that the additional resources are absorbed in its bundles of choice.

4.5 Conclusion

A New Keynesian model that features sticky prices, capital accumulation and foreign aid in a discrete time is constructed to study the optimal monetary policy in the form of targeting rules in foreign aid-receiving countries. In particular, given the calibrated values of the structural parameters of the model, policy parameters of the Taylor rule, namely interest rate smoothing, inflation targeting and output growth targeting, are optimized in order to maximize unconditional welfare under three cases: (i) only cost-push shock (CP), (ii) only foreign aid shock (FA); and (iii) cost-push and foreign aid shocks $(CP + FA)$.

The results demonstrate that when the economy is hit only by cost-push shock, monetary authority should react both to inflation and output growth with a more aggressive response to inflation as inflation and output tend to move in opposite directions conditional on the cost-push shock. However, when there is only foreign aid shock, monetary authority recovers from the short-run trade-off and strict inflation targeting emerges as the particular purpose of the monetary policy. In the presence of both cost-push and

foreign aid shocks, monetary policymakers, instead, are required to balance the targeting objectives. When the magnitudes of the shocks differ, similar monetary policy approaches are derived with a distinction of the policy coefficient on output growth being higher compared to the equal shocks case. This, in turn, means that when the shock to foreign aid is larger, i.e equal shocks, this "helicopter-drop" income is slightly more successful in stabilizing output growth. Since the foreign aid enters into the economy as wealth transfer, as an extra income, foreign aid supports the monetary policymakers by eliminating the trade-off that they are facing by mitigating the effects of the nominal rigidity exists in the economy. Yet, the diminished output growth response in the presence of both shocks illustrates that the effect of foreign aid shock is not strong enough to cancel out the real imperfection in the form of cost-push shock. Nevertheless, its presence serves to the monetary authority in anchoring output growth. This suggests that the foreign aid is not merely a shock that creates reallocation in this setting, but it can become an unconventional policy tool as well.

The findings of this chapter suggest that foreign aid resolves the need for the stabilization of income. In other words, foreign aid reduces the trade off between inflation and output stabilization faced by the monetary authority, leading to the idea that foreign aid recipient developing countries should act in favor of the inflation targeting as in industrialized countries.

Robustness check via the change of intermediacy of government shows that the results in terms of which regime to adopt from the setting of foreign aid in the form of non-durable consumption transfers are similar to the ones obtained in the wealth transfer setting. The findings show that whether the government transfers the foreign aid directly to the household as monetary transfers or directs it to the household via specific goods does not affect the optimal choice of monetary regime adopted by central banks as long as foreign aid shocks are transferred to the household in such a way that the additional resources are absorbed in its bundles of choice.

A caution on the interpretation of the results is still needed. This chapter should not be regarded as providing particular quantitative prescriptions to the optimal values of policy coefficients in the Taylor rule. Rather, their implications should be evaluated on a qualitative perspective as the responses are obtained from numerically optimized rules that are calculated in a finite interval.

Appendices

Appendix for Chapter 3

Table 3.15: List of Countries for Proximate Variables

Albania	Costa Rica	Malaysia	Romania
Algeria	Dominican Republic	Mauritius	South Africa
Argentina	Egypt	Mexico	Sri Lanka
Republic of Armenia	El Salvador	Moldova	Thailand
Belarus	Georgia	Morocco	Tunisia
Belize	Hungary	Nicaragua	Turkey
Bolivia	Jamaica	Pakistan	Ukraine
Brazil	Kazakhstan	Panama	Venezuela
Bulgaria	Republic of Korea	Paraguay	
China	Kyrgyz Republic	Peru	
Colombia	Macedonia	Philippines	

Table 3.16: List of Countries for Soci-economical Variables

Argentina*	Egypt*	Kenya*	South Africa
Bolivia*	El Salvador	Malaysia	Sri Lanka
Brazil	Ghana	Morocco*	Thailand
Central African* Republic	Guatemala	Nigeria	Tunisia*
China*	Honduras	Paraguay	Turkey
Colombia	Hungary	Peru	Zambia*
Costa Rica	India	Philippines	Zimbabwe*
Ecuador	Indonesia*	Romania	

* denotes the countries that are categorized as non-democratic.

Table 3.17: Results of Panel Unit Root Tests for Non-democracies, IPS

Variable	Wout trend		W trend	
	test stat.	p-value	test stat.	p-value
inf	-3.4519	0.0003	-2.6293	0.0043
$gini$	-1.2997	0.0969	0.8651	0.8065
$ginpol$	-0.1155	0.4540	-0.8662	0.1932
$D.gini$	-0.1224	0.4513	-1.9607	0.0250
$D2.gini$	-11.7303	0.0000	-9.5640	0.0000
$D.ginpol$	-9.1571	0.0000	-10.4386	0.0000

2 lags are used for level and 1 lag for first-difference variables.

Table 3.18: Results of Panel Unit Root Tests for Non-democracies, CADF

Variable	Wout trend		W trend	
	test stat.	p-value	test stat.	p-value
inf	-0.352	0.363	0.592	0.723
$gini$	2.049	0.980	3.022	0.999
cbi	0.093	0.537	1.012	0.844
$ginpol$	-0.539	0.295	0.879	0.810
$D.inf$	-9.423	0.000	-8.429	0.000
$D.gini$	0.109	0.543	-0.911	0.181
$D2.gini$	-8.686	0.000	-6.806	0.000
$D.cbi$	-3.967	0.000	-2.538	0.006
$D.ginpol$	-2.100	0.018	-2.455	0.007

2 lags are used for level, 1 lag for first-difference and 0 lag for second-difference variables.

Table 3.19: Results of Panel Unit Root Tests for Democracies, IPS

Variable	Wout trend		W trend	
	test stat.	p-value	test stat.	p-value
inf	-6.3965	0.0000	-6.5711	0.0000
$gini$	-1.9372	0.0264	-3.8127	0.0001
$ginpol$	-6.0378	0.0000	-6.3001	0.0000

2 lags are used for level variables.

Table 3.20: Results of Panel Unit Root Tests for Democracies, CADF

Variable	Wout trend		W trend	
	test stat.	p-value	test stat.	p-value
inf	-4.379	0.000	-4.213	0.000
gini	1.151	0.875	-4.929	0.000
cbi	-1.159	0.123	0.800	0.788
ginpol	-4.445	0.000	-0.903	0.183
$D.gini$	-2.245	0.012	-0.098	0.461
$D.cbi$	-6.928	0.000	-4.980	0.000
$D.ginpol$	-6.114	0.000	-4.876	0.000

2 lags are used for level and 1 lag for first-difference variables.

Appendix for Chapter 4

Equilibrium conditions for wealth transfer setting: $\{c_t, \lambda_t, \mu_t, m_t, v_t, n_t, I_t, fa_t, y_t, k_t, i_t, w_t, r_t, mc_t, \pi_t, z_t, x_t, GRI_t, u_t, W_t\}$

$$c_t^{-\phi} = \lambda_t + \mu_t \tag{13}$$

$$\nu n_t^{\sigma} = \lambda_t w_t \tag{14}$$

$$\lambda_t = \beta \mathbb{E}_t \lambda_{t+1} \frac{1+i_t}{\pi_{t+1}} \tag{15}$$

$$\lambda_t = \beta \mathbb{E}_t \lambda_{t+1} [r_{t+1} + (1-\delta)] \tag{16}$$

$$\lambda_t = \beta \mathbb{E}_t \frac{\lambda_{t+1}}{\pi_{t+1}} + \mu_t \tag{17}$$

$$y_t = e^{z_t} k_t^{\alpha} n_t^{1-\alpha} \tag{18}$$

$$z_t = \rho_z z_{t-1} + e_{zt} \tag{19}$$

$$r_t = \alpha mc_t \frac{y_t}{k_t} \tag{20}$$

$$w_t = (1-\alpha) mc_t \frac{y_t}{n_t} \tag{21}$$

$$m_t - \frac{m_{t-1}}{\pi_t} + fa_t = v_t \tag{22}$$

$$c_t = m_t + v_t \tag{23}$$

$$k_{t+1} = (1-\delta)k_t + I_t \tag{24}$$

$$fa_t + y_t = c_t + I_t + \frac{\chi}{2}(\pi_t - 1)^2 y_t \tag{25}$$

$$fa_t = x_t y_t \tag{26}$$

$$x_t = \bar{x} + \rho_x (x_{t-1} - \bar{x}) + e_{xt} \tag{27}$$

$$\ln\left(\frac{1+i_t}{1+\bar{i}}\right) = \rho_i \ln\left(\frac{1+i_{t-1}}{1+\bar{i}}\right) + (1-\rho_i)\left\{\rho_\pi \ln\left(\frac{1+\pi_t}{1+\bar{\pi}}\right) + \rho_y \ln\left(\frac{GRI_t}{\overline{RI}}\right)\right\} \tag{28}$$

$$GRI_t = \frac{(1+x_t)y_t}{(1+x_{t-1})y_{t-1}} \tag{29}$$

$$(\pi_t - 1)\pi_t = \beta \mathbb{E}_t \left(\frac{\frac{(n_{t+1})^\sigma}{w_{t+1}}}{\frac{(n_t)^\sigma}{w_t}} \right) \left((\pi_{t+1} - 1)\pi_{t+1} \frac{y_{t+1}}{y_t} \right) + \frac{\epsilon}{\chi} \left(mc_t - \frac{(1+\tau^s)(\epsilon - 1)}{\epsilon} \right) + e_{p_t} \tag{30}$$

$$\frac{c_t^{1-\phi}}{1-\phi} - \nu \frac{n_t^{1+\sigma}}{1+\sigma} \tag{31}$$

$$W_t = u_t + \beta W_{t+1} \tag{32}$$

Equilibrium conditions for consumption transfer setting: $\{\hat{c}_t, c_t, c_{fa_t}, \lambda_t, \mu_t, m_t, v_t, n_t, I_t, fa_t,$ $y_t, k_t, i_t, w_t, r_t, mc_t, \pi_t, z_t, x_t, GRI_t, u_t, W_t, b_t\}$

$$\hat{c_t}^{-\phi} \theta c_t^{\theta-1} {c_{fa_t}}^{1-\theta} = \lambda_t + \mu_t \tag{33}$$

$$\nu n_t^\sigma = \lambda_t w_t \tag{34}$$

$$\lambda_t = \beta \mathbb{E}_t \lambda_{t+1} \frac{1 + i_t}{\pi_{t+1}} \tag{35}$$

$$\lambda_t = \beta \mathbb{E}_t \lambda_{t+1} [r_{t+1} + (1 - \delta)] \tag{36}$$

$$\lambda_t = \beta \mathbb{E}_t \frac{\lambda_{t+1}}{\pi_{t+1}} + \mu_t \tag{37}$$

$$y_t = e^{z_t} k_t^\alpha n_t^{1-\alpha} \tag{38}$$

$$z_t = \rho_z z_{t-1} + e_{zt} \tag{39}$$

$$\hat{c_t} = c_t^\theta {c_{fa_t}}^{1-\theta} \tag{40}$$

$$r_t = \alpha mc_t \frac{y_t}{k_t} \tag{41}$$

$$w_t = (1 - \alpha) mc_t \frac{y_t}{n_t} \tag{42}$$

$$m_t - \frac{m_{t-1}}{\pi_t} + fa_t = c_{fa_t} + v_t \tag{43}$$

$$c_t = m_t + v_t \tag{44}$$

$$k_{t+1} = (1 - \delta) k_t + I_t \tag{45}$$

$$fa_t + y_t = c_t + c_{fa_t} + I_t + \frac{\chi}{2} (\pi_t - 1)^2 y_t \tag{46}$$

$$fa_t = c_{fa_t} \tag{47}$$

$$fa_t = x_t y_t \tag{48}$$

$$x_t = \bar{x} + \rho_x(x_{t-1} - \bar{x}) + e_{xt} \tag{49}$$

$$\ln\left(\frac{1+i_t}{1+\bar{i}}\right) = \rho_i \ln\left(\frac{1+i_{t-1}}{1+\bar{i}}\right) + (1-\rho_i)\left\{\rho_\pi \ln\left(\frac{1+\pi_t}{1+\overline{\pi}}\right) + \rho_y \ln\left(\frac{GRI_t}{\overline{RI}}\right)\right\} \tag{50}$$

$$GRI_t = \frac{(1+x_t)y_t}{(1+x_{t-1})y_{t-1}} \tag{51}$$

$$(\pi_t - 1)\pi_t = \beta \mathbb{E}_t \left(\frac{\frac{(n_{t+1})^\sigma}{w_{t+1}}}{\frac{(n_t)^\sigma}{w_t}}\right)\left((\pi_{t+1}-1)\pi_{t+1}\frac{y_{t+1}}{y_t}\right) + \frac{\epsilon}{\chi}\left(mc_t - \frac{(1+\tau^s)(\epsilon-1)}{\epsilon}\right) + e_{p_t} \tag{52}$$

$$u_t = \frac{\hat{c_t}^{1-\phi}}{1-\phi} - \nu\frac{n_t^{1+\sigma}}{1+\sigma} \tag{53}$$

$$W_t = u_t + \beta W_{t+1} \tag{54}$$

$$b_t = 0 \tag{55}$$

The difference between the two sets of equilibrium conditions roots in the inclusion of $b_t = 0$ in equilibrium conditions. Yet, with or without this condition, the results do not change. Because the market clearing conditions for the other markets except the bond market, by Walras's Law, indicate that the bond market has to clear as well. Hence, Walras's Law permits not to explicitly consider the bond market. On the other hand, although the bond market is taken into account by including FOC with respect to bond holdings, this approach does not allow to detect the equilibrium level of real bond holding of the household. Hence, exact conditions in wealth transfer setting do not include the last equation and the last variable in the list of the consumption transfer setting. Nevertheless, in both settings it is required that the sum of the bond holdings over households must be equal to zero. Since this is a representative agent problem[40] the condition for bond holding reduces to zero bond holding, which is the last condition in consumption transfer setting. In other words, presence of bonds in the economy facilitates providing the Fisher relationship to feed the economy as the nominal interest rate matters for calculations contrary to the level of bond holdings.

[40]Even if there were to be a continuum of households, they would be ex-ante and post identical as there is no aggregate risk or no heterogeneity among them.

Bibliography

Bibliography for Chapter 2

Akyol, A. (2004), "Optimal Monetary Policy in an Economy with Incomplete Markets and Idiosyncratic Risk", Journal of Monetary Economics, 51, 1245-69.

Albanesi, S. (2006), "Inflation and Inequality", Journal of Monetary Economics, 54, pp. 1088-1114.

Algan, Y. and Ragot, X. (2010), "Monetary Policy with Heterogeneous Agents and Borrowing Constraints", Review of Economic Dynamics, 13, 295-316.

Beetsma, R.M.W.J., Van Der Ploeg F. (1996), "Does Inequality Cause Inflation? The Political Economy of Inflation, Taxation and Government Debt", Public Choice (87), pp.143-62.

Bernanke B.S., and Mishkin. F. S. (1997), "Inflation Targetting: A New Framework for Monetary Policy?", NBER Working Paper No. 5893, January.

Bianchi, J. (2011), "Overborrowing and Systemic Externalities in the Business Cycle", American Economic Review, 101(7): 3400-3426.

Boel, P. and Camera, G. (2009), "Financial Sophistication and the Distribution of the Welfare Cost of Inflation", Journal of Monetary Economics, 56, 968-78.

Bullard, J. and Keating, J. (1995), "The Long-run Relationship Between Inflation and Output in Postwar Economies", Journal of Monetary Economics, vol. 36, 477-496.

Camera, C. and Chien, Y. (2014), "Understanding the Distributional Impact of Long-Run Inflation", Journal of Money, Credit and Banking, Vol. 46, No. 6 , September.

Campbell, J.Y. and Viceira, L.M. (2001), "Who Should Buy Long-Term Bonds?", American Economic Review 91:99-127.

Campbell J.Y., Sunderam A. and Viceira L.M. (2016), "Inflation Bets or Deflation Hedges? The Changing Risks of Nominal Bonds", Critical Finance Review. Forthcoming.

Chari, V.V., Christiano, L.J. and Kehoe P.J. (1996), "Optimality of the Friedman Rule in Economies with Distorting Taxes", Journal of Monetary Economics, 37(2), pp. 203-223.

Chari, V.V., Kehoe, P.J. and McGrattan, E. (2000), "Sticky Price Models of the Business Cycle: Can the Contract Multiplier Solve the Persistence Problem", Econometrica, 68(5), pages 1151-79.

Chiu, J. and Molico, M. (2010), "Liquidity, Redistribution, and the Welfare Cost of Inflation", Journal of Monetary Economics, 57, 428-38.

Crowe, C. (2006), "Inflation, Inequality, and Social Conflict", IMF Working Paper, WP/06/158, June.

Del-Rio, A. and Young, G. (2005), "The Determinants of Unsecured Borrowing: Evidence from the British Household Panel Survey", Bank of England Working Paper No. 263.

Desai R.J., Olofsgard, A. and Yousef, T.M. (2005), " Inflation and Inequality: Does Political Structure Matter?", Economics Letters, 87 : 41-46.

Doepke, M. and Schneider, M. (2006), "Inflation as a Redistribution Shock: Effects on Aggregates and Welfare", NBER Working Paper No. 12319, June.

Dolmas, J., Huffman, W. G. and Wynne, M. A. (2000), "Inequality, Inflation and Central Bank Independence", Canadian Journal of Economics, Vol. 33, No. 1, pp. 271-287.

Fafchamps, M. (2014), "Credit Constraints, Collateral and Lending to the Poor", Revue D'économie du Développement 22(HS01), January.

Camera, G. and Chien, Y. (2014), "Understanding the Distributional Impact of Long-Run Inflation", Journal of Money, Credit and Banking, Vol. 46, No. 6.

Iacoviello, M. (2005), "House Prices, Borrowing Constraints and Monetary Policy in the Business Cycle", American Economic Review, 95(3): 739-764.

Jappelli, T. (1990), "Who is Credit Constrained in the US Economy?", The Quarterly Journal of Economics, 219-234.

Kang, J. and Pflueger, C.E. (2015), "Inflation Risk in Corporate Bonds", The Journal of Finance, Volume 70, Issue 1, February, 115162.

Khan, M., Abdelhak, S. and Bruce S. (2006), "Inflation and Financial Depth", Macroeconomic Dynamics, 10(02), pp. 165-182.

Kiyotaki, N. and Moore, J. (1997), "Credit Cycles", Journal of Political Economy, 105(2), 211-248.

Korinek, A. (2009), "Excessive Dollar Borrowing in Emerging Markets: Balance Sheet Effects and Macroeconomic Externalities", Mimeo, University of Maryland. OR National Bureau of Economic Research (NBER) September 14, 2010.

Kremer, J., Lombardo, G. and Werner, T. (2003), "Money in a New Keynesian Model Estimated with German Data", Discussion Paper Series 1, Studies of the Economic Research Center No 15/2003, Deutsche Bundesbank.

Laibson D., Repetto A. and Tobacman J. (2003), "A Debt Puzzle", In: Aghion P., Frydman R., Stiglitz J., Woodford M. Knowledge, Information, and Expectations in Modern Economics: In Honor of Edmund S. Phelps. Princeton: Princeton University Press; p. 228-266.

Lucas, R. (2000), "Inflation and Welfare", Econometrica, 68(2), 247-274.

Mishkin. F. S. (1996), "Understanding Financial Crises: A Developing Country Perspective", NBER Working Paper No. 5600, May.

Molico, M. (2006), "The Distribution of Money and Prices in Search Equilibrium", International Economic Review, 47, 701-22.

Monacelli, T. (2006), "Optimal Monetary Policy with Collateralized Household Debt and Borrowing Constraints", NBER Working Paper No. 12470, August.

Pescatori, A. (2007), "Incomplete Markets and Households' Exposure to Interest Rate and Inflation Risk: Implications for the Monetary Policy Maker", Working Paper 07-09, Federal Reserve Bank of Cleveland.

Sheedy K. D. (2014), "Debt and Incomplete Financial Markets: A Case for Nominal GDP Targeting", Brookings Papers on Economic Activity, Spring, pp. 301-361.

Weil, P. (1991), "Is Money Net Wealth. International Economic Review", 32(1), pp. 37-53.

Wen, Y. (2010), "Liquidity Demand and Welfare in a Heterogeneous Agent Economy", Working Papers 2010-009, Federal Reserve Bank of St. Louis.

Zeldes, S.P. (1989), "Consumption and Liquidity Constraints: An Empirical Investigation", Journal of Political Economy, Vol. 97, No. 2, pp. 305-346, April.

Bibliography for Chapter 3

Abrigo, M.R.M. and Love, I. (2015), "Estimation of Panel Vector Autoregression in Stata: a Package of Programs", University of Hawaii, Department of Economics Working Paper Series, No. 16-2.

Acemoglu, D., Johnson, S. Querubin, P. and Robinson, J.A. (2008), "When Does Policy Reform Work? The Case of Central Bank Independence", NBER Working Paper No. 14033, May.

Adu, G. and Marbuah, G. (2011), "Determinants of Inflation in Ghana: An Empirical Investigation", South African Journal of Economics, Vol. 79:3, September.

Agénor, P.R. and Bayraktar, N. (2010), "Contracting models of the Phillips curve empirical estimates for middle-income countries", Journal of Macroeconomics, 32, PP. 555-570.

Albanesi, S. (2007), "Inflation and Inequality", Journal of Monetary Economics, Volume 54, Issue 4, pp. 1088-1114.

Alesina, A. and Tabellini, G. (1990), "A Positive Theory of Fiscal Deficit and Government Debt", Review of Economic Studies 57: 403-414.

Alkoum, A.O.A. and Agil, S.O.S (2013), "A Study of the Factors Influencing Inflationary Pressure in the Libyan Economy", Journal of Economics and Finance, Volume 1, Issue 6 (Nov. - Dec.), pp. 35-43.

Al-Marhubi, F. (1997), "A Note on the Link Between Income Inequality and Inflation", Economics Letters 55, 317-319.

Aisen, A. and Veiga, F.J. (2005), "Does Political Instability Lead to Higher Inflation? A Panel Data Analysis", IMF Working Paper, 05/49, March.

Andrews, D.W.K. and Lu, B. (2001), "Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models", Journal of Econometrics, Volume 101, Issue 1, March, pp. 123-164.

Arellano, M and Bover, O. (1995), "Another look at the instrumental variable estimation of error-components models", Journal of Econometrics, Vol. 68, Issue 1, 29-51.

Arellano, M., Honore, B. (2001), "Panel data models: some recent developments" In: Heckman J.J., Leamer E.E. (eds) Handbook of econometrics, Vol 5. North-Holland, Amsterdam.

Arnone, M., Laurens, B.J., Segalotto, J.F. and Sommer, M. (2007), "Central Bank Autonomy: Lessons from Global Trends", IMF Working Paper, 07/88.

Bhattacharya, R. (2013), "Inflation Dynamics and Monetary Policy Transmission in Vietnam and Emerging Asia", IMF Working Paper, 13/155, July.

Baldini, A. and Poplawski-Ribeiro, M. (2011), "Fiscal and Monetary Determinants of Inflation in Low-Income Countries: Theory and Evidence from Sub-Saharan Africa", Journal of African Economies, Volume 20 (3): 419-462.

Ball, L. and Mankiw, N.G. (1995), "Relative Price Changes as Aggregate Supply Shocks", Quarterly Journal of Economics, 161-194, February.

Bailliu, J., Garces, D., Kruger, M. and Messmacher, M. (2003), "Explaining and Forecasting Inflation in Emerging Markets: The Case of Mexico", Bank of Canada Working Paper 2003-17, June.

Barnichon, R. and Peiris, S.J. (2007), "Sources of Inflation in Sub-Saharan Africa", IMF Working Paper, 07/32, February.

Beetsma, R.M.V. and Van Der Ploeg, F. (1996), "Does Inequality Cause Inflation? The Political Economy of Inflation, Taxation and Government Debt", Public Choice 87, 143-162.

Bernanke, B. S. (2005), "Inflation in Latin America - A New Era?", Paper presented at the Stanford Institute for Economic Policy Research Economic Summit, Stanford, California, February 11, 2005.

Blavy, R. (2004), "Inflation and Monetary Pass-Through in Guinea", IMF Working Paper, 04/223, December.

Bonato, L. (2007), "Money and Inflation in the Islamic Republic of Iran", IMF Working Paper, 07/119, May.

Borio, C. and Filardo, A. (2007), "Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation", BIS Working Papers, No 227, May.

Bulir, A. (2001), "Income inequality: Does inflation matter?", International Monetary Fund Staff Paper, 48(1).

Caceres, C., Poplawski-Ribeiro, M. and Tartari, D. (2011), "Inflation Dynamics in the CEMAC Region", IMF Working Paper, 11/232, October.

Canova, F. and Ciccarelli, M. (2013), "Panel Vector Autoregressive Models: A Survey", Working Paper Series 1507, European Central Bank.

Capistrán, C. and Ramos-Francia, M. (2006), "Inflation Dynamics in Latin America", Banco de México, The Working Papers, No: 2006-11.

Catão, L. and Terrones, M. (2001), "Fiscal Deficit and Inflation: A New Look at Emerging Market Evidence", IMF Working Paper, 01/74, May.

Cheng, M.Y. and Tan, H.B. (2002), "Inflation in Malaysia", International Journal of Social Economics, Vol.29, Issue 5, pp. 411-425.

Coe, D.T. and McDermott, C.J. (1997), "Does the Gap Model Work in Asia?", IMF Staff Papers, Vol. 44, No. 1, March.

Coibion, O., Gorodnichenko, Y., Kueng, L. and Silvia, J. (2012), "Innocent Bystanders? Monetary Policy and Inequality in the U.S.", NBER Working Paper Series, No: 18170.

Corey, Mecagni and Offerdal (1996), "Disinflation in Transition Economies: The Role of Relative Price Adjustment", IMF Working Paper, 96/138, December.

Crowley, J. (2010), "Commodity Prices and Inflation in the Middle East, North Africa, and Central Asia", IMF Working Paper, 10/135, June.

Cukierman, A. (1992), "Central Bank Strategy, Credibility and Independence: Theory and Evidence", The MIT Press.

Cukierman, A., Webb, S.B. and Neyapti, B. (1992), "Measuring the Independence of Central Banks and Its Effect on Policy Outcomes", The World Bank Economic Review, Vol. 6, No. 3, Sep., pp. 353-398.

D'Amato, L. and Garegnani, M.L. (2009), "Studying the Short-Run Dynamics of Inflation: Estimating a Hybrid New-Keynesian Phillips Curve for Argentina (1993-2007)", BCRA (Central Bank of Argentina), The Working Papers Series, 2009 — 40.

Debelle, G. and Fischer, S. (1994), "How Independent Should a Central Bank Be?", Mimeo, MIT, May.

Desai, R., Olofsgard, A. and Yousef, T. (2003), "Democracy, Inequality, and Inflation", The American Political Science Review, Vol. 97, No. 3, Aug., pp. 391-406.

Desai, R., Olofsgard, A. and Yousef, T. (2005), "Inflation and Inequality: Does Political Structure Matter?", Economics Letters 87, 41-46.

Diouf, M.A. (2007), "Modeling Inflation for Mali", IMF Working Paper, 07/295, December.

Dolmas, J., Huffman, G.W. and Wynne, M.A. (2000), "Inequality, Inflation, and Central Bank Independence", The Canadian Journal of Economics / Revue canadienne d'Economique, Vol. 33, No.1, Feb., pp. 271-287.

Domaç, I. and Yücel, E.M. (2005), "What Triggers Inflation in Emerging Market Economies?", Review of World Economics, April, Volume 141, Issue 1, pp. 141164 OR World Bank Research Working Paper 3376, August 2004.

Duma, N. (2008), "Pass-Through of External Shocks to Inflation in Sri Lanka", IMF Working Paper, 08/78, March.

Durevall, D. and Sjö, B. (2012), "The Dynamics of Inflation in Ethiopia and Kenya", African Development Bank Group, Working Paper No. 151, August.

Durevall, Dick, Josef L. Loening, and Yohannes Ayalew Birru. 2013. "Inflation dynamics and food prices in Ethiopia." Journal of Development Economics 104, pp. 89-106.

European Central Bank (2008). Monthly Bulletin September 2008, European Central Bank.

Fanizza, D. and Söderling, L. (2006), "Fiscal Determinants of Inflation: A Primer for the Middle East and North Africa", IMF Working Paper, 06/216, October.

Fischer, S. (1995), "Central Bank Independence Revisited", The American Economic Review Papers and Proceedings, May, 201-206.

Fischer, S., Sahay, R. and Vegh, C.A. (1998), "From Transition to Market: Evidence and Growth Prospects", IMF Working Paper, 98/52, April.

Fischer, S., Sahay, R. and Vegh, C. (2002), "Modern Hyper- and High inflations", Journal of Economic Literature, Vol. 40, No. 3 September, pp. 837-80.

Galli,R. and Hoeven, R.V.D. (2001), "Is inflation bad for income inequality : the importance of the initial rate of inflation", International Labour Organization, Employment Paper 29.

Garriga, A.C. (2016), "Central Bank Independence in the World: A New Dataset", International Interactions, 42 (5):849-868.

Goldthorpe, J.H. (1978), "The Current Inflation: Toward a Sociological Account", In The Political Economy of Inflation, ed. Fred Hirsch and John H. Goldthorpe, pp. 186-213. London: Martin Robertson.

Gottschalk, J., Kalonji, K. and Miyajima, K. (2008), "Analyzing Determinants of Inflation When There Are Data Limitation: The Case of Sierra Leone", IMF Working Paper, 08/271, December.

Grigorian, D., Khachatryan, A. and Sargsyan, G. (2004), "Exchange Rate, Money, And Wages: What Is Driving Prices In Armenia?", IMF Working Paper, 04/229, December.

Grauwe, P. D. and Polan, M. (2005), "Is Inflation always and everywhere a monetary phenomenon?", Scandinavian Journal of Economics, 107, 239-259.

Grilli, V., Masciandaro, D. and Tabellini, G. (1991), "Institutions and Policies", Economic Policy, October, 365-392.

Gutierrez, E. (2003), "Inflation Performance and Constitutional Central Bank Independence: Evidence from Latin America and the Caribbean," IMF Working Paper, 03/53.

Habermeier, K., Ötker-Robe, I., Jacome, L., Giustiniani, A., Ishi, K., Vávra, D., Kışınbay, T. and Vazquez, F. (2009), "Inflation Pressures and Monetary Policy Options in Emerging and Developing Countries-A Cross Regional Perspective", IMF Working Paper, 09/1, January.

Hoggarth, G. (1996), "Monetary Policy in Russia", In Jouko Rautava, Ed., Russia's Financial Markets and the Banking Sector in Transition, Bank of Finland Studies A:95, pp. 53-83, Helsinki.

Ilzetzki, E., Reinhart, C.M. and Rogoff, K.S. (2010) "Exchange Rate Arrangements Entering the 21st Century: Which Anchor Will Hold?"

IMF (1996), "The Rise and Fall of Inflation: Lessons from the Postwar Experience", World Economic Outlook, October, Chapter VI. Washington, D.C.: International Monetary Fund.

IMF (2001), "The Decline of Inflation in Emerging Markets: Can it be Maintained?", World Economic Outlook, May, Chapter IV. Washington, D.C.: International Monetary Fund.

IMF (2003), "Public Debt in Emerging Markets: Is It Too High?" World Economic Outlook , September, Chapter 3.

IMF (2008). World Economic Outlook, October, Washington, D.C.: International Monetary Fund.

Islam, N. (1995), "Growth empirics: A panel data approach", Quarterly Journal of Economics 110, 1127-1170.

Judson, R.A. and Owen, A.L. (1999), "Estimating dynamic panel data models: A guide for macroeconomists", Economics Letters, 65(1), 9-15.

Juthathip, J. and Park, D. (2009), "Inflation in Developing Asia", Journal of Asian Economics, 20, 507-518.

Khan, M.S. and Schimmelpfennig, A. (2006), "Inflation in Pakistan: Money or Wheat?", IMF Working Paper, 06/60, March.

Khan, R.E.A. and Gill, A.R. (2010), "Determinants of Inflation: A Case of Pakistan (1970-2007)", Journal of Economics, 1(1), 45 -51.

Kinda, T. (2011), "Modeling Inflation in Chad", IMF Working Paper, 11/57, March.

Klein, N. and Kyei, A. (2009), "Understanding Inflation Inertia in Angola", IMF Working Paper, 09/98, May.

Koen, V. and Marrese, M. (1995), "Stabilization and Structural Change in Russia, 1992-94", IMF Working Paper, 95/13, January.

Korhonen, I. (1998), "An Error-Correction Model of Prices, Money, Output and Interest Rate in Russia", Rev. Econ. Trans. 5, 33-44.

Kutan, A.M., and Brada J.C. (1999), "The End of Moderate Inflation in Three Transition Economies?" Working Paper no. 1999-03A, Federal Reserve Bank of St.

Kwon, G., McFarlane, L. and Robinson, W. (2006), "Public Debt, Money Supply, and Inflation: A Cross-Country Study and Its Application to Jamaica", IMF Working Paper, 06/121, May.

Laurens, B.J., Arnoane, M. and Segalotto, J.F. (2009), "Central Bank Independence, Accountability and Transparency - A Global Perspective", International Monetary Fund, 2009.

Lim, C.H. and Papi, L. (1997), "An Econometric Analysis of the Determinants of Inflation in Turkey", IMF Working Paper, 97/170, December.

Lissovolik, B. (2003), "Determinants of Inflation in a Transition Economy: The Case of Ukraine", IMF Working Paper, 03/126, June.

Loungani, P. and Sheets, N. (1997), "Central Bank Independence, Inflation, and Growth in Transition Economies", Journal of Money, Credit and Banking, Vol. 29, No. 3, Aug., pp. 381-399.

Loungani, P. and Swagel, P. (2001), "Sources of Inflation in Developing Countries", IMF Working Paper, 01/198, December.

Love, I. and Zicchino, L. (2006), "Financial development and dynamic investment behavior: Evidence from panel VAR", The Quarterly Review of Economics and Finance, 46(2), 190-210.

Mishkin, F. (2007), "Monetary policy strategy", MIT Press.

Mohanty, D. and John, J. (2015), "Determinants of inflation in India", Journal of Asian Economics 36, 86-96.

Mohanty, M.S. and Klau, M. (2001), "What Determines Inflation in Emerging Market Countries?", BIS Papers No. 8: Modeling Aspects of the Inflation Process and Monetary Transmission Mechanism in Emerging Market Countries.

Monfort, B. and Peña, S. (2008), "Inflation Determinants in Paraguay: Cost Push versus Demand Pull Factors", IMF Working Paper, 08/270, December.

Montiel, P. (1989), "Empirical Analysis of High-Inflation Episodes in Argentina, Brazil and Israel", IMF Staff Papers, Vol.36, No. 3 (September), 527-249.

Moser, G.G. (1995), "The Main Determinants of Inflation in Nigeria", IMF Staff Papers, Vol.42, No. 2 (June), 270-289.

Nassar, K. (2005), "Money Demand and Inflation in Madagascar", IMF Working Paper, 05/236, December.

Nickell, S. (1981), "Biases in Dynamic Models with Fixed Effects", Econometrica, Vol. 49, 1399-1416.

Nikolic, M. (2000), "Money Growth-Inflation Relationship in Postcommunist Russia", Journal of Comparative Economics 28, 108-133.

Nguyen, A.D.M, Dridi, J., Unsal, D.F. and Williams, O.H. (2015), "On the Drivers of Inflation in Sub-Saharan Africa", IMF Working Paper, 15/189, August.

Oladipo, O.S., Ntoko, A. and Forrester, W. (2013), "Sources of Inflation in Developing Countries: Evidence from some West African Countries", Advances in Management and Applied Economics, vol.3, no.2, pp. 83-102.

Osorio, C. and Unsal, D.F. (2011), "Inflation Dynamics in Asia: Causes, Changes, and Spillovers from China", IMF Working Paper, 11/257, November.

Parker, M. (2017), "Global inflation: the role of food, housing and energy prices", European Central Bank, Working Paper Series, No:2024, February.

Patnaik, A. (2010), "Study of Inflation in India: a Cointegrated Vector Autoregressive Approach", Journal of Quantitative Economics, Vol. 8 No.1, January.

Pavlavani, M. and Rahimi, M. (2009), "Sources of Inflation in Iran:An Application of ARDL Approach", International Journal of Applied Econometrics and Quantitative Studies, Vol.6-1.

Pesaran, M.H. (2007), "A simple panel unit root test in the presence of cross-section dependence", Journal of Applied Econometrics, 22(2), 265-312.

Reinhart, C.M. and Rogoff, K.S. (2010), "From Financial Crash to Debt Crisis", NBER Working Paper No. 15795, March.

Roemer, J. (1995), "On the Relationship between Economic Development and Political Democracy", In Democracy and Development, ed. Amiya Kumar Bagchi, pp. 28-55. New York: St. Martin's Press.

Ross, K.L. (2000), "Post Stabilization Inflation Dynamics in Slovenia", Applied Economics 32, no.2:135-150.

Sargent, T.J. and Wallace, N. (1981), "Some Unpleasant Monetarist Arithmetic", Federal Reserve Bank of Minneapolis Quarterly Review, Vol. 5, pp. 1-17.

Siliverstovs, B. and Bilan, O. (2005), "Modeling Inflation Dynamics in Transition Economies: the Case of Ukraine", Eastern European Economics, vol. 43, no. 6, November-December, pp. 66-8 1.

Simpasa, A., Gurara, D., Shimeles, A., Vencatachellum, D. and Ncube, M. (2011), "Inflation dynamics in selected East African countries: Ethiopia, Kenya, Tanzania and Uganda." AfDB Policy Brief.

Solt, F. (2016), "The Standardized World Income Inequality Database" Social Science Quarterly 97(5). SWIID Version 5.1, July.

Thorton, J. (2008), "Money, Output and Inflation in African Economies", South African Journal of Economics, Vol. 76:3, September.

Ubide, A. (1997), "Determinants of Inflation in Mozambique", IMF Working Paper, 97/145, October.

Williams, O. and Adedeji, O.S. (2004), "Inflation Dynamics in the Dominican Republic", IMF Working Paper, 04/29, February.

Wolde-Rufael, Y. (2008), "Budget Deficits, Money and Inflation: The Case of Ethiopia", The Journal of Developing Areas, Vol. 42, No. 1 (Fall), pp. 183-199.

Woodford, M. (1998), "Public Debt and the Price Level", June 18-19 (unpublished; prepared for the Bank of England Conference on Government Debt and Monetary Policy).

Ziliak, J.P. (1997), "Efficient estimation with panel data when instruments are predetermined: An empirical comparison of moment-condition estimators", Journal of Business and Economic Statistics, 15, 419-431.

Bibliography for Chapter 4

Adam, C.S. and Bevan, D.L. (2003), "Aid, Public Expenditure and Dutch Disease", Centre for the Study of African Economies, CSAE WPS/2003-02.

Adam, K. and Woodford, M. (2013), "Housing Prices and Robustly Optimal Monetary Policy", Working paper, Columbia University.

Agenor, R., Bayraktar, N. and Aynaoui, K.E. (2008), "Roads out of Poverty? Assessing the links between Aid, Public Investment, Growth, and Poverty Reduction", Journal of Development Economics, 86(2), 277-295.

Agenor, R., and Montiel, P. (1999), "Development Macroeconomic", 2nd edition.

Aguiar, M. and Gopinath, G. (2007), "Emerging Market Business Cycles: The Cycle Is the Trend", Journal of Political Economy, Vol. 115, pp. 69-102.

Anand, R. Prasad, E. and Zhang, B. (2015), "What Measure of Inflation Should a Developing Central Bank Target?", IMF Working Paper, WP/15/205, September.

Annen, K., Batu, M. and Kosempel, S. (2016), "Macroeconomic effects of foreign aid and remittances: Implications for aid effectiveness studies", Journal of Policy Modeling, 38, 1136-1146.

Annen, K. and Kosempel, S. (2009), "Foreign Aid, Donor Fragmentation, and Economic Growth", The B.E. Journal of Macroeconomics, Volume 9, Issue 1, Article 33.

Annen, K. and Kosempel, S. (2012), "On the Effectiveness of Foreign Aid: A DSGE Approach", unpublished.

Aoki, K. Benigno, B. and Kiyotaki, N. (2016), "Monetary and Financial Policies in Emerging Markets", Working Paper, unpublished.

Arellano, C.A,. Bulir, Lane, T.D. and Lipschitz, L.J. (2005), "The Dynamic Implications of Foreign Aid and Its Variability", IMF Working Paper 05/119.

Arndt, C., Jones, S. and Tarp, F. (2011), "Aid Effectiveness: Opening the Black Box", UNU-WIDER Working Paper No. 2011/44.

Asem, E. and Gupta, K.L. (1999), "Foreign Aid: New Perspectives", Springer, Chapter 3.

Berg, A., Mirzoev, T., Portillo, R. and Zanna, L. (2010), "The short-run macroeconomics of aid inflows: understanding the interaction of fiscal and reserve policy", IMF Working Paper, WP/10/65.

Berg, A., Portillo, R., Yang, S.S. and Zanna, L. (2012), "Public Investment in Resource-Abundant Developing Countries", IMF Working Paper, November.

Berg, A., Portillo, R. and Zanna, L. (2014), "Policy Responses to Aid Surges in Countries with Limited International Capital Mobility: The Role of the Exchange Rate Regime", IMF Working Paper, WP/14/18, January.

Bhattacharya, R. and Patnaik, I. (2016) "Financial Inclusion, Productivity Shocks, and Consumption Volatility in Emerging Economies", World Bank Economic Review Volume 30, Issue 1, January, 171 - 201.

Blanchard, O. and Galí, J. (2007), "Real Wage Rigidities and the New Keynesian Model", Journal of Money, Credit and Banking, 39: 35-65.

Buffie, E., Adam, C., O'Connell, S. and Pattillo, C. (2004), "Exchange Rate Policy and the Management of Official and Private Capital Flows in Africa", IMF Working Paper, WP/04/216, November.

Burnside, C. and Dollar, D. (2000), "Aid, Policies and Growth", American Economic Review 90(4): 847-868.

Calvo, G. (1983), "Staggered Prices in a Utility Maximizing Framework", Journal of Monetary Economics, 12, 383-398.

Caselli, F. and Feyrer, J. (2007), "The Marginal Product of Capital", Quarterly Journal of Economics, Volume 122, Issue 2, May, Pages 535-568.

Carlstrom, C., Fuerst, T. and Paustian. M. (2010), "Optimal Monetary Policy in a Model with Agency Costs", Journal of Money, Credit, and Banking 42(6), 37-68.

Cavallo, A. (2012), "Scrapped Data and Sticky Prices", MIT Sloan Research Paper Number 4976-12.

Caplin, A. and Leahy, J. (1991), "State-Dependent Pricing and the Dynamics of Money and Output", Quarterly Journal of Economics, CVI, 683-708.

Chatterjee, S., Giuliano, P. and Kaya, I. (2012), "Where Has All the Money Gone? Foreign Aid and the Composition of Government Spending", The B.E. Journal of Macroeconomics, Volume 12, Issue 1, Article 26.

Chatterjee, S. and Turnovsky, S.J. (2005), "Financing Public Investment through Foreign Aid: Consequences for Economics Growth and Welfare", Review of International Economics, 13(1), 20-44.

Chatterjee, S. and Turnovsky, S.J. (2007), "Foreign Aid and Economic Growth: The Role of Flexible Labor Supply", Journal of Development Economics, 84, 507-533.

Choudhary, M.A., Faheem, A., Hanif, M.N., Naeem, S. and Pasha, F. (2016), "Price setting & price stickiness: A developing economy perspective", Journal of Macroeconomics 48, 44-61.

Clarida, R., Galí, J. and Gertler, M. (1999), "The science of monetary policy: A new Keynesian perspective", Journal of Economic Literature 37 (4): 1661-1707.

Clarida, R., Galí, J. and Gertler, M. (2000), "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory", Quarterly Journal of Economics, 115 (1): 147-80.

Coibion, O. and Gorodnichenko Y. (2011), "Strategic Complementarity among Heterogeneous Price-Setters in an Estimated DSGE Model", Review of Economics and Statistics 92(1), 87-101.

De Haan, E. (2009), "Aid: The Drama, the Fiction, and does It Work?" ISS Working Paper 488. The Hague: Institute of Social Studies.

Devereux, M.B., Lane, P.R. and Xu, J. (2006), "Exchange Rates and Monetary Policy in Emerging Market Economies", Economic Journal, Vol. 116, No. 511, pp. 478-506.

Dixit, A.K. and Stiglitz, J.E. (1977), "Monopolistic competition and optimum product diversity", American Economic Review 67, pp.297-308.

Dotsey, M., King, R.G. and Wolman, A.L. (1999), "State-Dependent Pricing and the General Equilibrium Dynamics of Money and Output", The Quarterly Journal of Economics, Vol. 114, No.2, May, pp. 655-690.

Easterly, W., R. Levine, and Roodman, D. (2004), "Aid, Policies, and Growth: Comment", American Economic Review, Vol. 94, No. 3, pp. 774-80.

Erceg, C.J., Henderson, D.W. and Levin, A.T. (2000), "Optimal monetary policy with staggered wage and price contracts", Journal of Monetary Economics,vol. 46, no 2, 281-313.

Feltrin Jr, C. and Guimaraes, B. (2014), "Time-dependent or state-dependent pricing? Evidence from a large devaluation episode", RAEP, Rede de Economia Aplicada, Working Paper 68, July.

Fernandez-Villaverde, J. (2010), "The Econometrics of DSGE Models", Journal of the Spanish Economic Association (1), 3-49.

Fisher, S. (1994), "Modern Central Banking", Forrest Capie (et al.) The Future of Central Banking. Cambridge: Cambridge University Press. Pp. 262308.

Gábriel, P. and Reiff, Á. (2010), "Price Setting in Hungary-A Store-Level Analysis", Managerial and Decision Economics, 31: 161-176.

Gagnon, E. (2009), "Price setting during low and high inflation: Evidence from Mexico", Quarterly Journal of Economics, 124: 1221-63.

Gali, J. (2002), "New Perspectives on Monetary Policy, Inflation, and the Business Cycle", Working Paper 8767. Cambridge: National Bureau of Economic Research, February.

Gali, J., Lopez-Salido, D.J. and Valles, J. (2004), "Rule-of-Thumb Consumers and The Design Of Interest Rate Rules", Journal of Money, Credit and Banking, Vol. 36, No. 4, pp. 739-763.

Garín, J., Lester, R. and Sims, E. (2015), "On the Desirability of Nominal GDP Targeting", NBER Working Paper No. 21420, July.

García-Cicco, J., Pancrazi, R. and Uribe, M. (2010), "Real Business Cycles in Emerging Countries?" American Economic Review, Vol. 100, No. 5, pp. 2510-31.

Gilchrist, S. and Leahy, J. (2002), "Monetary Policy and Asset Prices", Journal of Monetary Economics 49, 75-97.

Gollin, D. (2002), "Getting Income Shares Right", Journal of Political Economy, Vol. 110, pp. 458-74.

Golosov, M. and Lucas, R. (2007), "Menu Costs and Phillips Curves", Journal of Political Economy, 115(2).

Hussain, M., Berg, A. and Aiyar, A. (2009), "The macroeconomic management of increased aid: policy lessons from recent experience", Review of Development Economics, 13(3):491-509.

Ireland, P. (2004), "Technology Shocks in the New Keynesian Model", Review of Economics and Statistics 86(4), 923-936.

Leith, C. and Liu, D. (2016), "The inflation bias under Calvo and Rotemberg pricing", Journal of Economic Dynamics and Control, 73: 283-297.

Kim, J. and Kim, S. (2003) "Spurious Welfare Reversals in International Business Cycle Models", Journal of International Economics 60: 471-500.

Kovanen, A. (2006), "Why Do Prices in Sierra Leone Change So Often? A Case Study Using Micro-level Price Data", WP/06/53, February.

Kraay, A., and Raddatz, C. (2006), "Poverty Traps, Aid and Growth", Journal of Development Economics, Volume 82, Issue 2, March, Pages 315-347.

Michaely, M. (1981), "Foreign aid, economic structure and dependence", Journal of Development Economics 9, 313-330.

Mohanty, M.S. and Klau, M. (2005), "Monetary Policy Rules in Emerging Market Economies: Issues and Evidence", in Monetary Policy and Macroeconomic Stabilization in Latin America, eds. Rolf Langhammer and Lucio Vinhas de Souza (Springer), pp. 205-245.

Mwabutwa, C. Bittencourt, M. and Viegi, N. (2013), "Monetary Policy Response to Foreign Aid in an Estimated DSGE Model of Malawi", Economic Research South Africa, ERSA Working Paper 350, May.

Pallage, S. and Robe, M. A. (2003), "On the Welfare Costs of Economic Fluctuations in Developing Countries", International Economic Review, Vol. 44, No. 2, pp. 677-98.

Prasad, E. and Zhang, B. (2015), "Distributional Effects of Monetary Policy in Emerging Market Economies", IZA DP No. 9272, August.

Prati, A., and Tressel, T. (2006), "Aid Volatility and Dutch Disease : Is There a Role for Macroeconomic Policies?", IMF Working Paper No. 06/145, June.

Prescott, E. (1986), "Theory Ahead of Measurement", Federal Reserve Bank of Minneapolis Quarterly Review, Fall: 9-22.

Rajan, R. and Subramanian, A. (2005), "What Undermine Aid's Impact on Growth?" Cambridge, MA: NBER Working Paper 11657.

Rotemberg, J.J. (1982), "Sticky Prices in the United States", Journal of Political Economy, Vol. 90, No. December, pp. 1187-1211.

Rotemberg, J.J. and Woodford, M. (1997), "An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy", in NBER Macroeconomics Annual, Vol. 12, eds. Ben S. Bernanke and Julio J. Rotemberg (Cambridge, MA: MIT Press), pp. 297-346.

Schmitt-Grohé, S. and Uribe, M. (2007), "Optimal simple and implementable monetary and fiscal rules", Journal of Monetary Economics, Volume 54, Issue 6, September, 1702-1725.

Shen, W. Yang, S.S. and Zanna,L. (2015), "Government Spending Effects in Low-Income Countries", IMF Working Paper, WP/15/286, December.

Sims. E. (2013), "Growth or the Gap? Which Measure of Economic Activity Should be Targeted in Interest Rate Rules?", unpublished.

Smets, F. and Wouters, R. (2002), "An Estimated Stochastic Dynamic General Equilibrium Model of the Euro Area", European Central Bank, May.

Steinsson, J. (2002), "Optimal Monetary Policy in an Economy with Inflation Persistence", Cambridge: Harvard University, May.

Svensson, L.E.O. (1997/98), "Monetary Policy and Inflation Targeting", NBER Reporter: Pp. 5-8.

Taylor, J.B. (1980), "Aggregate Dynamics and Staggered Contracts", Journal of Political Economy, 88, 1-23.

Taylor, J.B. (1993), "Discretion versus Policy Rules in Practice", Carnegie-Rochester Conference Series on Public Policy, Vol. 39 December, pp. 195-214.

Van Wijnbergen, S. (1986), "Macroeconomic aspects of the effectiveness of foreign aid: On the two-gap model, home goods disequilibrium and real exchange rate misalignment", Journal of International Economics 21,123-136.

Woodford, M. (2001), "Inflation stabilisation and welfare", NBER Working Paper Series 8071.

Curriculum Vitae

Dila Asfuroglu

PERSONAL DATA

Place and Date of Birth:	Istanbul | 24 January 1988
Address:	Albertus-Magnus-Platz 50923 Cologne, Germany
E-mail:	asfuroglu@wiso.uni-koeln.de

POSITIONS HELD

2017-2018	Economics Tutor at Boston Education Economics for the IB Diploma
06-08.2016	Instructor at Bogazici University, Summer School EC 205 Macroeconomics I
06-08.2015	Instructor at Istanbul Bilgi University, Summer School EC 214 Macroeconomics II
2014-2018	Scientific Assistant at Center for Macroeconomic Research (CMR) Advanced Monetary Theory; grad. level International Macroeconomics; grad. level Macroeconomics, Demographics and Health (Seminar); undergrad. level
2014-	Referee at Economics Bulletin

EDUCATION

2013-2018	University of Cologne, Cologne Graduate School (CGS) PhD (Magna cum laude)
2011-2013	Bogazici University MA in Economics (Honors)
2008-2011	London School of Economics and Political Science BSc in Economics and Management (Merit) | International Programme
2006-2011	Istanbul Bilgi University BSc in Economics and Management Honors Programme (High Honors)
2002-2006	Istanbul Anadolu High School
1995-2005	Istanbul University State Conservatory Classical Ballet

FIELDS OF INTEREST

Macroeconomics, Monetary Policy, Growth and Development, Informal Sector, Political Economy

PUBLICATION

Asfuroglu, D. and Elgin, C. 2016. Growth Effects of Inflation under the Presence of Informality. (lead article) Bulletin of Economic Research, 68 (4), 311-328.

PRESENTATIONS

2017	12th BiGSEM Doctoral Workshop on Economic Theory
2017	5th International PhD Meeting in Economics 2017
2017	17th SAET Conference on Current Trends in Economics
2013-2018	CMR Lunch Seminars
2013	EBRD/INET Young Scholars Meeting
2011-2013	Bogazici University Departmental Seminars

WORKSHOPS AND SEMINARS

2017	REStud Tour 2017 in Bonn/Cologne
2015	University Teaching Johns Hopkins University
2013-2018	CMR Research Seminars
2013-2018	CGS Research Seminars
2014	Cologne Workshop on Macroeconomics
2014	Barcelona Political Economy Summer School Barcelona GSE
2013	EBRD/INET Young Scholars Meeting
2011-2013	Bogazici University Departmental Seminars

LANGUAGE AND COMPUTER SKILLS

Turkish (native), English (fluent), Russian (intermediate), German (intermediate)

Stata, EViews, Matlab, Dynare, Microsoft Office

HONORS AND AWARDS

Top scoring student of the faculty and the department in Bachelor

Second highest ranked student of the Bachelor's degree

2016-2017	Center for Macroeconomic Research Doctoral scholarship

2013-2016 | Cologne Graduate School
Doctoral scholarship

2013-2018 | Cologne Graduate School
Doctoral fellowship

2011-2013 | The Scientific and Technological Research Council of Turkey (TUBITAK)
National Scholarship Program for MA/MSc Students

2008-2011 | London School of Economics and Political Science
Honors Programme Tuition Waiver

2006-2011 | Istanbul Bilgi University & Measuring, Selection and Placement Center, Turkey (OSYM)
Undergraduate Tuition Waiver

REFERENCES

Andreas Schabert | University of Cologne
Professor, Executive Director of CMR
schabert@wiso.uni-koeln.de , +49 221 470 2483

Ceyhun Elgin | Bogazici University
Associate Professor, Vice Chair
ceyhun.elgin@boun.edu.tr , +90 212 359 7653

Fatma Didin Sonmez | Istanbul Bilgi University
Assistant Professor, Coordinator of Honors Programmes
fatma.didin@bilgi.edu.tr , +90 212 311 5433