

IMPLICATIONS OF GLOBAL FINANCIAL CRISIS ON  
INFLATION TARGETING FRAMEWORK

A Master's Thesis

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*To My Family*

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TARGETING FRAMEWORK

The Institute of Economics and Social Sciences  
of  
İhsan Doğramacı Bilkent University

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in

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## ABSTRACT

# IMPLICATIONS OF GLOBAL FINANCIAL CRISIS ON INFLATION TARGETING FRAMEWORK

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Aside from its devastating effects on global economy, global financial crisis has also shaken the mainstream economic theory. After the crisis, policies implemented by governments and Central Banks, issues of financial stability, impacts of international capital flows and exchange rates have become the center of macroeconomic research. This thesis examines the impact of global financial crisis on the IT framework. The aim is to discuss the imperfections and defections in the framework and propose extensions. In this context, a small open economy DSGE model, calibrated for Turkey during 2003-2012 is proposed. The base model is extended to capture dynamics of Turkish economy better. Since, trade and credit channels of transmission mechanism of crisis are the most powerful channels for the contagion of the crisis to Turkish economy, inclusion of net international investment position (to the problems of households and entrepreneurs) and imported capital good (to the production function) strengthen the explanatory power of the model considerably. Moreover, to address whether allowing Central Bank to respond exchange rates yields gains in terms of output and inflation stabilization, an augmented Taylor rule which incorporates exchange rates is constructed. Responses under the

benchmark model where Central Bank uses a traditional Taylor rule and an augmented Taylor rule are obtained. To provide a reference in interpreting the findings of the model, a Vector Auto Regression analysis is performed with interest rates, inflation, output level and exchange rates as endogenous variables. Finally, results of the model experiments and VAR are compared. The results indicate that, the model with the augmented Taylor rule can help to smooth business cycle fluctuations more effectively than conventional Taylor rule but, in some cases, Central Bank may encounter with a tradeoff between output gap and inflation.

Keywords: Global Financial Crisis, Inflation Targeting, Taylor Rule, International Capital Flows, Exchange Rates

## ÖZET

# KÜRESEL FİNANSAL KRİZİN ENFLASYON HEDEFLEME REJİMİ ÜZERİNE ETKİLERİ

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Küresel finansal krizin yıkıcı etkisi sadece küresel ekonomiler üzerinde olmamıştır. Aynı zamanda, hakim ekonomik anlayış da temellerinden sarsılmıştır. Krizden sonra hükümetler ve Merkez Bankaları tarafından uygulanan politikalar eleştiri oklarının hedefi haline gelmiş; makro ekonomik araştırmalar, finansal istikrar, uluslararası sermaye hareketleri ve döviz kuru oynaklıklarının etkileri üzerinde yoğunlaşmıştır. Bu tezde, küresel ekonomik krizin enflasyon hedeflemesi rejimi üzerindeki etkileri incelenmektedir. Amaç, enflasyon hedefleme rejiminin eksikliklerini tartışmak ve rejimi geliştirme önerileri sunmaktır. Bu çerçevede, 2003-2012 yılları arası Türkiye ekonomisi için kalibre edilmiş bir küçük açık ekonomi Dinamik Stokastik Genel Denge modeli kurulmuştur. Baz alınan modele, Türkiye ekonomisi dinamiklerini daha iyi yansıtmaları için, uluslararası net yatırım pozisyonu (hane halkı ve girişimcinin optimizasyon problemlerine) ve dış sermaye malı ithalatı (üretim fonksiyonuna) eklenmiştir. Krizin Türkiye ekonomisine yayılma sürecinde en etkili kanalların dış ticaret ve kredi kanalları olduğu saptandığından, yapılan eklemelerin, modelin açıklayıcı gücünü büyük ölçüde arttırdığı gözlenmiştir.



Buna ek olarak, Merkez Bankasının döviz kuru hareketlerine de karşılık vermesi durumunda üretim ve enflasyon stabilizasyonunda fayda sağlanıp sağlanmayacağını incelemek amacıyla, döviz kurlarının da dahil edildiği bir genişletilmiş Taylor kuralı kurulmuştur. Merkez Bankasının geleneksel Taylor kuralı ve genişletilmiş Taylor kuralı kullandığı durumlarda enflasyon, para politikası, döviz kuru ve verimlilik şoklarına gösterdiği tepki fonksiyonları elde edilmiştir. Daha sonra, model tepkilerinin yorumlanmasında bir referans oluşturması için enflasyon, faiz oranı, GSYH ve döviz kurunun endojen değişken olarak kullanıldığı bir Vektör Otoregresif analizi yapılmıştır. Son olarak, model bulguları ve Vektör Otoregresif bulguları karşılaştırılmış ve genişletilmiş Taylor kuralının iş döngüsü dalgalanmalarını, geleneksel Taylor kuralına nazaran yumuşattığı, fakat bazı durumlarda Merkez Bankasını enflasyon ve çıktı açığı arasında bir tercih yapmaya ittiği bulunmuştur.

Anahtar Kelimeler: Küresel Finansal Kriz, Enflasyon Hedeflemesi, Taylor Kuralı, Uluslararası Sermaye Akımları, Döviz Kurları

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# **CHAPTER 1**

## **INTRODUCTION**

The subprime crisis that began in 2007 has been called the worst financial crisis since the Great Depression. In addition to its devastating effects on US economy, crisis rapidly spread around the world and provoked other crises such as Euro zone debt crisis. By 2012, its impact on global economy has not been ceased yet. But, another important feature of this crisis is its impact on the mainstream economic theory. After the crisis, once glorified and praised policies/concepts became obsolete and discussions for new policies accelerated.

After the crisis, policies implemented by governments and central banks became the focus of attention. One of the most heavily criticized frameworks is the inflation targeting (IT) regime. Central Banks blamed for being blinded at the formation of the crisis. Mortgage crisis began with the burst of the housing price bubble and FED has not responded to the development of this asset price bubble. Although, it is hard to detect and respond to asset price bubbles, the fact that one bubble replacing the other in the US economy indicates there is a structural disorder in the system which requires attention. Excessive leverages due to the poor monitoring and regulation of the financial sector was another criticism which allowed building up of vulnerabilities for financial crisis.

However, creating the preconditions for the crisis is not the only issue. Central Banks of developed countries also criticized for implementing inaccurate strategies

during the crisis. Policy of lowering interest rates and injecting liquidity did nothing more than ballooning the asset prices further and easing the credit conditions. In the end, rather than curing, these policies contribute to the worsening of the global economy.

In this context, after this crisis, the belief that as long as the inflation is low and growth is strong, lowering interest rates for stimulating the economy is sufficient demolished. Financial stability became a focal point in policy conduction. Especially, many developed countries declared the financial stability as one of their primary objectives.

European banks had a huge stock of the toxic mortgage based securities as assets and when house prices collapsed, most of these assets became worthless. Worsening of the financial system triggered the debt crisis at Europe. So, contagion of financial crisis to developed countries occurred mostly via financial sector.

Owing to their past financial crisis experiences, developing countries monitoring and controlling mechanism were more developed and also, they were lack of deep mortgage markets. Hence, although they inevitably affected from the crisis via financial channel, the effect was very limited compared to developed countries. The impacts of the crisis felt via changes in the international capital flows, exchange rates, and contraction in the external demand. For developing countries, which finance their growth with capital inflows; decline of the capital inflows trigger domestic crisis. Given the volatility of international capital flows, emerging economies became more and more fragile to risk appetite of financial players. Furthermore, with intensive capital flows and associated appreciation in the currency, credit expansions may occur and asset bubbles may form.

As a typical developing country, Turkey had a strong supervision mechanism due to its past crisis experience. Financial sector strength indicators remained to be strong during crisis. Deficit in current accounts and dependence on capital inflows



were a few of the main fragilities. Also contraction in the external demand deteriorates trade balance. Hence, we can say that transmission of the global financial crisis to Turkish economy was mostly due to trade and credit channels.

A conventional IT does not respond to shocks to financial stability, international capital flows and exchange rates until their effect become apparent on output and prices. Threats associated with these issues were already present but came to surface after the financial crisis and required an immediate revision in the scope of the monetary policy. Considering its widespread use and threats of the philosophy of concentrating on a single objective, and throw all other elements background out of focus, call for special attention.

This thesis examines the impact of global financial crisis on the IT framework. The aim is to discuss the imperfections and defections in the framework and propose extensions. It is agreed that financial stability is indispensable for the macroeconomic stability. However, there is not one common recipe for sustaining financial stability since indicators of it alters from country to country. For instance, asset prices are a crucial indicator for the health of financial strength for US, where it is not very important for Turkish economy. For Turkey, main fragilities are divergence between external and domestic demand, deficit in current account and imbalance in external financing composition. Furthermore, for developing countries, financial channel too may work through international capital flows and exchange rates. Hence, in this thesis, these concepts will be particularly emphasized.

To answer the question whether responding to exchange rates makes a difference in dampening the business cycle fluctuations; a small open economy DSGE model is constructed. First contribution of this thesis is the proposition of a model that represents post- global financial crisis. Incorporation of net international investment position to the problems of households and entrepreneurs allows us to observe the effects of exchange rate fluctuations on model dynamics. Secondly, addition of

imported capital goods to the production function of the entrepreneur enriches the model by incorporating trade channel. Finally, it is found that an augmented Taylor rule with exchange rates helps to smooth business cycle fluctuations while it may lead to tradeoffs between output gap and inflation.

Outline of the paper will be as follows: In chapter two, an overview of IT will be made with an emphasis on the strengths and weaknesses of the framework. The role of exchange rates and international capital flows will be examined in a subsection since, they are the key variables in our quantitative and theoretical analyses and they are also important concepts in the macroeconomic balances of developing countries.

In Chapter 3, formation, causes and consequences of the global financial crisis will be discussed. This chapter is important in the sense that, it shows the weaknesses of the IT framework in practice and highlights the parts that need to be cured immediately. Impacts of the global financial crisis on Turkish economy will be discussed in a subsection to clarify the motivations for the extensions of the model.

In the fourth chapter, a small open economy DSGE model, calibrated for Turkish economy during 2003-2012 is proposed. The base model, which investigates the relationship between asset prices, borrowing constraints and monetary policy in the business cycle for US economy, is extended to capture dynamics of Turkish economy better. Since, trade and credit channels of transmission mechanism of crisis are the most powerful channels for the contagion of the crisis to Turkish economy, net international investment position (to the problems of households and entrepreneurs) and imported capital good (to the production function) are included to the model. With these additions, effects of exchange rate fluctuations and changes in international capital flows are captured. Hence, explanatory power of the model improved considerably. Moreover, to address whether allowing Central Bank to respond exchange rates yields gains in terms of output and inflation stabilization, an augmented Taylor rule, which incorporates exchange rates is constructed.

In Chapter 5, motivation and methodology of the VAR analysis which constructed with interest rates, exchange rates, output and inflation is reported. The aim of this analysis is to provide a quantitative reference for the model experiments i.e. to the test the success of the models fitting to Turkish economy. Hence, via VAR analysis, we obtain an expected outlook i.e. a reference point to evaluate model responses. This subsection ends with the interpretation of the VAR responses.

In Chapter 6, responses of model experiments under traditional and augmented Taylor rule are reported and responses of model experiments and VAR responses will be interpreted. Finally, at the conclusion chapter, key findings will be discussed after a very brief summary of the study.

## **CHAPTER 2**

### **INFLATION TARGETING FRAMEWORK**

In this chapter, an overview of the inflation targeting regime will be made. In this context, first section evaluates the formation, strengths and weaknesses of the framework and in Section 2.2, the role of international capital flows and exchange rates will be examined.

#### **2.1 Overview**

Although, there are many different definitions which vary in detail for what really inflation targeting is, unanimity exists on the main characteristics of this monetary policy regime. Initially, it is considered as a framework rather than a rule, where the main objective is the price stability, but the instruments, horizon and the form of the target is freely determined by the central banks. Due to the increases in oil prices during 1970s, a global trend of soaring inflation began. Since attempts to diminish inflation remained inadequate, expectations also became sticky at high levels which made it even harder to fight with. Taking their lessons from the destructive effects of this stagflation period, academics and policy makers began to emphasize the importance of sustaining price stability.

Earlier monetary policy regimes such as targeting exchange rate or monetary aggregates happened to fail or remain inadequate to perform this task. Fixed exchange rate regime was extremely fragile to international capital flows and vulner-

able against speculative attacks. Thus, system was prone to discrete breakdowns which may precede further financial and/or banking crises. Moreover, monetary policy was not flexible enough to respond domestic or external shocks; since the interest rates depend on the circumstances of the country the currency is pegged. Regime has interpreted as a surrender of monetary independence by Frankel (1999).

On the other hand, the success of money growth targeting was directly linked to the relationship between money growth rate and inflation. However, empirical studies like Bernanke and Mishkin (1997) and country experiences that practiced this regime showed that connection between the two is too unstable and unreliable. Moreover, rapid development of financial instruments made it even more difficult to define the quantitative variables and made this method even more ineffective. According to many economists (for example, Epstein and Yeldan, 2008), given the background of monetary policy regimes, it was natural to target inflation directly. Hence, on the contrary of Bretton Woods system, IT framework was adopted in an evolutionary manner.

In order to define a monetary regime as inflation targeting, it should satisfy a number of properties. Initially, relevant institutions primary task should be price stability. Other macroeconomic considerations should also be taken into account, but to the extent to their compatibility with this primary objective. Another characteristic is the public announcement of numerical target for the medium term inflation. The declaration shouldnt only consist of expectation or forecast of inflation, but also, it should contain an institutional commitment to realize the announced target. Central banks are bounded with the accountability principle in case of a failure to hit the target. The degree of enforcement differs from publishing a statement that explains the reasons for the failure and propose measures to be taken (Turkey) to the deposition of head of Central Bank (New Zealand) according to country.

The role of independence is also crucial in IT regime. Central Banks should be

given the freedom in its operation and choice of policy instruments to hit the target. Any assignment that conflict with the price stability, such as financing government budget deficits via printing money or lending credit would violate the success of the regime.

Transparency is another key feature of IT framework. Central banks all forecasts, strategies and behaviors should be traceable by public via speeches, articles, reports and web sites. To decide policy instrument and its path, inflation targeters should not consider monetary aggregates only but should also utilize a very broad information set including developments in exchange rates, aggregate demand and supply, monetary indicators, government budget, pricing behaviors, productivity, employment, balance of payment and most importantly expectations.

The essence of IT is to anchor inflationary expectations. If Central Bank manages to convince public that it would adjust interest rate in case of temporary deviations from output or inflation, to ensure target would be hit at the end of the planned horizon, expectations would be kept low and it would be unnecessary to alter the policy rate at all. Hence, we can say that IT is a preemptive measure rather than a cure in the fight of inflation. According to Loayza and Soto (2001), existence of the threat makes its practical application unnecessary. So, in order for this regime to be successful, public confidence should be developed by ensuring some perquisite conditions such as commitment, independence, accountability and transparency of Central Bank and existence of strong financial markets. Since, it is hard to provide such an environment immediately, many countries like Turkey preferred to practice implicit inflation targeting to create the desired preconditions. Adoption of IT before preparing the underlying foundations may lead to loss of credibility and diminish the probability of success.

At this point, we should review the credibility and flexibility concepts before proceeding. According to Svensson (2000), a Central Bank is flexible to the extent

it can also stabilize output and/or factors other than inflation. And credibility can be defined as the proximity of targeted inflation to private sector expectations. In the first glance, it may seem that, there exists a trade-off between the two. Making inflation targeting credible typically diminishes the authorities' short-term flexibility and constrain policy discretion. However, in the medium or long run, if Central Bank manages to acquire enough credibility, it would also become more and more flexible to respond other macroeconomic variables. Furthermore, commitment to hit to target overcomes the time-inconsistency problem.

Inflation targeting proved to be the best monetary policy regime used in fight with inflation. Collaboration with public enables to control expectations, pricing behavior and stabilization can be reached with no or little effort. Since, one of the hardest issues while dealing with inflation is to pull down the expectations once they became sticky at high levels; IT tries to prevent them to form at the high levels in the first place. Moreover, by averting high expected inflation, the inevitable lags that originate from the time required for the policy will be effective are diminished and economy will avoid from the costs of inflation in the disinflation period.

IT presents a midway for the long debated discretion versus rules problem. According to Bernanke and Mishkin (1997), it may be called as constrained discretion where it specifies certain targets for monetary policy, define responsibilities, and establish measures of transparency and accountability. However, it left the choice of policy instrument and the method to hit the target to the Central Banks (Loayza and Soto, 2001). In the case where CB succeeded in implementing credibility, flexibility would also be accomplished and best features of both approaches would be obtained.

Owing to these benefits, from its first adaption by New Zeland at 1990, inflation targeting regime praised by most economist and began to be adopted by increasingly more countries. The ever-increasing number of adoptions and the fact that only three

countries<sup>1</sup> abandoned the regime show that countries do not have a better alternative at the moment.

Many studies support the public opinion of IT is a successful regime in bringing down the inflation. Corbo, Landerretche and Schmidt-Hebbel (2002) have conducted an empirical study in which they compare the performances of inflation targeting countries with two different control groups: potential targeters and non-targeters. They found that, inflation targeters were able to hit their target and their sacrifice ratios were lower than both of the control groups. Based on country VAR analyses, inflation forecast errors also reduced among inflation targeters after adoption. Moreover, variance decomposition results indicate that response of inflation and output gaps to price and output shocks are stronger than control groups (Corbo, Landerretche and Schmidt-Hebbel, 2002). Levin, Natalucci and Piger (2004) found that inflation targeting is very effective in anchoring long run inflation expectations and diminishing inflation persistence by comparing medium term and long term inflation expectations using Consensus Economics surveys of market forecasters. Gürkaynak, Levin, and Swanson (2006) supports their findings of inflation targeting does anchor long run- private sector inflation expectations by comparing the behavior of daily bond yield data in the United States, the United Kingdom. For the critics of remaining blind to changes in real activity in favor of protecting inflation, Roger and Stone (2005) showed that in practice, IT is very flexible. Petursson (2004) showed that according to the sample of inflation targeters that have more than 10 years of IT experience, inflation fell from 9% to 3, 5% after adoption. The results were similar when the study repeated with industrial countries. In this case, decline in inflation was from 5% to 2, 5%.

From theoretical perspectives, Gali (2002) showed that for Central Banks to stabilize the output and inflation there should be a credible threat to vary interest rate

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<sup>1</sup>Finland, Spain and Slovakia left IT to accept Euro as currency.



sufficiently in response to deviations from target. However, if the central bank is credible enough, there may not be a need to implement the policy since the threat is already effective to shape expectations. Ravenna (2007) found that, inflation volatility had decreased significantly under inflation targeting by obtaining historical shock series from his estimate of a DSGE model. Majority of this decline has been found to originate from the changes in expectations.

Besides its benefits, IT has also its flaws. And ironically, its main strength of focusing inflation may also become its main weakness as well. Although, the main focus is inflation, its driving sources haven't been considered sufficiently. Thinking from the perspective of a small country, in the case of an adverse supply shock due to increased energy prices, Central Bank can keep the inflation low by raising the interest rates sufficiently. However, this move would have no impact on huge global forces. So, it wouldn't solve the overall problem. Moreover, effects of the decrease in output level and increase in unemployment level could be much more harmful than the effects of the raise in the inflation. Some developed countries such as United States exclude food and energy prices from their measurement of inflation. However, especially for developing countries, this is not applicable, since this would exclude more than 50% of their prices determination.

Another important flaw of the inflation targeting framework is the threat of zero lower bound and liquidity trap. In a deflationary economy, in case of a recession that requires an expansionary policy, authorities may not be able to push the already low interest rates further. Since placement of open market operation bonds at negative nominal interest rates is impossible, economy may catch into a liquidity trap. Japan economy during 1990s is a good example for such a case. In theoretical grounds, this situation is characterized by an unstable equilibrium. Some suggested remedies such as increasing the inflation target and others (for example, Loayza and Soto, 2001) claim that as long as sum of inflation target and long run average real interest rate

exceed a certain level of threshold (generally 5%), liquidity trap can be avoided. Moreover, even interest rates become useless as a tool, exchange rate channel will still work as a monetary policy stabilizer. However, effectiveness of these remedies is controversial and Japan experience still terrorizes policy makers.

Historical high inflation periods created a misperception that as long as inflation is low and growth rates are satisfactory, economy is healthy. It is thought that, as long as inflation level is low, if there are signals indicating a possible depression, Central Banks can supply money, inject liquidity to the system and stimulate demand. Of course, no Central Bank in the world is willing to ignore developments in the real economy such as growth and unemployment. However, along with the fear of losing credibility, within the unique objective framework Central Banks job is the price stability. Indeed, Mitchell and Anthea (2004) showed that after Australia adopted IT, it managed to bring down and stabilize the inflation but for the expense of huge rises in unemployment. Some economist claim that monetary policy focused initially on inflation (can be thought of origins of inflation targeting) increased unemployment, especially in European countries, over the 1990s.

Another common critique for inflation targeting framework is that, success of the regime for bringing down the inflation and improving macroeconomic performance is only coincidental since the timing of the transition to IT and the duration within it has practiced have relatively favorable conditions and lack of supply shocks. This problem also made it harder to make a proper comparison. Although, some claim that global economy experience shocks also during IT regime like oil crises in 90s and East Asian crisis, other claim they are relatively regional shocks and exemplify the failure of IT by indicating its performance during latest global financial crisis.

There were signs for the approaching crisis, however they were hard to detect and respond with traditional monetary policy tools. Heavy financialization, illogical leverages, soaring asset prices, global imbalances, huge increase in debt based con-

sumption were all indicating something was wrong with the economy, but monetary policy was blinded until the effects were felt at inflation and output. Some (for example, Stiglitz, 2010) even claimed that monetary policy contributed to prepare the necessary conditions for the crisis.

Now, almost all economists agreed that financial markets are a crucial part of the economy and for all decisions concerning economy; they should also be taken into account. Considering the interaction between the two, this is especially essential for conduction of the monetary policy. How could this be done and to what extent is a new and fruitful research area. It is impossible to find a global measure for financial stability since the definition and indicators of it differs significantly from country to country. Hence, difficulties in identifying asset bubbles and finding eligible indicators to measure the health of financial sector are only a few of the obstacles for this task. Without a doubt preventing the emergence of unsustainable developments in money and credit would be a great contribution for sustaining price stability.

In the end, we can say that, inflation targeting framework has some indisputable benefits and some of the concepts it bring along such as transparency, interaction with public and expectation management will continue to be essentials in conduction of monetary policy. But although price stability is the necessary condition for macroeconomic stability, it is not sufficient at all. Some revisions and adjustments are required for the prevailing monetary policy throughout the world to avoid from the crises become more and more frequent and oppressive or at least minimize the losses. One area needs revision is obviously the role of financial sector. But there is one more branch that should be considered: the role of exchange rate in inflation targeting framework which will be discussed in detail next section.

## **2.2 The Role of International Capital Flows and Exchange Rates**

As it is discussed in Section 2.1, after the outbreak of the global financial crisis, most economists agree that there exist deficiencies in the inflation targeting framework. Most of the studies (for example, Woodford, 2012; Aydın and Volkan, 2011; Takatoshi, 2010) focused on the consideration of financial stability in the monetary policy. This measure is surely reasonable especially, for developed countries where the financial markets are rooted, sophisticated and significantly effective for macroeconomic stability. However, little attention has been paid to emerging countries where, there exist some other factors beside financial instability for the origination of the domestic crises. These countries have relatively less developed financial sector (in this case absence of mortgage market and exotic financial derivatives) and/or better financial monitoring and regulation system due to their earlier financial crisis experiences. Hence, in their case, triggering factor for domestic crises were not country specific financial instabilities, but fragilities originated by decrease in capital inflows or even sudden stops by which they finance their high current account deficits, and inability to respond exchange rate fluctuations. These observations revitalized the discussion about the role of exchange rates and capital flows in the monetary policy and inflation targeting regime.

Capital inflows may be particularly risky factor for countries that have large current account deficits like Turkey. It leads to an increase in external credit volume and appreciation in local currencies which widen the deficit in current account balances further. For developing countries, financing growth and current account deficit via capital inflows is not an extra ordinary scenario, since it is hard to obtain entire sufficient resources domestically. However, type of the capital inflow should be the focus of attention here. Attracting FDI is the most beneficial type of foreign investment for the home country, owing to its permanence and ability to create employment opportunity. As inflows get more and more volatile, home country will become more and

more sensitive to the shifts in global market sentiments. Depending on hot money to finance growth and current account deficit may result unexpectedly higher growth rates when global trends are favorable. However, when uncertainties emerge due to a crisis or doubts arise even due to just speculation, home countries face deep domestic crisis. Furthermore, when the deficit in the current accounts become extremely high, doubts about the sustainability would also contribute to formation of pessimistic expectations. Hence, we can conclude that developing countries that finance their growth and current account deficits in this manner are bounded to experience fluctuations in their output and macroeconomic well being that originate from external shocks and shifts in global market sentiments.

Moreover, intensive capital inflows have an indirect impact on the rise of inflation. These inflows may lead asset bubbles and extension of credit beyond control which, in turn increase inflation. Moreover, policy makers may become obliged to adjust their policy decisions for not to be a subject of sudden stops. Balances become more complex, if the domestic interests like stimulating economy when there is a recession, conflict with the aim to convince investors to stay in the country with higher returns. Overvaluation of the currency and endearing the returns may deteriorate external balances and threaten the financial and macroeconomic stability.

After the 2007 crisis, one thing is certain. Controlling the excessive fluctuations in international capital flows is a must for the health of the economy. Capital account restrictions are one of the proposed measures for the control of exaggerated international capital flows. However, these restrictions may fail to differentiate desirable investment and unfavorable hot money and impede economies access to international capital markets in the long run by generating negative sentiments for possible investors. Additionally, this kind of restrictions could be administratively costly and difficult to manage. Overall, financial development may suffer considerably.

Central Banks and international institutions concentrated on new measures that

could be taken to decelerate and canalize capital flows. Most authorities once passionately defending free capital movement recognized its threats after global financial crisis. IMF economists proposed two new Tobin tax like devices. Financial stability contribution which is a supplementary tax that will be imposed on banking activities at a constant rate and financial transaction tax which will be an international implementation where the tax rate will be freely determined by home countries. Central Bank of Republic of Turkey also started to emphasize its possible risks on financial and macroeconomic stability. CBRT declared at 2010 Inflation Report that it will monitor the capital flows closely and will use the monetary policy devices including required reserve ratio and liquidity management to limit associated risks.

Exchange rate, the other factor we are investigating, is a key economic variable which is effective on inflation, exports, imports and economic activity. Previously, it had been used as the main tool for controlling inflation and/or as an implicit taxation tool to control export sectors.<sup>2</sup> The discussion about the role of exchange rates in inflation targeting framework is not as ancient as inflation targeting itself, since the first inflation targeters are industrial countries, for whom, exchange rate is not an overwhelming concern. However, after the consecutive crashes of exchange rate pegs during late 1990s and early 2000s, many emerging countries adopted inflation targeting and moved to flexible exchange rates. Problems started to arise and discussion about the role of exchange rate in this framework began at those times.

Especially for inflation targeters, exchange rates most direct effect is on inflation. It may affect inflation through the prices of traded final goods and imported intermediate goods, and through their impact on inflationary expectations. Hence, the higher the share of traded goods and imported intermediate goods in consumption basket, the higher the country is prone to inflationary pressures from abroad. Developing countries are more dependent to import of intermediate goods, especially, if

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<sup>2</sup>Argentina used deliberately overvalued exchange rates to control agriculture exports.

there are no or few domestic substitutes. Thus, depreciation in exchange rates lead to increase in cost of production, prices and inflation. Hence relationship between exchange rates and prices are stronger in developing countries compared to developed countries.

Another channel, through which exchange rates are effective is global competitiveness. Uncertain environment due to exchange rate fluctuations may endanger trade relations and external balances. Attraction of foreign direct investment would considerably fall. Moreover, the movement among major currencies may force policy makers to give symmetric reactions with other emerging market economies and diminish independence in policy conduction.

From financial stability perspective, a real appreciation and related large capital inflows may trigger credit expansion and lead asset bubbles and investment boom. Due to the overextension of domestic financial system, economy becomes more fragile to a slowdown and/or decreases in capital inflows. Finally, the collapse of the asset prices lead to the outbreak of the crisis. Furthermore, in case of a decline in exchange rates, solvency of firms and individuals would receive a blow which may lead bank runs if it becomes widespread. Hence, combining with the decline in asset prices and credit quality, financial problems could be transferred into real sector via credit channel as in East Asia and Latin crises.

In light of the consequences of problems due to exchange rate fluctuations, we can see that fear of floating is not an irrational concern. Furthermore, according to Ho and McCauley (2003), emerging countries like Turkey are more vulnerable to and less protective against exchange rate shocks than industrial countries for historical and industrial reasons. Hence, consideration of exchange rates in monetary policy help strengthening these vulnerabilities and shocks will become less destructive i.e. macroeconomic balances become less fragile. Conventional role of exchange rate in inflation targeting framework is to let exchange rates to be determined in the markets

freely and not to intervene as long as it has a direct effect on inflation or output. However, waiting for the indirect impact on inflation or output induce more and more vulnerabilities in a cumulative manner. Furthermore, response for the shock will come with a considerable lag and delay the recovery.

It is clear that remaining ignorant to exchange rates would result in problems that would heal in long run. However, how to respond to exchange rates and to what extent are still controversial discussion topics. One way to dampen exchange rate volatility and to slow or reverse currency movements in the inflation targeting framework is the foreign exchange interventions. Official intervention in the foreign exchange market means that the central bank or other agents of the government buy or sell foreign currency in an attempt to influence the exchange rate value. Purchases of foreign exchange usually are intended to push down the home currency value of the exchange rate, and sales usually are intended to push it up. Central banks may also engage in sterilized foreign exchange interventions where their purchase or sale of foreign exchange is offset by selling or purchasing domestic securities so as to keep the domestic interest rate at its target. Although its effectiveness is controversial, it is known that many governments engage in this practice.

Most advocates of IT recommend incorporating exchange in the policy rules (i.e. Taylor rules). Also, empirical studies show that Central banks tend to consider exchange rate while conducting monetary policy. Taylor (2001) proposed the following monetary policy rule which incorporates real exchange rates:

$$i_t = f\pi_t + gy_t + h_0e_t + h_1e_{t-1} \quad (1)$$

Here,  $i$  is the short term interest rate,  $\pi$  is the deviation of the rate of inflation from its target level,  $y$  is the deviation of real GDP from potential real GDP (often called the output gap), and  $e_t$  is the log of the real exchange rate in year  $t$ .  $f$  and  $g$  are the



traditional Taylor rule coefficients;  $h_0$  and  $h_1$  are the coefficients of the current and lagged log of the real exchange rates in the augmented Taylor rule, and are the main interest of this discussion. In the context of above equation, question about the role of exchange rate in a policy rule is identical to the question of what is the numerical value of the parameter  $h$  is. Naturally, if  $h_0$  and  $h_1$  are both equal zero, developments in exchange rate should not be incorporated in the policy rule and augmented Taylor rule reverts to its traditional form. And if  $h_0$  is smaller than 0 and  $h_1 = 0$ , an exchange rate that is above normal exchange rate requires lowering the policy instrument i.e. relaxing the monetary policy. In principle, optimal monetary policy may have both coefficients different than one.

Some argue (for example, Edwards, 2006) that if the policy makers can calculate and incorporate the effects of exchange rate on inflation and output, there may be no need to include exchange rate as a separate variable. On the other hand, others like Taylor (2001) argue that even central bank could able to calculate the effects and coefficients correctly, policy makers may prefer preempt the effect by adjusting policy stance when exchange rate changes occur, rather than the effect become observable from inflation and/or output. Moreover, country specific factors such as inflation dynamics, extent of pass-through effect or central banks loss function are crucial in determination of  $h_0$  and  $h_1$  coefficients.

However, there may be problems associated with this approach. Initially, some strict inflation targeters may oppose the incorporations of exchange rate into the policy function since it would harm the single price stability objective and diminish the confidence of public. Another problematic issue is the possibility of conflict of interests i.e. a policy action that is, intended to decrease inflation may hurt the exchange rate objective. These factors require a careful parameterization of the relevant coefficients. In spite of these drawbacks and declarations of central banks that they are considering exchange rates but not incorporating it into their policy rules

directly, such declarations are not assuring since announcements and actions of central banks vary frequently. Indeed, Mohanty and Klau (2005) show that eleven out of thirteen emerging countries coefficient for real exchange rates in policy functions proved to be significant. In chapter 7, effectiveness of incorporating exchange rates into the monetary policy rule will be discussed theoretically by comparing responses of traditional Taylor rule and augmented Taylor rule at a small open economy DSGE model.

## **CHAPTER 3**

### **GLOBAL FINANCIAL CRISIS**

This chapter examines the global financial crisis and its impact on Turkish economy. In Section 3.1, formation, causes and consequences of the global financial crisis will be discussed. By evaluating the origins of the crisis, deficiencies of the IT framework will be exemplified in practice. Section 3.2 studies the impacts of global financial crisis on Turkish economy. This section is important in two ways. Firstly, CBRT made significant modifications in its monetary policy framework after the crisis. Secondly, findings derived in this part motivates the extensions in the theoretical model.

#### **3.1 Formation, Causes and Consequences of Global Financial Crisis**

The impacts of the deepest crisis after Great Depression have not been ceased yet. This prolonged influence is mostly due to the ineffectiveness of traditional monetary and fiscal policies to revitalize the economy. But the most dramatic effect is the loss of confidence on banks, financial markets and even glorified concept of capitalism. As it is clear now, deficiencies and flaws in the financial market had the leading role in the freefall but one should also recognize the effects of structural defections on the real economy. Debt based excess consumption is one of the primary problems.

In the bottom sixty percent of the income distribution in United States, average consumption expenditures equaled or exceeded average pre-tax income. The one fifth of the population just above them consumed 5/6 of their income. A major proportion of the private savings have generated by the top of the income pyramid. So, saving investment mechanism which fosters capital accumulation that is essential for economic growth, depend on keeping wages down. These facts are supported by the statistical evidence. Real income has been stagnated for decades (except for a small period at the end of 1990s) and even decreased after 2003. But in spite of the falling income, consumption continued to grow, even reached the seventy percent of the GDP. Low interest rates and financial markets in predatory lending behavior encouraged households to borrow, in order to maintain their previous consumption levels. This debt-based excessive consumption is not a domestic danger only. It also creates global imbalances that threaten the health of the global economy. Current account deficit of United States is largely financed by the excess saving in the developing countries. With China and other developing countries holding so much dollar reserves and Treasury Bills of US government, US comforts itself with borrowing at a low cost, and lenders feels more secure in case of a possible crisis. Right now both parties may be satisfied with the deal. However, if lenders starts to question the solvency of US economy or disruptive changes in exchange rates occur, the consequences may be catastrophic.

Superfluous financialization process had a key role in the crisis. It can be defined as disengagement of economy from real activities such as production and investment and tending towards to financial markets and financial instruments. This holds both for firms and financial institutions, especially commercial banks. The problem was to focus on higher private returns and completely ignore the social causes. Making more and more profits owing to productivity increases, fewer and fewer profitable investment opportunities became available to firms. In order not to lose their sur-

plus value, they preferred purchasing financial assets with high returns. Although they managed to maintain (raise) their excess surplus, capital accumulation process essential for economic growth was hindered. Since executives were paid by stock options, they do whatever they can do (including creative accounting to show the company good on the short run) and enjoy the rise in the stock prices. Due to this shortsighted behavior, firms long run performance negatively affected.

On the other side, banks forgot their crucial role in economy of providing necessary funding to small and middle sized entrepreneurs which are the basis of job creation. They abandoned the role of intermediation between borrowers and savers and began involving in the transactions directly by preferring securities to loans as assets. Besides dampening the investment, production and growth, this structure had a substantial impact in creating bigger and bigger bubbles that burst more frequently with more devastating effects.

Another fundamental problem is the persistent existence of asset bubbles. Excess liquidity which took its source from low interest rates creates asset bubbles. Since 1970s, a bubble has replaced by another in the US economy. According to Kindleberg (2000), basic pattern of speculative bubbles includes five stages: a novel offering, credit expansion, speculative mania, distress and crash/panic. I will characterize recent real estate bubble in this context. A novel offering may be a new market, revolutionary new technology, an innovative product, etc. In this case, it was the newly invented mortgage based tropic securities. With securitization, mortgages bundled in such a way that subprime mortgages with high risks at great quantity combined with low risk assets in minimum amounts to ensure AAA rating. Rating agencies had already revealed their incompetence at East Asia crisis by giving high rates to the assets from countries on the verge of a cliff. Furthermore, the private and social returns were not matched since they were paid by the very companies they were rating.

Although securitization spread the risk, it also break link between borrowers and lenders. Lenders trusted banks to check the affordability of mortgages and banks trusted to mortgage firms. But mismatch of social and private incentives appeared again. Mortgage firms were paid with the quantity of the mortgages they sold. So to obtain more profit, they ignore the quality. Another example of misguided intentions was the invention of tropic mortgage products. While some countries succeeded in creating secure mortgages with low fees, financial engineers deliberately created complex products to minimize regulation and competition and charged high transaction fees to maximize profits. These new products were also flawed in the sense that, they were based on two ungrounded assumptions: the housing prices will not decrease and house prices in different states are not correlated. Of course, the lack of regulation did not originated by the complexity of these products alone. FED rejected the proposal of government about the authority augmentation for regulation purposes. Also, lobbying activities processed by financial markets have bigger responsibility in this failure. Without necessary regulation, banks did not act as intermediaries only and directly involved in process by holding these risky mortgage backed securities as assets.

In the second stage, a credit expansion is required to feed the asset price bubble. After a process of continuous increase in technology stock prices, between March 2000 and October 2002, stocks witnessed 78% decline. With the burst of the bubble, government tried to cure the corresponding recession with tax cuts and further decreases in interest rates. However, the economy was yet experiencing excess capacity and the low interest rates and changes in reserve requirements did not stimulate more investment in plant and equipment. The extraordinarily low interest rates and diminished requirement for down payments combined with the longer mortgages which eased the financing and made it affordable for anyone even at soaring prices. Increasing number of mortgages, especially subprime mortgages consequently boosted

mortgage based securities (MBS). Furthermore, repeal of Glass-Steagall Act which had separated the investment banking and commercial banking at 1999, enabled birth of too big to fail banks and encourage moral hazard. Relying on the deposit insurance and knowing they will not be allowed to fail, banks engaged in excessive risk taking more and more. The number of subprime mortgages issued and imbedded in MBS doubled twice from 2000 to 2005.

According to Foster and Magdoff (2009), speculative mania is characterized by rapid increase in quantity of debt and an equally rapid decrease in its quality. Households considered the increasing prices as driving motive rather than the income streams it would generate and depend on excessive borrowing for financing. Not only mortgage lenders and borrowers involved in the soaring bubble. Real estate speculators also engaged in the purchase of houses to sell them at a higher price in the future. For many homeowners, the largest asset in their portfolio was their houses. So to maintain their consumption under declining real income, they withdraw cash value from their homes depending on the low interest rates. At the top of the bubble, new mortgage borrowing increased by 1.1 trillion dollars in October and December 2005 alone.

In the fourth stage this popular asset fell into decline by an exogenous factor. The first sign of this decline in real estate prices was detected at 2006, with the increase in interest rates and decrease in the housing prices in some subprime regions such as California, Arizona and Florida. These changes began to worry the borrowers who were depending on two digit increases in housing prices and zero like interest rates. Soon, investors recount their concerns about a possible contagion of the falling prices in real estate to other states. In the first half of the 2007, credit a debt swap which was designed to protect investors raised by 49% globally.

Finally, panic began when some investors couldnt resist the pressure and started to sell off their assets. Initial crash took place when two Bear Stearns hedge funds

imploded at July 2007, and failure and bailing out of British mortgage lender Northern Rock marked the crisis globally at September 2007. Financial panic diffused rapidly throughout the world. This panic was partly due to the complexity of the system, since nobody knew where these toxic assets were accumulated. By January 2008, it was officially accepted by newspapers and authorities that system was at panic stage. Fed lowered interest rates from 4.75% at September to 3% at January and announced more cuts could be expected. Federal government succored with a 150 billion dollars stimulus package.

Package was far from being enough and one fail followed the other. Loosening of the accounting standards has enabled banks to hide their off balance sheet activities, where toxic assets were buried. Non performing mortgages were showed as if they were valuable assets. The failures of banks were rescued by purchase of toxic assets by state, bailouts and nationalizations. Opponents proposed different solutions such as giving low interest loan to mortgage owners. It seems logical since such a move would allow borrowers to pay their debts and made them homeowners (rather than more foreclosure of houses); this would reflect as better prices in real estate markets which would enable banks heal their balance sheets.

Now, world is facing a trade off. One way is to let this burst bubble replaced by another. Of course this will not be a permanent solution but a precursor of more frequent and devastating crises. The other way is to reforming the economy especially the financial markets. Recovery measures for the crisis is not within the scope of this thesis however the most fundamental issues to be considered is discussed. Households took their lesson from the recent crisis. They began saving and cut down consumption. But because of the stimulation packages and bail outs by trillion dollars, fiscal deficit reached record amounts. We can say that America switched debt financed private spending to debt financed public spending. So excessive consumption problem is not severe as before now but the inequality in the income distribution



continues to be a major trouble since it disturbs the saving investment process further in the case of insufficient consumption. At the moment, capital gains from speculation are taxed at a lower rate than wages. A new progressive taxing system, which gives more weight to the incomes of rich, may be a feasible solution. Arrangements should be done to prevent encouragement of predatory lending such as Bankruptcy Abuse Prevention and Consumer Protection Act which allowed banks to disain a quarter of an individuals income in case of a bankruptcy.

One of the most significant consequence of the crisis is the questioning the role of state. Bailing out of banks is still a controversial topic for economists. But everybody agrees with the need for regulation. But, regulations should be organized specific to industry. Finance sector that lies at the heart of the economy requires much more care than any other sector. Strict regulation and monitoring is a must. But taking domestic measures will not be sufficient. Capital always flows to less regulated country and because of the externalities lack of global coordination, financial markets may be subject to fragmentation and segmentation. Furthermore, incentives should be improved in order to avoid mismatch of private and social returns. Crisis has highlighted the importance of transparency. Firms and financial institutions should be obliged to publish their financial statements which clearly demonstrate the real position of the institution. One of the most essential adjustments is restrictions on excessive risk taking. More capital requirement for high risk actions, offering high deposit insurance fees and dealing with problematic financial instruments such as derivatives are just a few examples of such measures.

### **3.2 Impacts of Global Financial Crisis on Turkish Economy**

In this section, impacts of the global financial crisis on Turkish economy will be examined. This chapter is particularly important, since findings derived here will clarify the motivations for extensions of theoretical model.

Just before the outbreak of the crisis, Turkish economy was at the peak of the recovery trend from the 2001 crisis. Owing to unbending monetary and fiscal discipline, single digit inflation level had been preserved and economic growth trend began at 2002 sustained at 4.5% at 2007. These improvements on economic conditions along with the optimistic expectations made Turkey an attractive emerging market and increases in capital inflows during 2006 continued in 2007. 36.7% of these net capital inflows (excluding IMF credits and reserve changes) were composed of foreign direct investments. However, decrease in saving ratios and rapid increases in consumption and investment of private sector mainly financed externally, which widened the current account balance further, and lead to an increase in external debt stock.

Central Bank continued to implement explicit inflation targeting framework it began at 2006 and proceeded using flexible exchange rate regime. CBRT adopted the philosophy of not to intervene to exchange rates unless, there exists excessive fluctuations. In order to minimize effects on demand and supply conditions of market, foreign currency auctions were made at earlier announced dates and limits.

According to Kibritçioğlu (2010), there are four main channels through which other countries can be affected from global financial crisis. First channel is high risk asset trade channel. In this channel, balance sheets of the international entities that own toxic mortgage based securities are weakened due to the collapse of house prices. Second way for contagion of the crisis is credit channel. Contraction in international credit channels contaminate flow of funds and create problems for firms that finance their new investment externally. Trade channel works through the contraction in external demand for third countries. Decline in the demand of developed countries lead disorders in demand composition and deteriorate trade and current account balances. Final channel is through the rise in uncertainties which lead decline in confidence to economic policies. In this chapter, impacts of the global financial

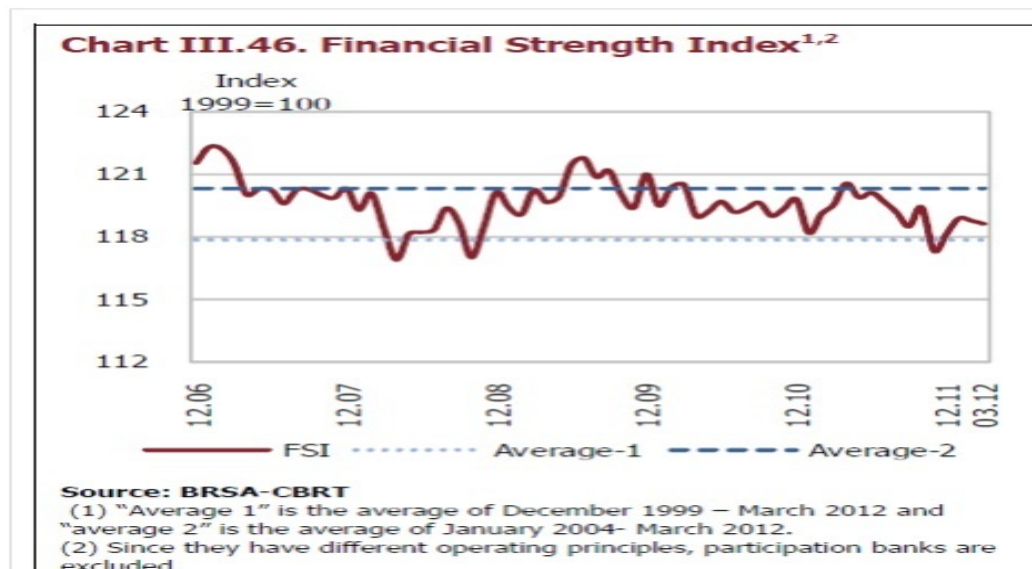
crisis will be examined within this scope.

When we take a look at the immediate effects of the crisis, we can observe that like many emerging countries, impact was limited. Owing to its earlier crises experiences, Turkish economy had a relatively stronger financial system. After the establishment of Banking Regulation and Supervision Agency, monitoring and supervision of banking sector became very efficient and regulations on capital adequacy ratio and leverages ensured the strength of the sector. During 2007, banking sector kept on growing and sector share in GDP rose. At 2008, increase in the cost of external funds and worsening of credit opportunities reflected on the credit costs, which builds up more than half of the assets of the banks, along with the decline in the risk appetite leaded to decrease in speed of credit increase. 2009 brought an improvement in capital structure of banks. But, in spite of the gloomy financial environment, banking and financial sector managed to protect its strength after the European Debt Crisis. Financial Strength Index which is an indicator of the well being of financial sector remained high at post crisis period. Moreover, lack of deep mortgage markets and absence of toxic mortgage based securities in the balance sheets of entities, protected Turkish economy from high risk asset channel. Hence, Turkey had much less fragility problem via asset channel, compared to its own history and developing and developed countries.

2008 was the year where real impacts were began to be felt. Economic growth declined sharply especially for the developed countries. Due to the contraction in external demand, export level decreased sharply. With the effect of the uncertainties due to the global crisis, consumption decisions postponed, both domestic and external demand contracted and trade volume declined.

It can be inferred that trade channel worked in the transmission mechanism of crisis in Turkey. Economies of major trade partners of Turkey faced deep domestic crisis and their external demand diminished significantly. After 2009, economic

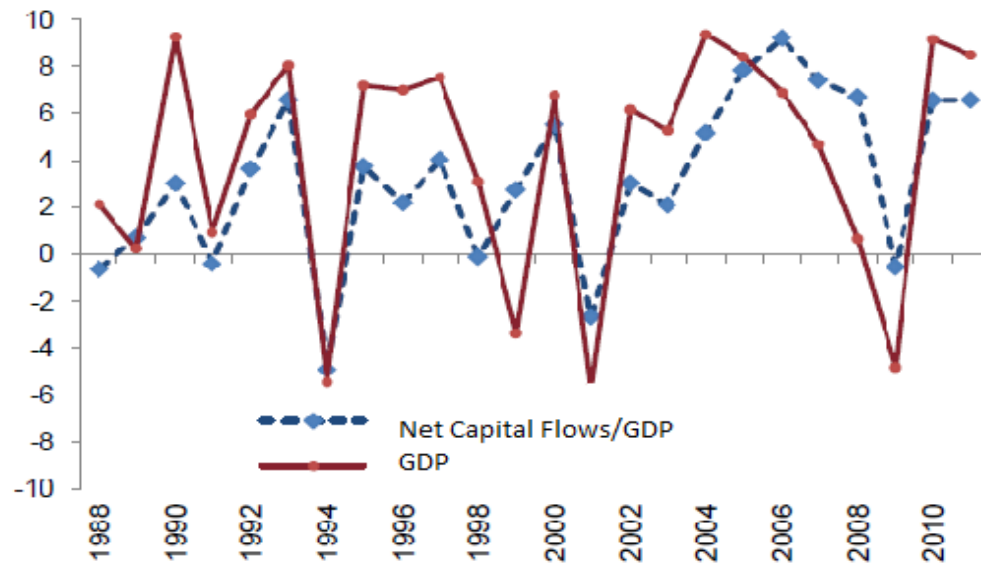
Figure 1: Financial Strength Index



growth which took its source from domestic demand began to accelerate. However, economies of Turkey's major trade partners didn't improve as fast as Turkish economy. As a consequence, domestic and external demand began to diverge. Concentration of capital inflows leads to overvaluation of Turkish Lira which deteriorated the trade balance further. Ever growing deficit between imports and exports can be observed from the graph above.

With the deepening of the crisis, at the last quarter of 2008, concerns raised in the financial markets and international credit markets contracted. Accordingly, capital flows slowed down and net exits observed at the last quarter. Weakness and instability of precursor indicators of global economy, high levels of unemployment and inability to solve structural deficiencies in banking sector kept markets suspicious about the sustainability and permanence of this recovery. In conjunction, capital inflows considerably fell at 2009. With the impact of expansionary policies implemented in the developed countries, global liquidity enlarged during 2010. Relatively better economic structures and higher interest rates diverted capital flows to devel-

Figure 2: Capital Flows and GDP



Source: CBRT

oping countries. Turkey, as well, was affected from this portfolio sourced capital inflows that reached 16.3 billion dollar during 2010. Foreign direct investment also increased by 3.9% and reached 7.1 billion dollars.

In the above graph, it can be observed that growth of Turkish economy is highly dependent on the international capital flows. GDP growth and capital flow completely act in unison. These international capital flows display a fluctuating structure and when a sudden stop or reversal of capital flows occurs due to external factors, Turkish economy faces a sharp decline in GDP growth and domestic crisis. Contraction of GDP at 1994, 2001 and 2008 all coincided with the decline in the capital flows. These observations alone indicate the importance of capital flows and credit channel; and need for measures to strengthen the economy against changes in risk appetites.

To sum up, after the mortgage crisis, importance of financial stability has understood better and many developed and developing countries including Turkey started to take financial stability as one of their main objectives. It is already mentioned

that financial stability indicators are different for each country since fragilities are not identical. For Turkey, high current account deficit, divergence between domestic and external demand and imbalances in external financing compositions(see Figure 7.) can be named for major fragilities. In this context, CBRT concentrated on monitor and control undesirable capital inflows, balancing external and domestic demand and dampen the cyclical component of current account balances.

In order to achieve these objectives, Central Bank designated two intermediate tools to provide transmission mechanism between two objectives: credits(see Figure 6.) and exchange rates. These are perfect variables for the task, since they can be observed with no lags, can be easily monitored and directly related with final objectives. To support the traditional monetary policy tools of traditional one week matured repo auction interest rate, the Central Bank used overnight lending and borrowing interest rate corridor, and required reserve ratios actively. For instance, after concentration of short term external financing and credit enlargement started at 2010, CBRT followed a strategy to discourage capital inflows by keeping short term interests low and by controlling the domestic demand and credit growth by raising required reserve ratios.

## **CHAPTER 4**

### **MODEL**

The model utilized in this thesis study is a discrete time infinite horizon dynamic stochastic general equilibrium (DSGE) model, designed to explain the impacts of recent global financial crisis on Turkish economy. In contrast to majority of experiences throughout the world, influence of this crisis in Turkey has been observed mostly on real economy rather than the financial sector (Tandırcıoğlu, 2009). While some economists claim the underlying reason for this case was the absence of a rooted mortgage market in Turkey, others (for example, Çanakçı, 2009) argued that measures taken at the 2001 crisis especially the establishment of BDDK has protected the financial sector by taking preventive measures such as repressing excessive leverages. There are also many theories that attempt to explain the transmission mechanism of the crisis in Turkey. In Section 3.1, it is proposed that, the transmission mechanism of the crisis to Turkish economy was via credit and trade channels. Model that will be used is extended in order to capture these channels impact.

The model is a variant of M. Iacoviello (2005). The original paper places the real estate sector to focus of attention and investigates the relationship between housing prices, borrowing constraints and business cycles in US economy. Since in the US economy, housing prices are a crucial factor for the health of the financial stability,

model is very successful in capturing the real business cycle dynamics of US economy. This paper aims to examine the Turkish economy and our findings at section 3.1 indicate that Turkish economy affected from the crisis via credit and trade channels. In this context, model is extended to capture these channels along with the exchange rate fluctuations. On the contrary of the base paper, variable of focus is net international investment position which may be a good predictor of international capital flows. Price of the net international investment position is taken as real exchange rates. There exists a preference parameter subject to exogenous shocks which affect exchange rates and allows us to examine the change in dynamics in response to a shock. Another contribution of this thesis study is the inclusion of imported capital goods into the production function of the entrepreneurs. The reasoning behind this inclusion is to evaluate the effects of a shock in the exchange rate to the production as well. Imported intermediate good evolution is symmetric to domestic capital goods evolution. Furthermore, capital adjustment functions of both capital goods share the same functional form. Foreign capital is taken broadly to refer to both foreign capital and imported intermediate goods. This generalization will allow greater interpretation power considering Turkish experience.

Nominal price rigidities are included to the model in order to capture the business cycle dynamics. The model requires five basic agents in the economy: Patient and impatient household, entrepreneurs, retailers and the central bank. The base model has two important features which also preserved in the extended model. Firstly, the borrowing limit of the impatient households and entrepreneurs depend on their net international investment position. That is, the higher their foreign asset holding abroad (or the less their foreign liabilities), the higher they can borrow. And the second is that, households lend in real terms but receive back in nominal terms. This assumption is imposed since it replicates results closer to real data and also allows us to investigate the effects of an inflation shock on borrowing, consumption and



output.

## 4.1 Patient Households

Patient households consume, supply labor, demand international assets, international currency and money. The term "patient" indicates the assumption that a portion of the households care less about current consumption thus they have lower discount rates. They use their savings at international financial markets, buying foreign currencies and/or bonds. Variables with prime symbol will be used for patient household for the rest of the paper. Patient households maximize a lifetime utility function given by:

$$E_0 \sum_0^{\infty} \beta^t (\ln(c'_t) + j_t \ln(d'_t) - (L'_t)^\eta / \eta + \kappa \ln(M'_t / P_t))$$

where  $E_0$  is the expectation operator,  $\beta \in (0, 1)$  is the discount factor,  $c'_t$  is consumption at  $t$ ,  $d'_t$  is the net international investment position for patient household,  $L'_t$  are the hours of household work for the entrepreneurs and  $M'_t / P_t$  are money balances divided by the price level.  $j_t$  allows for random disturbances to the marginal utility of investing/borrowing abroad, and, given that it directly affects housing demand, offers a parsimonious way to assess the macroeconomics effects of an exogenous shock on exchange rates. Now denoting  $q_t = P_t^f / P_t$  as the exchange rate where  $P_t^f$  is the foreign price level calculated by a foreign currency bundle, and  $w_t = W_t / P_t$  as real wage. Patient households lend in real terms  $b'_t = B'_t / P_t$  and receive back  $R_{t-1} B_{t-1} / P_t$  where  $R_{t-1}$  is the nominal interest rate on loans between  $t-1$  and  $t$ . Denoting  $\Delta$  as difference operator, the flow of funds is:

$$c'_t + q_t \Delta d'_t + R_{t-1} b'_{t-1} / \pi_t = b'_t + w'_t L'_t + F_t - \xi_{d,t} + T'_t - \Delta M'_t / P_t \quad (1)$$

where  $\xi_{d,t} = \phi_d (\Delta d'_t / d'_t - 1)^2 q_t d'_t - 1/2$  denotes the international investment ad-

justment cost which can also be thought of intermediation cost of financial institutions,  $\pi_t = P_t/P_t - 1$  is the gross inflation rate,  $F_t$  are the lump sum profits received from the retailers, and the last two terms are net transfers from the central bank that are financed by printing money. First order conditions for the patient household optimization problem are below:

$$\frac{1}{c'_t} = \beta E_t \left\{ \frac{R_t}{\pi_t + 1 c'_{t+1}} \right\} \quad (2)$$

$$w'_t = (L'_t)^\eta - 1 c'_t \quad (3)$$

$$\frac{q'_t}{c'_t} = \frac{j}{d'_t} + E_t \left\{ \frac{\beta q'_{t+1}}{c'_{t+1}} \right\} \quad (4)$$

$$\frac{M'_t}{P_t} = \beta^t \kappa E_t \left\{ \frac{P_{t+1}}{R_{t+1}} \right\} \quad (5)$$

Although, first order conditions yields a money demand function, money supply will always meet money demand at desired interest rate since our focus is the interest rate rules. Since we have separable utility function, the quantity of money has no implications for the rest of the model.

## 4.2 Impatient Households

Impatient households discount the future more heavily than patient households. Similarly, they choose consumption, international investment position, labor and money. Variables with double prime symbol will be used for patient household for the rest of the paper. Impatient households maximize a lifetime utility function given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t (\ln(c''_t) + j_t \ln(d''_t) - (L''_t)^\eta / \eta + \kappa \ln(M''_t / P_t))$$

where  $\beta'' < \beta$ . This guarantees an equilibrium in which the borrowing constraint is binding for impatient households. Borrowing constraint is as follows:

$$c_t'' + q_t \Delta d_t'' + R_{t-1} b_{t-1}'' / \pi_t = b_t'' + w_t'' L_t'' + T_t'' - \Delta M_t'' / P_t - \xi_{d,t} \quad (6)$$

$$b_t'' \leq m'' E_t(q_{t+1} d_{t+1}'' \pi_{t+1} / R_t) \quad (7)$$

where  $\xi_{d,t} = \phi_d (\Delta d_t'' / d_{t-1}'')^2 q_t d_{t-1}'' / 2$  which is an analogous term also appears at budget constraint of patient household. Borrowing of the impatient household is limited to a fraction of the value of the individual's net international investment position which may be thought as an indicator of well being of the household. In other words,  $m'' = 0$  is like a limit case where household is excluded from the financial markets since their international assets are not considered reliable enough to let them borrow. First order conditions for the impatient household optimization problem are below:

$$\frac{1}{c_t''} = E_t \left\{ \frac{\beta'' R_t}{c_t'' \pi_{t+1}} + \lambda_t R_t \right\} \quad (8)$$

$$w_t'' = (L_t'')^\eta - 1 c_t'' \quad (9)$$

$$\frac{q_t}{c_t''} \left( 1 + \frac{\phi_d \Delta d_t''}{d_{t-1}''} \right) = \beta'' \frac{q_{t+1}}{c_{t+1}''} \left( 1 + \frac{\phi_d \Delta d_{t+1}''}{d_t''} \right) + \frac{j_t}{d_t''} + \lambda_t (m'' q_{t+1} \pi_{t+1}) \quad (10)$$

$$\frac{M_t''}{P_t} = \frac{\kappa(P_t c_t'')(P_t + 1 c_{t+1}'')}{(P_{t+1} c_{t+1}'') - \beta'' (P_t c_t'')} \quad (11)$$

where,  $\lambda_t$  is the shadow value associated with the borrowing constraint. We can see that first order conditions of the patient and impatient household differ (except (9)) with addition of a multiplier associated with borrowing constraint.

### 4.3 Entrepreneurs

Entrepreneurs produce intermediate good using  $L_t', L_t''$  patient and impatient household labor,  $K_t$  and  $F_t$  are domestic and foreign capital goods respectively which de-

preciate at rate  $\delta$  and created at the end of each period. Net international investment position is also assumed to contribute production. Production function of the intermediate good is as follows:

$$Y_t = A_t K_{t-1}^\nu d_{t-1}^\nu F_{t-1}^\zeta L_t'^{\alpha(1-\nu-\nu-\zeta)} L_t''^{(1-\alpha)(1-\nu-\nu-\zeta)} \quad (12)$$

where technology  $A_t$  is random. There exists an analogous of international investment adjustment term,  $\xi_{e,t}$ . Furthermore, an adjustment costs of capital  $\xi_{K,t}$  and  $\xi_{F,t}$  are included to capture real data dynamics.

$$\xi_{e,t} = \phi_e (\Delta d_t / d_{t-1})^2 q_t d_{t-1} / 2$$

$$\xi_{F,t} = \psi_e (M_t / F_{t-1} - \delta)^2 F_{t-1} / 2\delta$$

where  $M_t = F_t - (1 - \rho)F_{t-1}$  is the import of foreign capital

$$\xi_{K,t} = \psi_e (I_t / K_{t-1} - \delta)^2 K_{t-1} / 2\delta$$

where  $I_t = K_t - (1 - \delta)K_{t-1}$  is the flow of motion for capital.

The remainder of the problem is standard: Entrepreneurs maximize

$$E_0 \sum_0^\infty \gamma^t \log c_t$$

where  $\gamma < \beta$ . subject to technology (12), borrowing constraint (7) and budget constraint:

$$\frac{Y_t}{X_t} + b_t = c_t + q_t \Delta d_t + R_{t-1} b_{t-1} / \pi_t + w_t' L_t' + w_t'' L_t'' + q_t M_t + I_t + \xi_{e,t} + \xi_{K,t} + \xi_{F,t} \quad (13)$$

The first order conditions for the entrepreneurs are below:

$$\frac{1}{c_t} = \frac{\gamma R_t}{\pi_{t+1} c_{t+1}} + \lambda_t R_t b \quad (14)$$

$$v_t = \frac{1}{c_t} \left( \frac{\Psi}{\delta} \left( \frac{I_t}{K_{t-1}} - \delta \right) \frac{I_t}{K_{t-1}} - \frac{\Psi}{2\delta} \left( \frac{I_t}{K_{t-1}} - \delta \right)^2 \right) + \Psi E_t \frac{\mu Y_{t+1}}{c_{t+1} X_{t+1} K_t} + v_{t+1} (1 - \delta) \quad (15)$$

$$\text{where } v_t = \left( \frac{1}{c_t} \right) \left\{ 1 + \left( \frac{\Psi}{\delta} \right) \left[ \left( \frac{I_t}{K_{t-1}} \right) - \delta \right] \right\}$$

$$v'_t = \frac{1}{c_t} \left( \frac{\Psi}{\rho} \left( \frac{M_t}{F_{t-1}} - \rho \right) \frac{M_t}{F_{t-1}} - \frac{\Psi}{2\rho} \left( \frac{M_t}{F_{t-1}} - \rho \right)^2 \right) + \Psi E_t \frac{\mu Y_{t+1}}{c_{t+1} X_{t+1} F_t} + v'_{t+1} (1 - \rho) \quad (16)$$

$$\text{where } v'_t = \left( \frac{1}{c_t} \right) \left\{ 1 + \left( \frac{\Psi}{\rho} \right) \left[ \left( \frac{M_t}{F_{t-1}} \right) - \rho \right] \right\}$$

$$w'_t = \alpha (1 - v - v) \frac{Y_t}{X_t L'_t} \quad (17)$$

$$w''_t = (1 - \alpha) (1 - v - v) \frac{Y_t}{X_t L''_t} \quad (18)$$

where (16) and (17) are labor demand schedules and (15) states that shadow price of the capital,  $v_t$  equals marginal product of capital next period plus capital contribution to lower installation costs plus the shadow value of capital next period.

#### 4.4 Retailers

Retailers are the source of the nominal price rigidities. They purchase intermediate goods from entrepreneurs at  $P_t^w$  in a competitive market, differentiate goods at no cost into  $Y_t(z)$  and sell at price  $P_t(z)$ . The final goods production function is as follows:

$$Y_t^f = \left( \int_0^1 Y_t(z)^{\varepsilon-1/\varepsilon} dz \right)^{\varepsilon/\varepsilon-1}$$

correspondingly, each retailer faces the following demand curve

$$Y_t(z) = \left(\frac{P_t(z)}{P_t}\right)^{-\varepsilon} Y_t^f$$

retailers choose  $P_t(z)$  taking  $P_t^w$  and above demand curve. When probability of a producer to change prices is  $(1 - \theta)$ , optimal  $P_t^*$  solves

$$\sum_0^\infty \theta^k E_t \left\{ \Lambda_{t,k} \left( \frac{P_t^*(z)}{P_{t+k}} - \frac{X}{X_{t+k}} \right) Y_{t+k}^*(z) \right\} = 0 \quad (18)$$

where  $X_t = \frac{P_t^w}{P_t}$  is the mark-up and  $\Lambda_{t,k} = \beta^k \left( \frac{c_t}{c_{t+k}} \right)$  the first order condition with respect to  $P_t^*(z)$

$$\frac{\partial(\cdot)}{\partial P_t^*(z)} = 0 \rightarrow P_t^*(z) = \left( \frac{X_{t+k}}{X} \frac{1}{Y_{t+k} \varepsilon} \right)^{1-\varepsilon} P_{t+k} \quad (*)$$

Thus,  $P_t^*(z)$  equates expected discounted marginal utility and expected marginal cost (discounted). Profits,  $F_t = (1 - \frac{1}{X_t}) Y_t$  are finally rebated to patient households. Aggregate price level is:

$$P_t = (\theta P_{t-1}^{1-\varepsilon} + (1 - \theta) (P_t^*)^{1-\varepsilon})^{1/1-\varepsilon} \quad (**)$$

where the first term represents the fraction of retailers who do not change prices and the latter represent the fraction who change the prices at period t. Combining (\*) and (\*\*) and linearising yields a forward looking Phillips Curve which states that inflation depends on  $\pi^e$  positively and  $X_t$  negatively.

## 4.5 Central Bank

Central Bank makes lump-sum transfers of money to the real sector to implement a Taylor- type interest rate rule. To evaluate whether incorporating exchange rates

into the Taylor rule makes a difference along with the traditional Taylor rule, an augmented Taylor that incorporates exchange rates is constructed. Responses under both Taylor rules will be reported and compared at the next chapter.

Traditional Taylor rule:

$$R_t = (R_{t-1})^{r_R} (\pi_{t-1}^{1+r_\pi} (\frac{Y_{t-1}}{Y})^{r_y} \bar{r}_r)^{1-r_R} e_{R,t} \quad (19)$$

where  $\bar{r}_r$  is the steady state real rate and  $Y$  is the steady state real output. Hence, monetary policy responds systematically to past inflation and past output. We prefer backward looking rule to the forward looking rule since data favors this one. If  $r_R > 0$  the rule allows for interest rate inertia. And  $e_{R,t}$  is a white noise shock process with zero mean and variance  $\sigma_e^2$

Following Svensson (1999, 2000), both current and one period lagged exchange rates were added into the augmented Taylor rule.

$$R_t = (R_{t-1})^{r_R} (\pi_{t-1}^{1+r_\pi} (\frac{Y_{t-1}}{Y})^{r_y} \bar{r}_r)^{1-r_R-r_{q1}-r_{q2}} q_t^{r_{q1}} q_{t-1}^{r_{q2}} e_{R,t} \quad (20)$$

## 4.6 Equilibrium

Equilibrium is an allocation  $\{h_t, d'_t, d''_t, L'_t, L''_t, Y_t, c_t, c'_t, c''_t, b_t, b'_t, b''_t, K_t\}_{t=0}^\infty$  together with the sequence of values  $\{w'_t, w''_t, R_t, P_t, P_t^*, X_t, \lambda_t, \lambda'_t, \lambda''_t, q_t\}_{t=0}^\infty$  satisfying (1)-(15), market clearing conditions, sequence of shocks and transversality conditions.

- (1)  $\frac{1}{c'_t} = \beta E_t \left\{ \frac{R_t}{\pi_{t+1} c'_{t+1}} \right\}$
- (2)  $\frac{1}{c''_t} = \beta E_t \left\{ \frac{R_t}{\pi_{t+1} c''_{t+1}} + \lambda_t R_t \right\}$
- (3)  $w'_t = (L'_t)^{\eta-1} c'_t$
- (4)  $w''_t = (L''_t)^{\eta-1} c''_t$
- (5)  $\frac{q_t}{c'_t} = \frac{j}{d'_t} + E_t \left\{ \frac{\beta q_{t+1}}{c'_{t+1}} \right\}$
- (6)  $\frac{q_t}{c''_t} = \frac{j}{d''_t} + E_t \left\{ \frac{\beta q_{t+1}}{c''_{t+1}} + \lambda_t \{m'' q_{t+1} \pi_{t+1}\} \right\}$

$$(7) Y_t = A_t K_{t-1}^\mu d_{t-1}^\nu L_t'^{\alpha(1-\mu-\nu)} L_t''(1-\alpha)(1-\mu-\nu)_t$$

$$(8) \frac{Y_t}{X_t} + b_t = c_t + q_t \Delta h_t + \frac{R_{t-1} b_{t-1}}{\pi_t} + w_t' L_t' + w_t'' L_t'' + I_t + \xi_{e,t} + \xi_{K,t}$$

$$\text{where } X_t = \frac{P_t}{\bar{P}_t^w}$$

$$(9) \frac{1}{c_t} = E_t \left\{ \frac{\gamma R_t}{\pi_{t+1} c_{t+1}} \right\} + \lambda_t R_t$$

$$(10) v_t = \frac{1}{c_t} \left( \frac{\Psi}{\delta} \left( \frac{I_t}{K_{t-1}} - \delta \right) \frac{I_t}{K_{t-1}} - \frac{\Psi}{2\delta} \left( \frac{I_t}{K_{t-1}} - \delta \right)^2 \right) + \gamma E_t \left\{ \frac{\mu Y_{t+1}}{c_{t+1} X_{t+1} K_t} + v_{t+1} (1 - \delta) \right\}$$

$$\text{where } v_t = \frac{1}{c_t} \left( 1 + \frac{\Psi}{\delta} \left( \frac{I_t}{K_{t-1}} \right)^{-\delta} \right)$$

$$(11) w_t' = \alpha(1-\mu-\nu) \frac{Y_t}{X_t L_t'}$$

$$(12) w_t'' = (1-\alpha)(1-\mu-\nu) \frac{Y_t}{X_t L_t''}$$

$$(13) b_t = m E_t \left\{ \frac{q_{t+1} h_t \pi_{t+1}}{R_t} \right\}$$

$$(14) \sum_{t=0}^{\infty} \theta^k E_t \left\{ \Lambda_{t,k} \left( \frac{P_t^*(z)}{P_{t+k}} - \frac{X}{X_{t+k}} \right) Y_{t+k}^*(z) \right\} = 0$$

$$(15) P_t = (\theta P_{t-1}^{1-\varepsilon} + (1-\theta)(P_t^*)^{1-\varepsilon})^{1/1-\varepsilon}$$

Market Clearing Conditions

$$(1) L_t = L_t' + L_t''$$

$$(2) d_t = d_t' + d_t''$$

$$(3) Y_t = c_t + c_t' + c_t'' + I_t$$

$$(4) b_t + b_t' + b_t'' = 0$$

$$\text{given } \{h_{t-1}, R_{t-1}, b_{t-1}, P_{t-1}\}$$

and shocks  $\{e_{R,t}, e_{\pi,t}, e_{j,t}, e_{A,t}\}$  and following transversality conditions :

$$\lim_{t \rightarrow \infty} \beta^t u_{c,t} m_t = 0$$

$$\lim_{t \rightarrow \infty} \beta^t u_{c,t} k_t = 0$$



## **CHAPTER 5**

### **VAR ANALYSIS**

In this chapter, reaction of Turkish economy to the shocks to monetary policy, inflation, technology and exchange rates (through preferences) will be examined. At the first glimpse, it may seem confusing to use both empirical and theoretical models. But by conducting an empirical analysis, the aim is to measure the success of the fitting of the model i.e. tests whether the theoretical model constructed for post-crisis Turkish economy provide realistic dynamics compared to the data. Furthermore, we will have the opportunity to compare the responses at different equilibriums.

For this purpose, a vector auto regression analysis is constructed based on policy interest rate, real GDP, inflation and exchange rates. Exchange rate is the key variable in the analysis since aim is to answer whether responding exchange rates makes a difference in business cycle fluctuations. In this sense, output and inflation are also inevitable to measure the volatility of business cycle in IT framework. Finally, importance of interest rate in the theoretical model and IT framework make it necessary to incorporate interest rate in the analysis. Furthermore, these variables maximize the compatibility with the theoretical model since in the model; shocks are given to the system via technology (output), preferences (exchange rates), monetary policy (interest rates) and inflation. A constant and a time trend was also added as exogenous variables. For the output values, the log of real GDP was detrended

with Hodrick-Prescott filter. Change in the log of consumer price index was used for inflation data and exchange rates were sampled from real effective exchange rates based on CPI.

The analysis is based on monthly data covering the time period January 2003 to March 2012. There are two reasons to make such a selection. First is to use an overlapping sample as the one used in the calibration of the model. Also, during this period, inflation targeting framework was actively being used by Central Bank of Republic of Turkey (implicit and explicit). All data is obtained from CBRT and TURKSTAT.

The unit root tests are undertaken to evaluate the time series properties of the selected variables. Augmented Dickey Fuller (ADF) test reports that nominal exchange rate and CPI are non-stationary in levels and first distances, but stationary in second differences, suggesting that they are integrated of order 2, I(2). Output and interest rates are first difference stationary variables, I(1). Although, differencing the data even if they contain a unit root is a controversial subject, this thesis adopts the strategy of differencing. Hence, all variables enter the model in second differences.

Model can be expressed as follows:

$$Y_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \varepsilon_t$$

$$\text{where } Y_t = \begin{bmatrix} r_t \\ \pi_t \\ q_t \\ y_t \end{bmatrix}, X_{t-1} = \begin{bmatrix} r_{t-1} \\ \pi_{t-1} \\ q_{t-1} \\ y_{t-1} \end{bmatrix}, X_{t-2} = \begin{bmatrix} r_{t-2} \\ \pi_{t-2} \\ q_{t-2} \\ y_{t-2} \end{bmatrix}, \varepsilon_t = \begin{bmatrix} \varepsilon_{r,t} \\ \varepsilon_{\pi,t} \\ \varepsilon_{q,t} \\ \varepsilon_{y,t} \end{bmatrix},$$

$$\beta_0 = \begin{bmatrix} \beta_{1,0} \\ \beta_{2,0} \\ \beta_{3,0} \\ \beta_{4,0} \end{bmatrix}, \beta_1 = \begin{bmatrix} \beta_{1,1} & \beta_{1,3} & \beta_{1,5} & \beta_{1,7} \\ \beta_{2,1} & \beta_{2,3} & \beta_{2,5} & \beta_{2,7} \\ \beta_{3,1} & \beta_{3,3} & \beta_{3,5} & \beta_{3,7} \\ \beta_{4,1} & \beta_{4,3} & \beta_{4,5} & \beta_{4,7} \end{bmatrix}, \text{ and } \beta_2 = \begin{bmatrix} \beta_{1,2} & \beta_{1,4} & \beta_{1,6} & \beta_{1,8} \\ \beta_{2,2} & \beta_{2,4} & \beta_{2,6} & \beta_{2,8} \\ \beta_{3,2} & \beta_{3,4} & \beta_{3,6} & \beta_{3,8} \\ \beta_{4,2} & \beta_{4,4} & \beta_{4,6} & \beta_{4,8} \end{bmatrix}$$

And system of equations is :

$$(1)r_t = \beta_{1,0} + \beta_{1,1}r_{t-1} + \beta_{1,2}r_{t-2} + \beta_{1,3}\pi_{t-1} + \beta_{1,4}\pi_{t-2} + \beta_{1,5}q_{t-1} + \beta_{1,6}q_{t-2} + \beta_{1,7}y_{t-1} + \beta_{1,8}y_{t-2} + \epsilon_{r,t}$$

$$(2)\pi_t = \beta_{2,0} + \beta_{2,1}r_{t-1} + \beta_{2,2}r_{t-2} + \beta_{2,3}\pi_{t-1} + \beta_{2,4}\pi_{t-2} + \beta_{2,5}q_{t-1} + \beta_{2,6}q_{t-2} + \beta_{2,7}y_{t-1} + \beta_{2,8}y_{t-2} + \epsilon_{\pi,t}$$

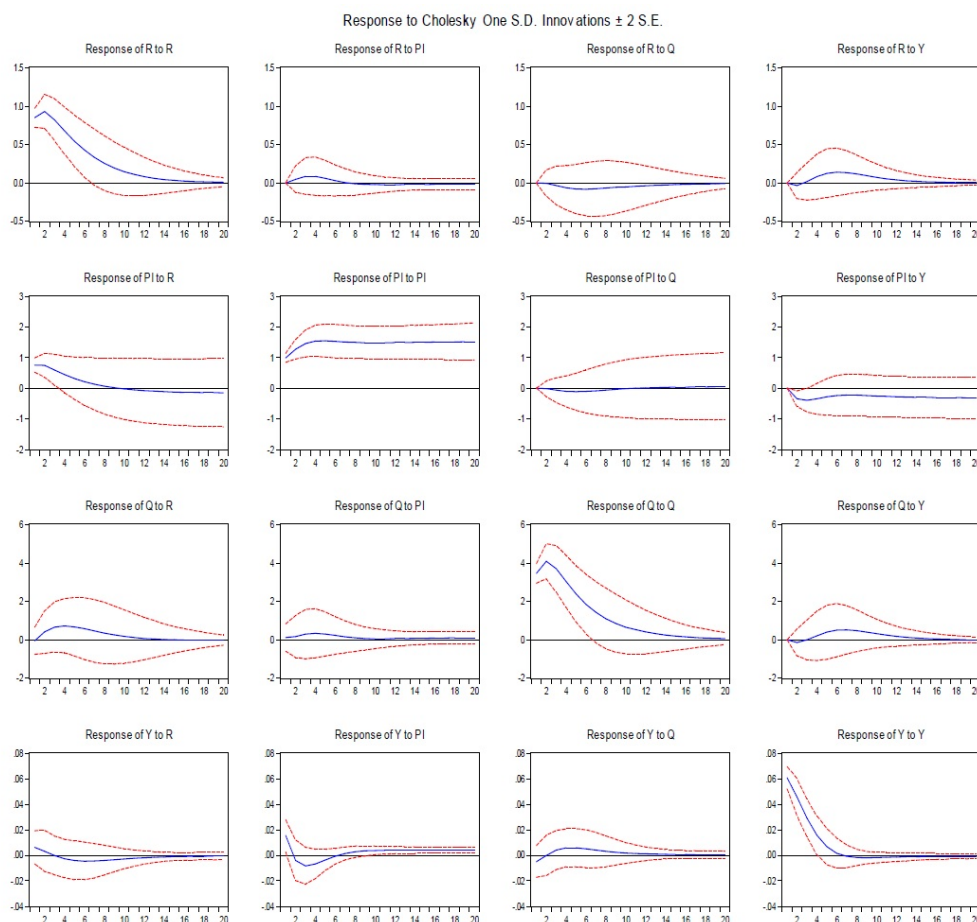
$$(3)q_t = \beta_{3,0} + \beta_{3,1}r_{t-1} + \beta_{3,2}r_{t-2} + \beta_{3,3}\pi_{t-1} + \beta_{3,4}\pi_{t-2} + \beta_{3,5}q_{t-1} + \beta_{3,6}q_{t-2} + \beta_{3,7}y_{t-1} + \beta_{3,8}y_{t-2} + \epsilon_{q,t}$$

$$(4)y_t = \beta_{4,0} + \beta_{4,1}r_{t-1} + \beta_{4,2}r_{t-2} + \beta_{4,3}\pi_{t-1} + \beta_{4,4}\pi_{t-2} + \beta_{4,5}q_{t-1} + \beta_{4,6}q_{t-2} + \beta_{4,7}y_{t-1} + \beta_{4,8}y_{t-2} + \epsilon_{y,t}$$

Identification of the shocks of such model is achieved by applying Cholesky decomposition. Cholesky decomposition imposes restrictions which is necessary to identify the structural VAR model that links the reduced form and the structural residuals. Economically, these restrictions imply that some of the structural shocks do not have a contemporaneous impact on some of the variables. Therefore, economic interpretation is obtained through the ordering of the variables, as it specifies which shocks are not allowed to contemporaneously affect which variables. In line with the earlier studies, Cholesky ordering in this study is: policy rate, inflation, exchange rates and output respectively. However, later simulations with different orderings did not alter the results significantly. Furthermore, system found to be stable since all inverse roots of polynomial function are within unit circle(see Figure 8).

At the above table, impulse response functions of the VAR analysis can be observed. After a shock to monetary policy, interest rates raise immediately around 10 basis points. Inflation also responds with an immediate one base point increase. Exchange rates rises gradually and respond of output is negative. All variables except interest rates (1.5 years) normalize around a year (first column). To a shock to inflation, exchange rates positive respond is weak, on the contrary to outputs weak negative respond. All responds are normalized after six months (second column).

Figure 3: Impulse Responses of VAR Analysis



Responds to exchange rate are all weak except its own. Interest rate and inflation moved together where outputs sudden decrease followed by a gradual raise and then normalized. Excluding exchange rates, all other variables normalize less than a year (third column). Finally, in respond to a technology shock, interest rates and exchange rates move positively with around 3 months lag and inflation respond negatively. Impacts of the technology shock are relatively long termed (fourth column).

In summary, in light of this analysis, one may expect:

- A positive response of inflation and exchange rate, and a negative response of output in case of a monetary tightening.

- A small negative response of output and a slight positive response of exchange rates to a positive inflation disturbance.
- A positive co movement of inflation, exchange rates and output with some lags to a preference shock that affects exchange rates.
- And a negative response of inflation and exchange rates to output shocks.

## CHAPTER 6

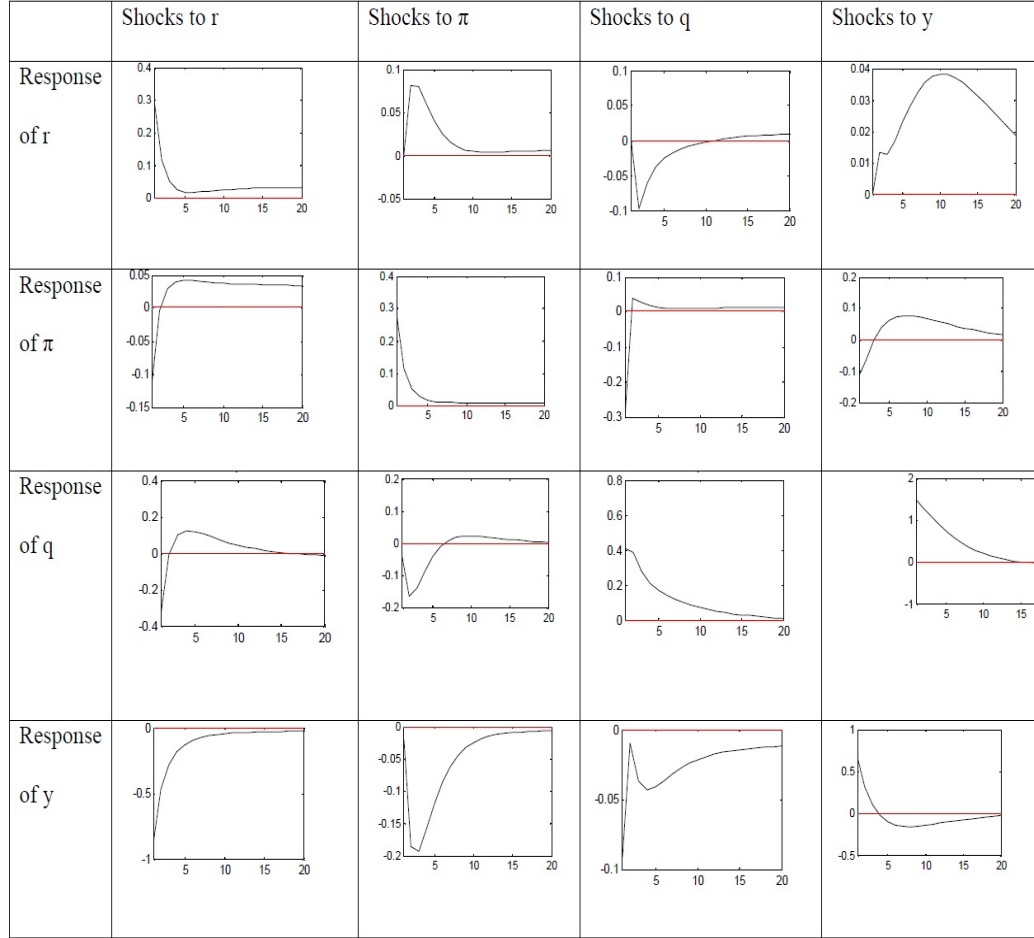
### RESULTS

In this section, VAR responses and model responses under a traditional Taylor rule and an augmented Taylor rule that incorporates exchange rates will be compared. In the traditional Taylor rule, greater importance is given to the stabilization of output to approximate the monetary policy responses of post crisis Turkish economy.

Into the augmented Taylor rule, both current and one period lagged exchange rate are added. Following Svensson (1999, 2000), coefficients are selected as -0.37 and 0.17 for the current periods and previous periods exchange rates, respectively. Svensson run a series of simulation exercises and suggested that these values are optimal. Although, optimality is dependent on the model specification and parameterization, they may serve as a good starting point for this study.

At the above tables, model responses under two Taylor rules can be found. First columns show a monetary tightening. As expected, responses are very similar under both Taylor rules with a shock to monetary policy. One difference is that inflation stabilizes sooner at the model with augmented Taylor rule. Models differ from the VAR with the immediate decreases in  $\pi$  and  $q$ . Both responses approximate the VAR after their fifth period. On the other hand, model and VAR varied significantly for output responses. Both models deliver strong negative reactions where VAR reports

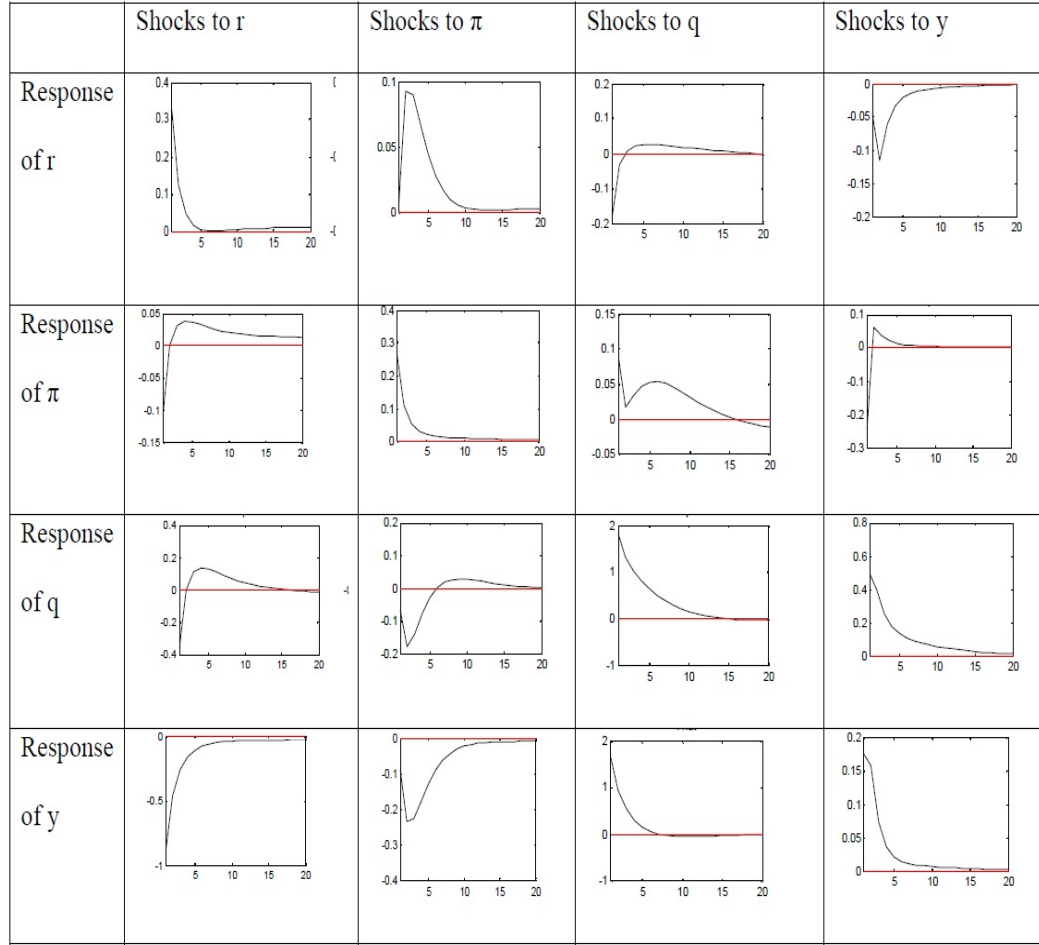
Figure 4: Impulse Responses of Model with Traditional Taylor Rule



slight positive response and gradual decline until normalization.

Considering the shock to inflation case, one could observe that the two models only differ slightly in the sense that normalization is sooner at the model with augmented Taylor rule. Impacts of the shock to the inflation do not die out at the VAR, on the contrary to the models in which normalization occurs approximately 6 months later. This may be interpreted with the rise of the inflationary expectations and becoming sticky at high levels. Combining with the inflation history of Turkey, this may be a plausible explanation for the difference. Response of the output is well approximated but model failed to capture the impact on exchange rates.

Figure 5: Impulse Responses of Model with Augmented Taylor Rule



Responses of models to a productivity shock are very similar excluding the response of exchange rates. Under traditional Taylor rule set-up, after shock hits, a strong negative response is observed after a sharp recovery, followed by a decline began around third month and another recovery period began after fifth month. In other words, response of exchange rate is volatile. But at the model with augmented Taylor rule, the response is pretty smooth. When the results of VAR and the models are compared, matching can be observed for only output responses. Neither the immediate declines in interest rate, nor the sharp increase in inflation can be observed in the VAR responses. Moreover, positive response of exchange rates comes with a



lag of 4 months at VAR, where the response is immediate at models.

The most dramatic effect of including exchange rates in Taylor rule can be observed at the responses to a preference shock that influence exchange rates. In the traditional model, response of interest rate is very strong and permanent where in the model with augmented Taylor rule, after the initial impact of a decline, interest rate normalizes in 1,5 years. Response of exchange rates are very similar and only magnitude differs at the responses of output. VAR results approximate responses of interest rate but with a lag. Response of inflation at the model with augmented Taylor rule do not match with VAR well, which may be a consequence of ignorance of exchange rates in the policy rule. Relative similarity between traditional model and VAR may be a supportive finding for this interpretation. Finally, response of output is underestimated in the model.

In general, the model responses mostly differ from the VAR responses in the case of a shock to productivity. A possible reason for this may be the fact that, it is harder to take VAR shock as a productivity shock since a tax or government spending shock could be observationally equivalent. For this reason, comparison between VAR and model is harder in this case. Responses of VAR and model to a shock to monetary policy and inflation match quite well. But interestingly, at the model there exists common sudden declines immediately after the shock. After approximately five periods, these sudden declines come to the levels to VAR responses initial levels. Another point to note is that, model responses are less in magnitude i.e. model is successful in minimizing output and inflation fluctuations. Especially, after an inflation shock, at VAR, inflation does not return to its initial returns, however with the model both response is much smaller and normalization occur less than half a year. The hardest issue is to evaluate a shock to exchange rates. Exchange rates own response is similar but smaller in magnitude where the outputs response is larger in magnitude. Although, VAR response of inflation is very limited, model delivers

positive response of inflation which is in line with the theory.

On the other hand, along with reducing volatility, incorporating exchange rates into the monetary policy create a tradeoff between inflation and output in some cases. To a shock to monetary policy and inflation, there are obvious gains in stabilization of inflation however, that may require an output gap sacrifice. On the contrary, in the case of an exchange rate shock, output gains and inflation convergence to the target tradeoff exists.

## **CHAPTER 7**

### **CONCLUSION**

In this thesis, impacts of global financial crisis on IT framework are examined. Deficiencies of the framework are discussed and some extensions are proposed. After the global financial crisis, one of the most criticized concepts was IT framework, for remaining blinded to building up of vulnerabilities and could not respond to instabilities in financial sector. However, finding a universal formula for ensuring financial stability is not an easy task since, for every country, financial stability indicators differ significantly. Furthermore, for developing countries, financial channels work through international capital flows and exchange rates.

This study aims to propose a model for post crisis Turkish economy, where trade and credit channels are more effective compared to financial channels. In this context, to clarify the motivation of the study, first an overview of the inflation targeting is made with an emphasis on the role of financial stability, international capital flows and exchange rates. Discussion of global financial crisis and its impact on Turkish economy helps to motivate the extensions of the model.

To answer the question whether responding to exchange rates makes a difference in dampening the business cycle fluctuations; a small open economy DSGE model is constructed. Base model is extended to capture Turkish economy's dynamics. According to the finding that Turkish economy mostly affected from the global financial crisis via

credit and trade channels, net international investment position and imported capital goods are incorporated to the model. Additionally, a VAR analysis is performed to measure the fitting and success of the model quantitatively. Although, it may seem the combination of two different methodologies, we like to measure the success of the theoretical model empirically. Within this scope, responses of VAR analysis and models with traditional and augmented Taylor rules are compared.

Main contribution of this thesis is the construction of the model that allows exchange rate fluctuations. Ability to capture the trade channel and credit channel are key features. Finally, addition of exchange rates into the Taylor rule in this model allows comparison with traditional Taylor rule in this set up.

According to the model responses, model with the augmented Taylor rule approximates the Turkish economy dynamics better. Furthermore, model with the augmented Taylor rule helps to smooth business cycle fluctuations compared to traditional Taylor rule and VAR responses. However, in case of a shock to inflation and monetary policy, gains from volatility in inflation may require a sacrifice in output gap and on the contrary, in case of a shock to exchange rates, there exists a tradeoff between gains from output gap and higher inflation.

In conclusion, global financial crisis made it clear that IT framework should be revised and extended to avoid potential threats from financial sector, international capital flows and exchange rates. Global financial crisis also indicated that, a universal cure is impossible since fragilities of each country are different. This thesis focuses on countries that suffer from high current account deficits and vulnerable against sudden stops and contraction in external demand through fluctuations in exchange rates like Turkey or more generally emerging economies.

With the extensions, model is able to capture the dynamics of Turkish economy pretty good. We can generalize that it can be used for developing economies that are affected from global crisis via trade and credit channels rather than developed countries

that are affected by financial channels. Model responses indicate that overall, incorporating exchange rates into the Taylor rule helps to dampen the business cycle fluctuations. But in above mentioned circumstances, Central Bank should clarify its priorities between output gap and inflation volatility since there exist a tradeoff between them.

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## APPENDIX A

### The Complete Log-Linearized Model

#### Aggregate Demand

Goods market clearing

$$(A1) \hat{Y}_t = \frac{c}{Y} \hat{c}_t + \frac{c'}{Y} \hat{c}'_t + \frac{c''}{Y} \hat{c}''_t + \frac{I}{Y} \hat{I}_t$$

Euler equation for patient household

$$(A2) \hat{c}'_t = E_t\{\hat{c}'_{t+1}\} - \hat{r}r_t$$

Investment schedule

$$(A3) \hat{I}_t - \hat{K}_{t-1} = \gamma(E_t\{\hat{I}_{t+1}\} - \hat{K}_t) + \frac{1-\gamma(1-\delta)}{\psi}(E_t\{\hat{Y}_{t+1} - \hat{X}_{t+1}\} - \hat{K}_t) + \frac{1}{\psi}(\hat{c}_t - E_t\{\hat{c}_{t+1}\})$$

#### Net international investment position/consumption margin

Entrepreneur's optimality condition for net international investment position/consumption

$$(A4) \hat{q}_t = \gamma_e E_t\{\hat{q}_{t+1}\} + (1 - \gamma_e)(E_t\{\hat{Y}_{t+1} - \hat{X}_{t+1}\} - \hat{d}_t) - m\beta \hat{r}r_t - (1 - m\beta)E_t\{\Delta \hat{c}_{t+1}\} - \phi_e(\Delta \hat{d}_t - \gamma \hat{d}_t + 1)$$

Impatient household's optimality condition for net international investment position/consumption

$$(A5) \hat{q}_t = \gamma_d E_t\{\hat{q}_{t+1}\} + (1 - \gamma_d)(\hat{j}_t - \hat{h}_t'') - m''\beta \hat{r}r_t + (1 - m''\beta)(\hat{c}_t'' - \omega E_t\{\hat{c}_{t+1}''\}) - \phi_d(\Delta \hat{d}_t'' - \beta'' E_t\{\Delta \hat{d}_{t+1}''\})$$

$$\text{where } \omega = (\beta'' - m''\beta'')/(1 - m''\beta), \gamma_h = \beta'' + m''(\beta - \beta'')$$

Patient household's demand incorporating market clearing

$$(A6) \hat{q}_t = \beta E_t \{\hat{q}_{t+1}\} + (1 - \beta) \hat{j}_t + \mathfrak{u} \hat{h}_t + \mathfrak{u}'' \hat{h}_t'' + \hat{c}'_t - \beta E_t \{\hat{c}'_{t+1}\} + \frac{\Phi_d}{d'} (d \Delta \hat{d}_t + d'' \Delta \hat{d}_t'' - E_t \{\beta d \Delta \hat{d}_{t+1} - \beta d'' \Delta \hat{d}_{t+1}''\})$$

$$\text{where } \mathfrak{u} = (1 - \beta) d / d', \mathfrak{u}'' = (1 - \beta) h'' / h' x_z$$

## Borrowing constraints

Borrowing constraint for entrepreneurs

$$(A7) \hat{b}_t = E_t \{\hat{q}_{t+1}\} + \hat{d}_t - \hat{r} \hat{r}_t$$

Borrowing constraint for impatient households

$$(A8) \hat{b}_t'' = E_t \{\hat{q}_{t+1}\} + \hat{d}_t'' - \hat{r} \hat{r}_t$$

$$\text{where } \hat{r} \hat{r}_t = \hat{R}_t - E_t \{\hat{p} i_{t+1}\}$$

## Aggregate Supply

Production function combined with market clearing

$$(A9) \hat{Y}_t = \frac{\eta}{\eta - (1 - \nu - \mathfrak{u})} (\hat{A}_t + \nu \hat{d}_{t-1} + \mu \hat{K}_{t-1}) - \frac{1 - \nu - \mu}{\eta - (1 - \nu - \mu)} (\hat{X}_t + \alpha \hat{c}'_t + (1 - \alpha) \hat{c}_t'')$$

Phillips Curve

$$(A10) \hat{p} i_t = \beta E_t \{\hat{p} i_{t+1}\} - \kappa \hat{X}_t + \hat{u}_t$$

## Flows of funds/evolution of state variables

Law of motion for capital

$$(A11) \hat{K}_t = \delta \hat{I}_t + (1 - \delta) \hat{K}_{t-1}$$

Net worth dynamics for entrepreneurs

$$(A12) \frac{b}{Y} \hat{b}_t = \frac{c}{Y} \hat{c}_t + \frac{qd}{Y} \Delta \hat{d}_t + \frac{I}{Y} \hat{I}_t + \frac{Rb}{Y} (\hat{R}_{t-1} + \hat{b}_{t-1} - \hat{p} i_t) - (1 - s' - s'') (\hat{Y}_t - \hat{X}_t)$$

Net worth dynamics for impatient households

$$(A13) \frac{b''}{Y} \hat{b}_t'' = \frac{c''}{Y} \hat{c}_t'' + \frac{qd''}{Y} \Delta \hat{d}_t'' + \frac{Rb''}{Y} (\hat{R}_{t-1} + \hat{b}_{t-1}'' - \hat{p} i_t) - s'' (\hat{Y}_t - \hat{X}_t)$$

## Monetary policy rule and shock processes

Traditional Taylor rule

$$(A14) \hat{R}_t = (1 - r_R)(1 + r_\pi)\hat{p}i_{t-1} + r_Y(1 - r_R)\hat{Y}_{t-1} + r_R\hat{R}_{t-1} + \hat{e}_{R,t}$$

Augmented Taylor rule

$$(A15) \hat{R}_t = (1 - r_R - r_{q1} - r_{q2})(1 + r_\pi)\hat{p}i_{t-1} + r_Y(1 - r_R)\hat{Y}_{t-1} + r_R\hat{R}_{t-1} + r_{q1}\hat{q}_t + r_{q2}\hat{q}_{t-1} + \hat{e}_{R,t}$$

Stochastic AR(1) process for preferences

$$(S1) \hat{j}_t = \rho \hat{j}_{t-1} + \hat{e}_{j,t}$$

Stochastic AR(1) process for inflation

$$(S2) \hat{u}_t = \rho_u \hat{u}_{t-1} + \hat{e}_{u,t}$$

Stochastic AR(1) process for technology

$$(S3) \hat{A}_t = \rho_A \hat{A}_{t-1} + \hat{A}_{A,t}$$

## APPENDIX B

### Figures and Tables

Figure 6: Total Loan Growth Rates  
(13 weeks moving average, annual fx adjusted, percent)

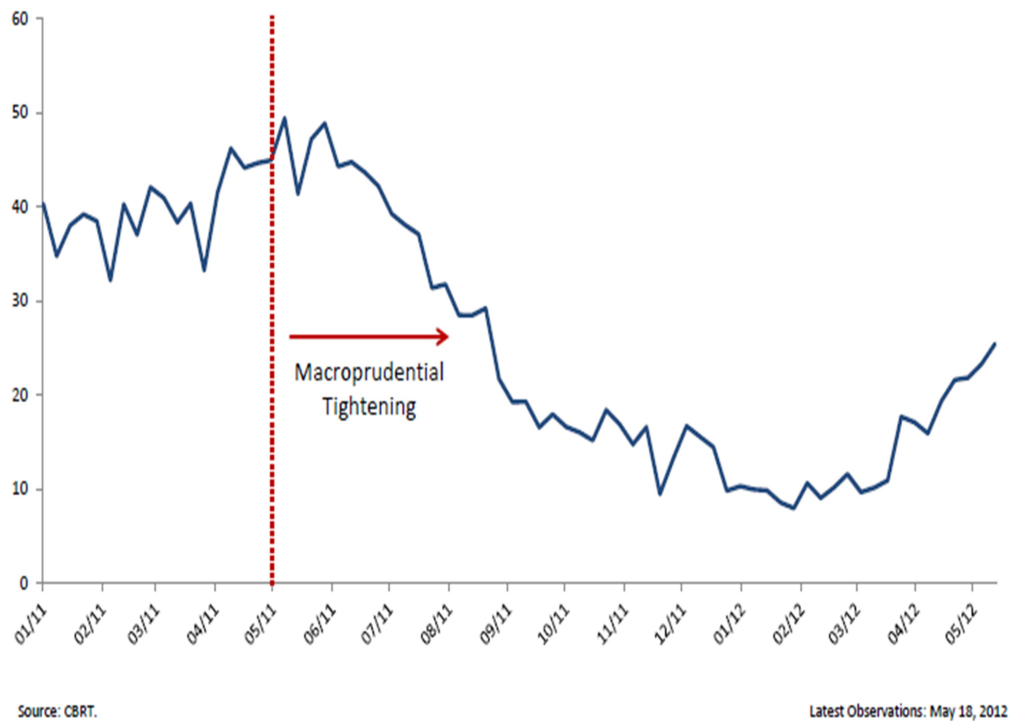
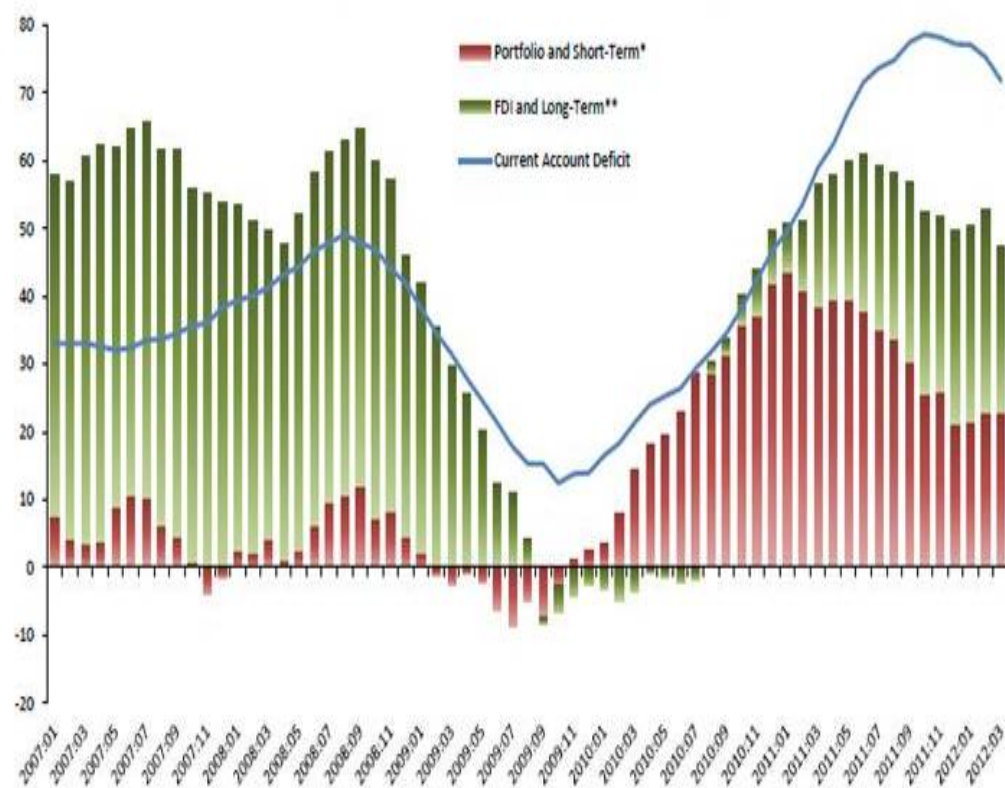


Figure 7: Main Sources of Current Account Deficit Finance  
12-months cumulative, billion USD



Source: CBRT.

\*Short-term capital movements are sum of banking and real sectors' short term net credit and deposits in banks.

\*\*Long-term capital movements are sum of banking and real sectors' long term net credit and bonds issued by banks and the Treasury.

Figure 8: Inverse Roots of AR Characteristic Polynomial

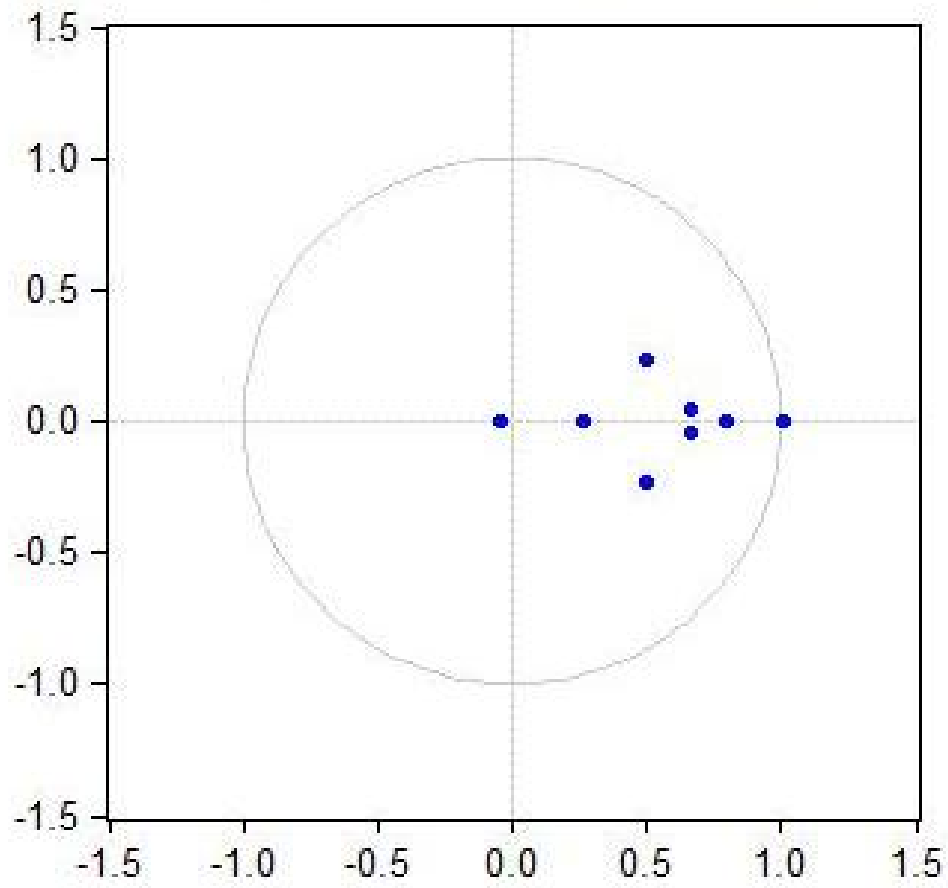


Figure 9: Combined Impulse Responses

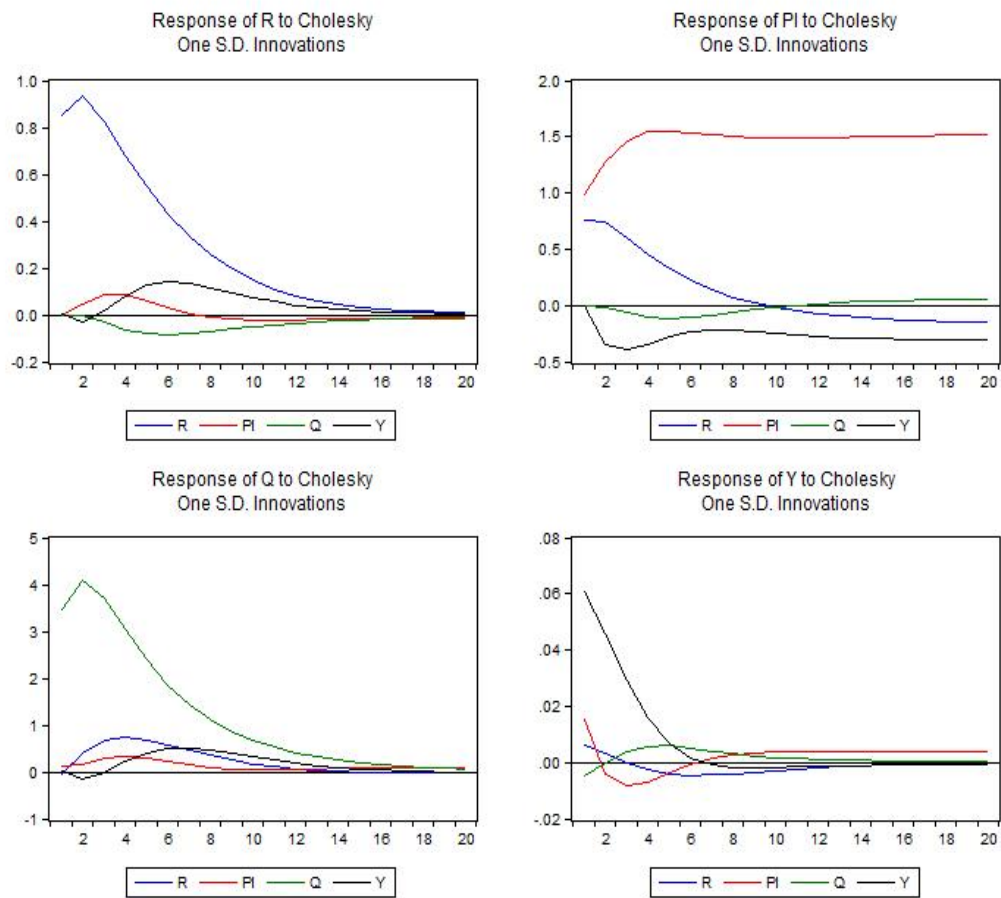


Table 1: VAR Estimates

Sample (adjusted): 2004M05 2012M03				
Included observations: 95 after adjustments				
Standard errors in ( ) & t-statistics in [ ]				
	R	PI	Q	Y
R(-1)	1.050678	-0.30623	0.501579	0.012449
	-0.13126	-0.19233	-0.53478	-0.00976
	[ 8.00449]	[-1.59218]	[ 0.93791]	[ 1.27519]
R(-2)	-0.18847	0.153942	-0.37625	-0.01709
	-0.13443	-0.19698	-0.5477	-0.01
	[-1.40193]	[ 0.78152]	[-0.68695]	[-1.70901]
PI(-1)	0.055586	1.374356	0.064194	-0.01584
	-0.08772	-0.12854	-0.3574	-0.00652
	[ 0.63365]	[ 10.6922]	[ 0.17961]	[-2.42836]
PI(-2)	-0.05956	-0.37368	-0.06008	0.016866
	-0.08878	-0.13008	-0.3617	-0.0066
	[-0.67083]	[-2.87262]	[-0.16612]	[ 2.55432]
Q(-1)	-0.00181	-0.01295	1.180371	0.001035
	-0.0249	-0.03648	-0.10143	-0.00185
	[-0.07287]	[-0.35504]	[ 11.6372]	[ 0.55915]
Q(-2)	-0.00417	0.010389	-0.31862	-0.00035
	-0.02525	-0.03699	-0.10286	-0.00188
	[-0.16520]	[ 0.28082]	[-3.09759]	[-0.18484]
Y(-1)	-0.56187	-5.68342	-2.29551	0.750875
	-1.4174	-2.07688	-5.77476	-0.10542
	[-0.39641]	[-2.73652]	[-0.39751]	[ 7.12255]
Y(-2)	1.611412	5.398749	4.923466	-0.16383
	-1.42809	-2.09254	-5.8183	-0.10622
	[ 1.12837]	[ 2.58000]	[ 0.84620]	[-1.54243]
C	-14.3262	6.660468	-27.4302	6.404891
	-17.5937	-25.7795	-71.6799	-1.30856
	[-0.81428]	[ 0.25836]	[-0.38268]	[ 4.89459]
R-square	0.804372	0.998132	0.848148	0.719242
Adj. R-sq	0.786174	0.997958	0.834022	0.693125
Sum sq. ri	62.03619	133.1927	1029.737	0.34318
S.E. equa	0.849324	1.244489	3.460302	0.06317
F-statistic	44.20123	5744.806	60.04269	27.53915
Log likeli	-114.557	-150.85	-248	132.3113
Akaike Ai	2.601192	3.365271	5.410533	-2.59603
Schwarz S	2.843138	3.607217	5.652479	-2.35408
Mean de	8.352311	149.2436	116.4426	15.93206
S.D. depe	1.836721	27.54328	8.49355	0.114033
Determinant resid c		0.031011		
Determinant resid c		0.020827		
Log likelihood		-355.299		
Akaike information		8.237882		
Schwarz criterion		9.205667		