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THE OPTIMAL MONETARY POLICY AND THE CHANNELS OF MONETARY TRANSMISSION MECHANISM IN CIS-7 COUNTRIES: THE CASE OF GEORGIA

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The Optimal Monetary Policy and the Channels of Monetary Transmission Mechanism in CIS-7 Countries: The Case of Georgia*

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Abstract

The main purpose of this paper is estimation of monetary transmission mechanism in the post-stabilization experience of CIS-7 economy. Specifically, I set up a model consistent with economic theory and practical for monetary policy analysis within a structural vector autoregression (SVAR) framework. This model is used to study the real effects of monetary policy instruments and to determine the most significant channels of monetary transmission in Georgia. The paper finds that a shock in the exchange rate has more sound impact on the behavior of the economy than an interest rate shock and a foreign exchange interventions shock. Next, an external shock to the US interest rate has less significant impact on the Georgian economy than the domestic monetary policy shocks. Finally, a shock to the forex interventions is more important source of fluctuations in the exchange rate level than a shock to the interest rate.

Keywords: monetary transmission mechanism, structural vector autoregressions, monetary policy

JEL classification: E52, C32

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Table of Contents

Introduction

The transition from a planned economy to a market-oriented one started to take place in the early 1990s in all Former Soviet Union (FSU) countries. Transition in the financial sector involved transforming the only existing specialized bank, which was responsible for both monetary policy and commercial banking, into a decentralized financial system being fully integrated into a market economy. This process was not painless nor without mistakes; moreover, the optimality of a monetary policy is still questionable in CIS-7 countries, which represent a particular group of FSU economies. These are relatively small economies with a high degree of dollarization, and in which the financial system is still far from Ill-developed. The instability in these countries, which is usually caused by a poorly designed monetary policy, can be explained by the lack of any deep examination of the channels through which changes in monetary policy affect the economy (for example, Gigineishvili, 2002).

In recent years, CIS-7 central banks have opted for inflation and/or price stability as primary targets of monetary policy giving less consideration to other goals such as real growth and employment. As opposed to industrialized countries, in transitional economies that typically have a fragile economic structure, under-developed financial markets, a history of high inflation and a lack of central bank credibility, the influence of monetary instruments on the real sector becomes unpredictable. Nevertheless, even if price stability is the only objective of a monetary policy for CIS-7 countries listed earlier (National Bank Organic laws of CIS-7 countries, 2001); its impact on output and employment needs to be considered. That is, to design and implement a prudent monetary policy that would insure targeted price stability in these countries, it is essential to understand properly the monetary transmission mechanism (MTM), which determines the linkage between the financial and real sectors and explains how decisions of monetary authorities affect their final target – inflation.

Moreover, it should be noted and taken into account that this linkage can be of different strengths depending on the state of the economy. The transition process makes a great impact on the functioning of the whole system. Much attention has been given to structural vector autoregressions (SVAR) for

modeling a transition economy (for example, Elbourne and Haan, 2006). Indeed, SVARs are a useful modeling tool for transition economies characterized by a short data series and rich economic interactions which make reliance on traditional theoretical models doubtful (Ganev, Molnar, Rybinski and Wozniak, 2002). However, SVAR might have problems capturing the dynamics of institutional change related to the transition process, and one has to be careful about the presence and relevance of structural breaks. Structural breaks or regime shifts contain the information that should be taken into account in order to attain better forecasts or achieve better policy analysis (Vogelsang, 1997). In this work, I use the SVAR methodology to capture the transition features of the CIS-7 economies. The data set for Georgia is used to study the real effects of the monetary policy in this country.

In addition, most National Banks in CIS-7 countries have been actively conducting interventions since the start of the transition process. Foreign exchange rate intervention is probably the most important instrument of exchange rate management in these countries and should be taken into account in monetary transmission analysis. Many central banks view interventions as a supplementary instrument of monetary policy.[3] In most countries, however, the actual foreign exchange intervention data typically is not available. Even for the US, this data has become accessible only recently (Kim, 2003). The National Bank of Georgia (NBG) has made the data on foreign exchange interventions available for research only this year. Having this data in hand, in this paper, I analyze not only the effects of common monetary policy instruments (the interest rate and the exchange rate) but also the effect of foreign exchange interventions on the real sector of the Georgian economy.

There is substantial work on the MTM issue that consists of a large number of theoretical studies and empirical overviews for many particular countries. First of all, the channels of transmission are defined and their importance is discussed in different ways in the literature (for example, Bernanke and Blinder, 1988; Bernanke and Gertler, 1995 and Mishkin, 2001). There is no agreement, however, as for the particular way a monetary policy affects the real sector of an economy by means of transmission

[3] For example, Japan, Australia, Norway, Turkey, the USA, Switzerland, Sweden, West Germany, and a number of transition economies have conducted foreign exchange interventions under a floating exchange rate regime.

channels. Therefore, it is particularly important to determine the most important channels for a particular country. Second, there are different methodologies for modeling and investigating the impacts of various channels on the real sector used in the literature (Sims and Zha, 1996; Christiano and Eichenbaum, 1992; Blanchard and Quah, 1989 and Kim & Roubini, 2000 among others). However, most papers assessing the monetary transmission mechanism base their study either on the US or on the Euro-area economy but not on transition CIS-7 countries. Thus, the main objective of this paper is to study monetary transmission in a transition CIS-7 Georgian economy within structural vector autoregression (SVAR) framework. Learning the results obtained will further develop the understanding of how the monetary transmission works in the Georgian CIS-7 economy.

Statement of the Problem

As it was mentioned in the introduction, there is a large stream of literature studying the monetary transmission mechanism (MTM) for different countries. Many articles assessing monetary transmission of the US and of Euro-area developed countries (for instance, Christiano, Eichenbaum and Evans, 1998) find that a contractionary monetary policy indeed leads to an increase in the interest rate, a reduction in the volume of monetary aggregates, and a fall in the aggregate output. Peersman and Smets (2003) found that monetary tightening in the Euro-area is typically followed by the real appreciation of the exchange rate and a decline in output. That is, some consensus of how the MTM works has been reached based on US and European developed countries data. Particularly, changes in monetary policy have a persistent but not a permanent effect on output. A natural question is whether this consensus view on the monetary transmission mechanism holds for the transition countries.

However, the research focusing on transition Central and Eastern European (CEE) economies usually find a weak first step in monetary transmission (from a monetary policy impulse to an intermediate variable) and, moreover, do not find a significant second step of transmission between the intermediate variables and the ultimate goals of a monetary policy such as GDP and its growth. They explain these facts with institutional considerations. First of all, the banking sector is generally

underdeveloped, financial intermediation is weak, the level of banking competition is low, and the legal framework for financial activities (including monetary policy setups) is problematic and constantly changing in these economies. Besides, most authors claim that MTM significance has a tendency to improve with time thanks to the process of integration into the EU (see Ganev et al., 2002 for a review of papers on MTM for CEE countries).

To my knowledge, no model has been published that allows for an investigation into the monetary transmission mechanism in CIS-7 countries that can be applied to Georgia. Such a model would help to investigate the real effects of a monetary policy and to formulate an appropriate monetary policy organization in this country. Therefore, the main goal of this research is to set up a model that allows for a study of the real effects of monetary policy for the case of Georgia.

The main questions I address in the this research are

- To what extent are macro fluctuations in the Georgian economy caused by external shocks?
- What are the effects of domestic monetary policy shocks on the real sector of economy? How fast do changes in monetary policy affect output and prices?
- Is there a significant credit channel?
- What are the effects of foreign exchange interventions on the real sector of economy and the exchange rate?

The model I set up aims not to be only an empirically valid description of actual data interrelationships but also be a model consistent with economic theory and practical for monetary policy analysis. I use the structural vector autoregressions (SVAR) methodology that seems to fulfill all these criteria. That is, the SVAR model for the CIS-7 countries is constructed aiming to study the MTM and the effects of different monetary policy instruments in the particular case of Georgia.

Having in mind the discussion of the Georgian economy presented in the next section, I would, of course, expect results from monetary transmission different than those for developed European countries/the US and even for transition CEE countries. In particular, the real effects of monetary policy

may appear similar, but not completely the same, to those for CEE. The reason is that CIS-7 countries still experience the problems CEE countries used to have in their early stages of transition (Nicolo, Geadah, and Rozhkov, 2005). First, due to under-developed financial markets, external US interest rate shocks are likely to matter more than the domestic ones in Georgia. Second, the interest rate channel may appear insignificant, and the credit channel, on the other hand, may work. Next, the exchange rate may appear to be more effective instrument of monetary policy than the interest rate. Finally, the foreign exchange intervention policy shocks are likely to have a sound impact on the exchange rate level and on the real sector of the economy. In Georgia, the authorities do not use the interest rate (or money) setting monetary policy directly to stabilize the exchange rate. Instead, the foreign exchange interventions are widely used.

The empirical results obtained in this paper, in general, are similar to the likely effects of shocks presented in the previous paragraph. The paper finds that the interest rate, the exchange rate and the forex interventions are efficient tools for influencing fluctuations in the output, the cross boarder deposits and the credit variable. As expected, the exchange rate is more efficient instrument of domestic monetary policy than the interest rate. Next, a shock to the forex interventions indeed is more important source of fluctuations in the exchange rate level than a shock to the interest rate. Also, the credit channel of MTM in Georgia works in line with basic economic theory and is significant. However, the domestic interest rate shocks have more sound impact on the Georgian economy than the external shock to the US interest rate. One possible explanation of this unexpected result is the fact that the domestic interest rate variable absorbs not only the information about domestic economy but also about the fluctuations in the US FFR due to high dollarization in Georgia. Thus, the domestic interest rate is more informative and has more impact on the domestic economy than the US interest rate alone.

1. Theoretical Background

1.1 Monetary Transmission Channels

Before proceeding to an investigation of the MTM in Georgia, it is useful to have insight into the most significant channels of monetary transmission in small FSU countries. It has been agreed that monetary policy significantly influences the behavior of agents in an economy (for example, Mishkin, 1996). However, the channels through which it operates are very complex and of different importance in different countries, and therefore, there is less agreement about the way monetary policy exerts its influence on the real sector of the economy- about monetary transmission mechanism. The MTM is defined in a rigorous way as a description of how the monetary policy changes influence real variables such as output or employment (Ireland, 2005).That is, it is a set of various channels commonly specified in the literature such as, the exchange rate channel, the money channel, the credit channel, the expectations channel, and the interest rate channel. There are many different and sometimes polar views on the different channels' significance in the whole transmission mechanism.

The reason for the absence of consensus is the fact that monetary policy changes provide only the initial impulse in the process of monetary transmission that is not under direct control of the central bank anymore. In order to judge the relative importance of channels, one should keep in mind that the extent to which monetary policy affects the real sector heavily depends on the economy structure and, in particular, on financial markets structure. In the case of Georgia and other CIS-7 countries, one should consider the three main channels of monetary transmission that are discussed below.

It is commonly argued by central bankers and supported by evidence that *exchange rate channel* plays an important role in the MTM (for example, Mishkin, 2001; Ireland, 2005; Gigineishvili, 2002). The exchange rate channel of transmission works when monetary policy uses the exchange rate as an intermediate operating target. Of course, in a country with a fixed exchange rate, domestic interest rates adjust in such a way as to leave the exchange rate unchanged. That is, the domestic interest rate is determined by the foreign interest rate to which the domestic currency is pegged (the US dollar in most CIS-7 countries in early 1990s). This puts a constraint on the use of the monetary policy. In a country

with a flexible exchange rate, the Central Bank can influence the exchange rate by increasing or decreasing the interest rate and, thus, the exchange rate channel has a significant role in the MTM. By the Keynesian argument, expansionary monetary policy depreciates the currency and this positively affects output through an increase in net exports. In addition, there is also a worth effect. Particularly, exchange rate depreciation lowers net worth, and it makes investors' collateral and, thus lending, decrease. As a result, investment and output decrease (Mishkin, 2001).

Special attention is required to one of the most important channels of transmission, namely the *interest rate channel*. One should take into account that the direct effect of the interest rate channel on the real sector most likely is of no significant importance in the countries under investigation. One of the reasons is the fact that their financial markets are poorly developed, and thus, interest rates cannot perform the function of an intermediate variable in CIS-7countries. In particular, the absolute volume of loans as a percentage of GDP is still too small in all of these countries, and therefore, the interest rate channel is almost insignificant in the MTM. For example, only 7.76% of GDP is financed by loans from banks in Georgia (Annual Report of the National Bank of Georgia, 2004) and this percentage ranges from 7.2% in Armenia to 33.9 % in Uzbekistan (IMF databases, 2004). However, note that the ratio of private sector credit to GDP in CIS-7 countries has grown faster than in CEE countries but more slowly than that in other CIS countries (Nicolo, Geadah and Rozhkov, 2005).[4] However, its level remains Ill below that of other transition economies (above 50% in other CIS and CEE countries).

Moreover, one should not forget that in a high- inflation economy, the interest rate channel looses its strength because of the high volatility of inflation (Lopes, 1998). A given real interest rate will be more controllable when inflation is low and less volatile than when inflation is high and more volatile. Thus, I cannot rely much on the interest rate channel in Georgia due to still high inflation rates. The average annual inflation in CIS-7 countries is around 12.3% while, for example, in the European Union and other developed economies it is only 1.8-2.0% (CIA World Fact book, 2005).

[4] The percentage change in the ratio of average bank credit to the private sector to GDP (1995-2002): 43.6% for CIS-7 countries; 170.9 % for other CIS countries; and 22.4 % for CEE countries (IMF, International Financial Statistics, 2004).

The credit channel operates as an accelerator of monetary policy transmission. It is closely linked to the interest rate channel in a way that it further extends the effect of the monetary policy. However, unlike the interest rate channel, it shows an indirect impact of monetary policy on the real economy. There are two different approaches to defining the credit channel of monetary transmission. The first one is known as the balance sheet channel, where financial market imperfections play a key role (Bernanke and Gertler, 1995). Here, monetary policy changes have an impact on interest rate through the changes in borrower financial positions. This, in turn, influences the size of the finance premium and then of investment spending. On the other hand, Mishkin (2001) does not define credit channel but implicitly includes it into both the stock price and real estate price channels. In particular, inside a stock price channel, an increase in money supply makes interest rates go down, and as a result, investors rearrange their portfolios, and the demand for bonds decreases resulting in stock prices rising. From a credit point of view, an increase in stock prices raises investors' net worth, and thus, borrowers have higher-valued collateral. Therefore, banks will be willing to give larger loans creating an investment and output increase. The real estate channel that emphasizes the importance of housing prices in the MTM also includes a part of the credit channel. Particularly, a rise in real estate prices improves a bank's balance sheet and lending capacity resulting in an investment and output increase.

The balance sheet channel is a broad definition of a credit channel that usually should be applied to more advanced economies than those of the CIS-7. In CIS-7 countries, stock and financial markets are poorly developed or almost non-existent (Nicolo, Geadah and Rozhkov, 2005), and thus, I cannot follow this credit channel definition modeling the MTM for this group of countries. The second type is the bank-lending channel that highlights the importance of the banking sector in monetary policy transmission. The necessary condition for the bank lending channel is the lack of substitutes such as government bonds for deposit liabilities and for bank credit (Carl E. Walsh, 1998). Actually, the channel is based on the dual nature of banks as holders of deposits and as sources of loans (Bernanke and Blinder, 1988). The channel is presented by firms acting as borrowers from banks and a reduction in reserves engineered by the monetary authority causes the volume of bank lending to decline. In addition,

some firms cannot causelessly replace losses of bank credit with other types of finance, but rather must cut their investment spending. Bernanke and Blinder (1988) provide a logical but only introductory insight into how monetary policy changes influence the real sector of the economy through the credit channel. In spite of this, the presented lending view of monetary transmission would allow a look at the general chain: MB→ loans →interest rate → output assuming that loans and bonds are imperfect substitutes on the balance sheet of banks for CIS-7 countries.

To summarize, a shock to the monetary policy transmits into the economy through different channels. The interest rate channel seems to be weaker in transition countries due to the high volatility of inflation. Due to growing banking infrastructure, the credit channel, which shows an indirect impact of interest rates on output, may matter in monetary transmission in the countries under investigation. In addition, in CIS-7 countries, where the inflation pressure and dollarization is high the exchange rate channel becomes an important part of the monetary policy transmission. Moreover, as financial markets are poorly developed, this channel seems to be crucial.

1.2 The Georgian Economy

As the purpose of this essay is to set up a model for the Georgian economy, at this stage a brief outline of the Georgian economy is in order.

After the collapse of Soviet Union, Georgia fell into recession and output dramatically fell. A lack of transfers from the Soviet budget resulted in economic chaos, and a poorly designed monetary policy resulted in the collapse of financial sector in the economy. In particular, inflation turned into hyperinflation and reached 3000 percent in 1993- early 1994. Moreover, from the beginning of independence, Georgia was involved in a civil war and local armed conflicts, which had a great impact on the stability and economical development of the state. In the environment of economical collapse the "shadow economy" dramatically increased. In 1995, monetary reform was implemented and a new currency the Lari was introduced. Until 1998, the annual Lari depreciation rate was only about 2-3 %,

and inflation ranged between 7.6 and 13.5 percent; output was growing as Ill (by 3 % in 1995, and by 11 % in 1996 and 1997).

However, the Russian crisis in 1998 had a large negative impact on rehabilitating Georgian economy. As a result, the central bank faced a trade-off: either maintain the exchange rate stability through huge foreign exchange interventions that would lead to exhausting international reserves or abandon the managed floating exchange rate regime and let the Lari float freely, which would surely imply devaluation and an increase of the inflation rate. In addition, the banks' liabilities Ire more dollarized than assets, and the banking system experienced serious liquidity problems. In order to reduce the negative influence of the Russian crises, the central bank implemented a tight monetary policy through foreign exchange interventions, and only after several months the exchange rate regime was switched to a free-float. This change in exchange rate regime is particularly important because under a managed flow the exchange rate level was almost the same and thus, the role of the exchange rate channel was insignificant. After the regime change, prices became very sensitive to the changes in exchange rate, and the exchange rate channel seems to be highly significant in monetary transmission. In addition, only after the second half of 1999 did the trust in the banking sector start to recover and thus, so does the significance of the credit channel of MTM.

Therefore, while constructing a model, one should take into account several features of the Georgian economy. First, the regime shift in exchange rate policy: 1996-1998 the Lari was pegged to the US dollar; December 1998-2004 the Lari freely floats; and from 2004, the National bank of Georgia started market interventions again. Second, one should take into account the importance of the external sector for this economy due to dollarization [5] and poorly developed domestic financial markets. Next, Russia as the main trade partner has much influence on the Georgian economy. Moreover, starting from 1999, the National Bank of Georgia actively conducted foreign exchange interventions. That is, the NBG is constantly present at the interbank foreign exchange market equating demand and supply of the foreign exchange by buying out excess supply and selling foreign exchange in the case of unsatisfied demand.

[5] Dollarization degree (the fraction of foreign deposits in total deposits) in Georgia was reported to be 72% in 2005 (IMF country report, 2006).

By carrying out this practice the NBG is pursuing exchange rate stabilization policy. Having the data on these interventions, I can look at the effect of this policy instrument on the exchange rate and on the real sector of the Georgian economy.

2. Methodology

2.1. Literature Review

Since the seminal work of Sims (1980), it has become a common practice to estimate the effects of the monetary policy on the real sector using vector autoregressions (VAR). This methodology avoids the problem of specifying the whole structural model of an economy and allows for the study of the dynamics of monetary policy shocks on the real economy. Rapid progress was made in the 1990s by many researchers who studied different specifications as they included different macro indicators within the VAR framework (Bernanke and Blinder, 1992; Cristiano and Eichenbaum, 1992 among others).

The key aspect in applying the VAR methodology is the identification of the monetary policy shock. Alternative identifications might lead to different results being obtained from the MTM estimation. Many studies are constrained with prior theorizing making economic theory crucially important for the identification of monetary policy shocks (for example, Rotemberg, 1994). That is, they claim that VAR analysis makes sense only if a specification does not conflict with some theory. For example, restrictions on the causal relationship between policy and real variables are introduced. Sims and Zha (1996), allowing for the contemporaneous impact of the monetary policy on target variables, estimate the VAR model using US data to access how monetary policy transmits into the economy. The study argues that the monetary policy is largely determined by the development of the state of an economy. Besides that, the monetary policy does not have a significant impact on generating recessions during the estimation period. Shocks to the monetary policy do not cause large changes in output but have a stronger effect on prices. Thus, the observed relationship between the high interest rate and the low output is not caused by the contractionary policy but rather by the high inflationary pressure. Bernanke and Mihov (1998) do not assume but derive the indicator of monetary policy from an estimated model of central banks

operating procedure. They identify only one shock (or one set of shocks) to monetary policy using prior information about central bank operating procedures. Uhlig (2005) imposes even less structure than this. He just uses sign restrictions on impulse responses. In order to answer the question of the effects of monetary policy on output, he applies the agnostic identification procedure and finds that contractionary monetary policy shocks have no clear effect on real GDP. In fact, he uses the same data set as in Bernanke and Mihov (1998) but imposes no restrictions on the response of real GDP.

As it was discussed previously, the VAR approach allows the researcher to treat all of the variables as endogenous, and thus, solves the problem of any feedback that variables can have on each other. This approach helps to avoid "incredible identification restrictions" as Sims (1980) notes. However, the only role of an economist is to choose the variables to include in the VAR, and therefore, the result from the procedure is likely to have little economic interpretation. To account for this, in the recent economic literature, structural vector autoregressions (SVAR) have been extensively used to model the MTM. The name "SVAR" comes from the fact that it is a Vector Autoregression (VAR) generated by an economic model ("a structure").

The main goal of structural vector autoregressions (SVAR) is to use economic theory to identify structural shocks from their reduced form counterparts by imposing identifying restrictions. In particular, to recover the structural parameters from an estimation procedure of the reduced form, restrictions (known as identifying restrictions) must be imposed. That is, the idea is to run vector autoregressions for the data and impose identifying assumptions to get impulse responses to various shocks (Blanchard and Quah, 1989; Christiano, Eichenbaum, and Vigfusson, 2003; and Uhlig, 2004 among others).

Unlike arbitrary Choleski decomposition for VAR, the SVAR approach does not make any overly strong assumptions about structural errors. Particularly, the Choleski decomposition implies a particular ordering of the variables. Without some economic intuition behind, this may appear to be wrong. Therefore, the structural shocks may be improperly identified, and thus, the impulse responses may be misleading. Sims (1986) proposes an alternative to Choleski decomposition that is consistent with

equilibrium in the money market. He considers a 6-variable VAR and imposes contemporaneous restrictions consistent with *a priori* theoretical expectations to identify the impact of structural shocks. Imposing theory-consistent restrictions on the structure of the contemporaneous coefficients matrix, thus, gives economic meaning to the derived shocks.

Another way to obtain a structural identification is to impose long run (LR) restrictions. A popular technique is proposed by Blanchard and Quah (1989) to estimate potential output. The authors review the decomposition of output into permanent and temporary components first used by Beveridge and Nelson (1981) for the univariate case. Assuming that an aggregate demand shock has no long run effect on output and for the stationarity of variables, Blanchard and Quah provide four restrictions that exactly identify the four coefficients for the bivariate case. They used the US data sets for output and unemployment and provide a unique decomposition of output into temporary and permanent components. Bayoumi and Eichengreen (1994) estimated the same system with output and inflation instead of unemployment, for their sample countries (several Western European and East Asian countries).

In summary, the VAR analysis is appropriate when there is a need to treat all the variables as jointly endogenous and to capture dynamics of the system. However, the underlying structural model cannot be recovered from the estimated VAR unless an extra restriction is provided for the identification of the structural model (for example, Choleski decomposition). SVAR imposes economic theory on the contemporaneous movements in variables. This allows for the identifying of the parameters of the economic model and for the recovering of structural shocks.

In addition to the discussed literature on VAR and SVAR methodology, my research is connected to one more body of literature. It focuses on the implementation of SVAR methodology when studying the international transmission of a US monetary shock to non-US countries. The main reason for this is the high degree of dollarization in transition CIS-7 countries. Moreover, the influence of Russia as the biggest trade partner should not be ignored while modeling the external sector. Kim (2001) examines the impact of U.S. monetary policy shocks on the G-6 countries and finds that a U.S. expansionary

monetary policy increases real GDP abroad, decreases net exports in the U.S. in the short-run and increases net exports abroad in the short run. Canova (2005) finds that U.S. monetary policy shocks have important effects on Latin America, accounting for 20-50% of the macroeconomic fluctuations there. In addition, there are some studies done for industrial economies using US interest rate and oil prices as a measure of the external sector of the economy (for example, Kim & Roubini, 2000) that base the identification strategy on a macro model with optimizing agents developed by Sims and Zha (1998). Elbourne and Haan (2006) adapt this model to transition countries using the broad commodity price index instead of the price of oil and derive impulse responses of variables to interest rate shocks. Golinelli and Rovelli (2002, 2005) construct the models for Hungary, the Czech Republic, and Poland with the presence of an external sector. They claim that inflation targeting is the best strategy in these countries during the process of accession into the EU. The authors find that in the Czech Republic, a more aggressive policy induces negative output effects. The results for other two countries, however, are uncertain.

2.2 Structural Vector Autoregressions (SVAR) Framework

As this paper constructs a structural VAR model to identify and to test asymmetric effects of monetary policy influence in transition period for Georgia, the brief description of the methodology that is be applied is offered in this section.

SVARs are a multivariate, linear representation of a vector of observable variables on its own lags. These models are economically interpretable simplifications of VAR models where the identification restrictions are used according to some economic theory. Let n be the number of endogenous variables in the model and the economy is described by a *structural form* (SF) equation:

$$G(L)x_t = \varepsilon_t$$

Where G (L) is a matrix polynomial in the lag operator L; x_t is the n-dimensional vector of data; ε_t is n-dimensional the structural disturbances vector that contains shocks to a particular variable that are

orthogonal to other shocks in the economy. These shocks are serially and mutually uncorrelated and Var (ε_t) = Λ is a diagonal matrix with elements being the variances of structural disturbances.

The *reduced form (RF)* representation that can be estimated is the following:

$x_t = B(L)\, x_t + u_t$

Where

$$E\left(u_t u_t'\right) = \Sigma$$

$$E\left(u_t u_{t+s}'\right) = 0$$

for any non-zero s. x_t again is a vector of n macro variables, B (L) is a matrix polynomial (without constant) of order p and L is a lag operator, u_t are shocks not orthogonal to each other. Σ is a positive definite matrix, and shocks are linearly independent.

Let us define G_0 to be a non-singular matrix on L_o in G (L). This matrix is called the *contemporaneous coefficients matrix* in structural form. Let G_0 (L) be a coefficients matrix without G_0 coefficients. Thus,

G (L) = G_0+ G_0 (L).

Therefore, the link between structural and reduced forms is the following:

$B(L) = -G_0^{-1}G_0(L)$, $G_0 u_t = \varepsilon_t$ and $\Sigma = G_0^{-1}\Lambda(G_0^{-1})'$.

The reduced form can be easily estimated by MLE. I can get point estimates of parameters and of the variance-covariance matrix Σ, but I need to impose identification restrictions in order to recover structural form parameters. Thus, the reduced form *and* the identifying restrictions deliver both the estimates of the economic shocks as Ill as the impulse response of the variables in the economy to those shocks.

The estimates for Λ and parameters in structural form representation can be obtained only through estimates of Σ. The matrix $G_0^{-1}\Lambda(G_0^{-1})'$ has n (n+1) parameters to be estimated, while Σ contains n (n+1)/2. Therefore, I need at least n (n+1)/2 restrictions to recover the SF parameters. Given that the diagonal elements of G_0 are all unity, it contains n^2 –n unknown values. Thus, I still need at least n (n-

1)/2 restrictions for identification. By restricting the matrix G_0, I can get these restrictions. Therefore, to identify the structural model from the estimated VAR, I need to impose n (n-1)/2 restrictions on the structural model. Note that the matrix G_0 does not have to be necessarily triangular as in VAR Choleski decomposition. The estimation of G_0 allows orthogonal structural shocks to be obtained.

I can now recover the structural innovations ε_t from the residuals u_t. The next step is to obtain impulse response functions to trace out the effect of structural innovations on observed variables. Rewrite SVAR in a vector moving average form in terms of structural innovations

$$x_t = \mu + \sum_{i=0}^{\infty} \phi_i \varepsilon_{t-i}$$

Where ϕ_i are used to generate the effects of structural innovations on time paths of data sequences. The sets of these coefficients are called an impulse response function $\phi_{jk}(i)$ against i. Plotting this function gives visual representation of the behavior of observed series in response to structural shocks.

3. Estimation and Results

3.1 Model Specification

This section provides a set up of a SVAR model for the CIS-7 Georgian economy.

The small open transition economy is characterized by external and domestic sectors and includes nine variables. While a larger SVAR would allow for even richer interactions, a more parsimonious model with more degrees of freedom is easier to estimate and more stable. The data vector takes the form

$$x_t = \left(i_t^{us}, p_t^{rus}, y_t, p_t, m_t, i_t, cr_t, e_t, f_t\right)'$$

The external sector is represented by the US interest rate (i_t^{us}) and the Russian output variable (p_t^{rus}). Open economy macro models often include both foreign and domestic interest rates, and following Kim and Roubini (2000) I will take US Federal Fund rate (FFR). It is introduced to control for foreign monetary policy shock in setting domestic monetary policy. This will help to isolate the

"exogenous" monetary policy changes. The inclusion of the Russian output variable can be justified by the fact that Russia is the main trade partner of all CIS-7 countries (in Georgia 76% of foreign trade). Moreover, it has been shown to have strong relationships with Georgian economic activity (Gigineishvili, 2002). That is, the external shocks can be an important driver for the Georgian economy, and thus, are included into the model.

The next four variables are the main macro indicators in an emerging market economy. The inclusion of real GDP (y_t) and CPI (p_t) represents domestic activity and characterizes a goods market in the economy. One more variable, the real credit (cr_t)- nominal credit deflated by CPI, is included. This allows a look at the interaction of monetary policy and credit through the credit channel of the MTM. Credit is an important macro variable that drives economic activity and is, in fact, dependent on economic activity. The variable i_t is a domestic short-term interest rate. The nominal exchange rate (e_t) is included to consider the effects of monetary policy shocks on the national currency value. The variable f_t is the foreign exchange intervention data that is included to identify its effects on the real sector of economy and the exchange rates.

The next modification to the Kim and Roubini (2000) model is the construction of monetary aggregate (m_t) different than typically used M1, M2, or M3. The main motivation for this is a high degree of currency and asset substitution in CIS-7 countries. These processes mean that individuals in a country allocate their total holdings of money across foreign currencies and their domestic currency. This allocation is known as cross border deposits (CBD) which can be expected to be sensitive to changes in exchange rates, foreign economic variables and interest rates. The traditionally defined monetary aggregates do not reflect the effects of currency substitution in CIS-7 economies. Thus, I propose to extend the monetary aggregates so that they include the relevant cross border deposits. This will give a more precise definition of the money that circulates in the economy.

The extended monetary aggregate that includes the CBD can be defined based on one of the following criteria. First is a currency of denomination. The aggregate should include monetary assets denominated in domestic currency. Second criterion is a residence: the aggregate should include

monetary assets held by the residents of one country. Finally, it is the location of the intermediary service. The aggregate includes monetary assets issued by the intermediaries in the country (Yildirim, 2003). However, the aggregate based on currency of denomination and on a location of the intermediary service are difficult to interpret from economic point of view (Giucca and Levy, 1992; Monticelli and Papi, 1996). Therefore, in this research, the extended monetary aggregate based on residency of holder criterion is selected as the appropriate monetary aggregate, when estimating the money demand within the SVAR framework.

Thus, I assume that the economy is described by the structural form equation (SF) with structural shocks that are assumed to be mutually uncorrelated.

$$(G_0 + G_0(L))x_t = \varepsilon_t$$

I can estimate a reduced form model

$$x_t = B(L)\, x_t + u_t$$

SF and RF are related by

$$B(L) = -G_0^{-1}G_0(L)\ ,\ \ G_0 u_t = \varepsilon_t \text{ and } \Sigma = G_0^{-1}\Lambda(G_0^{-1})'.$$

3.2. Identification

Ideally, the identifying restrictions would result from a fully specified macroeconomic model. In practice, however, this is rarely done. Instead, the common approach is to impose a set of identification restrictions that are consistent with economic theory. Uhlig (2005) argues that, using vector autoregressions, complete model specification is a very difficult task. It is usually unclear which aspects of the model arise from assumptions imposed on the model and which arise from the data. Leeper, Sims, and Zha (1996) argue convincingly that an approach of imposing economic theory consistent restrictions is typically not different from other specification methods. Of course, there are no "correct" identifying restrictions, and the results are likely to be sensible to model specification and imposed restrictions, but it makes the approach more transparent.

The structural shocks are identified from their reduced form counterparts by imposing restrictions on the contemporaneous matrix G_0 with elements g_{ij}:

$$\begin{bmatrix} \varepsilon_{us} \\ \varepsilon_{rus} \\ \varepsilon_{y} \\ \varepsilon_{cpi} \\ \varepsilon_{md} \\ \varepsilon_{ms} \\ \varepsilon_{cr} \\ \varepsilon_{e} \\ \varepsilon_{f} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & g_{32} & 1 & 0 & 0 & 0 & g_{37} & 0 & 0 \\ 0 & 0 & g_{43} & 1 & 0 & 0 & 0 & 0 & 0 \\ g_{51} & 0 & g_{53} & g_{54} & 1 & g_{56} & 0 & g_{57} & 0 \\ 0 & 0 & 0 & 0 & g_{65} & 1 & g_{67} & g_{68} & g_{69} \\ g_{71} & 0 & g_{73} & g_{74} & g_{75} & g_{76} & 1 & 0 & 0 \\ g_{81} & g_{82} & g_{83} & g_{84} & g_{85} & g_{86} & g_{87} & 1 & g_{89} \\ g_{91} & 0 & 0 & 0 & 0 & 0 & 0 & g_{98} & 1 \end{bmatrix} \begin{bmatrix} u_{us} \\ u_{rus} \\ u_{y} \\ u_{cpi} \\ u_{m} \\ u_{i} \\ u_{cr} \\ u_{e} \\ u_{f} \end{bmatrix}$$

In this specification $\varepsilon_{us}, \varepsilon_{rus}, \varepsilon_{y}, \varepsilon_{cpi}, \varepsilon_{md}, \varepsilon_{ms}, \varepsilon_{cr}, \varepsilon_{e}, \varepsilon_{f}$ are structural disturbances. They are FFR shocks, Russian output shocks, GDP shocks, CPI shocks, total (including foreign currency) money demand shocks, money supply shocks, shocks to total credit, exchange rate shocks, and foreign exchange intervention shocks respectively. The vector of u_i consists of residuals from RF which show unexpected movements of each variable given the information in the system.

This identification procedure reflects the features of a transition economy. The non-zero coefficients indicate that a variable i affects contemporaneously variable j. The restrictions I impose on matrix G_0 are motivated in the following ways. First is the timing of information. I can impose zero restrictions based on the fact that certain variables are only available after a lag. For example, the information about output for time t is only available after one quarter or month, at time t+1. Next is the imposition of behavioral assumptions. For instance, domestic monetary authorities do not respond contemporaneously to movements in foreign interest rates. A different type of behavioral restrictions is that some variables respond slowly to movements in financial and policy variables such that output and prices do not respond contemporaneously to changes in domestic monetary policy variables. Considering the system equation by equation, I impose the following restrictions consistent with *a priori* theoretical expectations.

First, the external variables are unaffected by contemporaneous movements in any domestic variable. However, the transmission of international shocks to the domestic economy can be very rapid. I can take the Russian crisis as an example of rapid influence on the Georgian economy. Therefore, foreign variables are allowed to affect domestic variables contemporaneously.

The third and fourth equations characterize equilibrium in a good market. The large number of zero restrictions reflects the idea of nominal rigidities (Kim and Roubini, 2000). That is, the real activity responds to prices, financial signals and foreign variables only with lag. Firms do not change the output and prices due to changes in financial variables and monetary policy within a quarter due to inertia. However, the Georgian real GDP is assumed to be affected contemporaneously by credit reflecting a quick pass-through of credit to an aggregate demand (Safaei and Cameron, 2003). Given the cost of borrowing, credit will be spent as soon as funds are obtained and this adds to aggregate demand immediately. I allow for the possibility of a contemporaneous response of prices to output as in Bernanke and Blinder (1992).

The next equation represents the money demand for the domestic and foreign currency (US dollars). It depends on real income, the opportunity cost of holding money in the domestic currency (nominal interest rate), and in the foreign currency opportunity cost (FFR) due to dollarization in the economy. The money supply equation is a reaction function of the monetary authority. I exclude price level and output due to information delays. That is, the interest rate responds contemporaneously only to credit, the money aggregate, and the exchange rate. Domestic information on these variables is available within the quarter.

Credit is assumed to respond contemporaneously to domestic output, money demand for both currencies, prices, and domestic and foreign interest rates. First, the current real activity and domestic interest rate give agents the expectations of future economic activity, and thus, are important determinants of credit demand. Second, the contemporaneous reaction of credit to CPI and to the domestic interest rate can be justified by the notion that borrowers and potential borrowers will respond quickly to the real cost of credit (difference between inflation and interest rate).

The nominal exchange rate modeling depends on institutional arrangements in Georgia. Before December 1998, the exchange rate with respect to the dollar enters the model exogenously and introduces a measure of external pressure on the economy recognizing a fixed exchange rate regime. Under a floating exchange rate regime, the exchange rate enters endogenously and is assumed to respond contemporaneously to all the variables in the system.

Finally, the monetary authority implements foreign exchange interventions and this is seen as the instrument of monetary policy (Kim, 2003). This equation can be understood as the second reaction function of the monetary authority. It implements foreign exchange intervention reacting to the current exchange rate and the US interest rates, but not to other current variables.

That is, I have 45 zero exclusion restrictions. For identification, I need at least n (n-1)/2=36 restrictions, so I have overidentification. No further restrictions on lagged structural parameters are needed.

3.3 Data Description

Having accumulated the macro data for Georgia for a ten-year period the econometric modeling is now feasible.[6] For domestic sector variables in the SVAR model I use the quarterly time series data for the period of 1996-2006. This period is characterized by a single monetary policy regime.[7] Earlier observations are excluded due to high instability in Georgia characterizing the period after the collapse of the Soviet Union until 1996. The source of this data set is the National Bank of Georgia. The data for external sector variables is taken from the Russian Statistical Department (Russian GDP) and from the Board of Governors of the Federal Reserve System (Federal Fund Rate, FFR). All the variables except interest rates, exchange rate and foreign exchange interventions are expressed in logarithmic form. The detailed description of the data is presented in the Table1 below.

[6] I am very grateful to Archil Imnaishvili (the NBG, research department) for his support and the data set provided
[7] Note that the NBG conducts foreign exchange interventions despite official pure floating exchange rate regime

Table 1. Data Description

Variable	Description	Data Source
i_t^{us}	Federal Fund Rate	FRS, USA
p_t^{rus}	Real Russian GDP, log, SA	RSD, Russia
y_t	Real GDP, log, SA	NBG, Georgia
p_t	Consumer Price Index, log	NBG, Georgia
m_t	Cross Boarder Deposits (residency criterion), log	NBG, Georgia
i_t	Short-term Interest Rate	NBG, Georgia
cr_t	Loans Granted to National Economy, log	NBG, Georgia
e_t	Average Exchange Rate: Lari/US dollar	NBG, Georgia
f_t	USD Transactions on Tbilisi Interbank Foreign Exchange	NBG, Georgia

Where: FRS - the Federal Reserve System, RSD- the Russian Statistical Department, NBG – the National Bank of Georgia, log –a logarithmic data transformation, SA- seasonally adjusted time series.

For the output variables I take the log of adjusted real GDPs for Georgia and Russia with the base year 2000. The plot of time series showed the seasonal pattern: the decline in the end of every year. So, seasonal adjustment was applied for the real GDPs. For inflation variable I use the log of quarterly CPI with the base year of 2000. All real variables in the model are calculated by dividing the nominal variable by the CPI. For the money supply variable I use cross boarder deposits (CBD) with residency criterion in real terms. Short-term interest rate is used as one of monetary policy instruments. This interest rate is expressed in levels not in logs. Next, I include the US dollar/Georgian lari nominal exchange rate in endogenous variables. As a supplementary monetary policy instrument, I take the data for the net interventions of the NBG in forex domestic market.

Before estimating the model, I have checked the stationarity of time series applying several unit root tests. For this purpose, three different tests were applied, namely the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. All the tests suggest non-stationarity, I(1), of all time series in levels except the foreign exchange intervention series.

This raises the issue of the appropriate estimation methodology. One possibility is to use the first differences because all the series display stationarity for first differences. However, this would result in loosing part of the information contained in the series. Another possibility is to estimate the model in levels. Even with I(1) variables, the residuals will be stationary because of the inclusion of lagged levels of the variables in the VAR. Yet, the possibility of spurious relationships between the I(1) variables still remains. To guarantee that this is not the case, I have to confirm that the relationships summarized by the SVAR are plausible on economic grounds. Moreover, the Johansen cointegration tests indicate the presence of many cointegration relations. This result confirms the appropriateness of Sims (1990) strategy to estimate VAR in levels even with integrated series. Thus, in this paper, I include all the series in levels following the literature which estimates VAR in levels despite non-stationarity (for example, Kim and Roubini, 2000). Standard likelihood test is applied to determine the lag order of the SVAR and it is found that the model is of lag order two. I have checked for the structural break in the model and found that the model is stable over the estimation period.

3.4 Estimation Results

This section presents the estimation results.[8] First is the estimation of contemporaneous structural parameters and the testing for over-identifying restrictions. Next, the effects of monetary policy shocks are examined through estimated impulse responses. The impulse responses can be constructed for shocks in any variable in the model. In this paper, I consider the effects of three policy instruments, namely the interest rate, the exchange rate and the foreign exchange interventions on the real sector of economy. Next, the responses of domestic macro variables to external shocks are examined. Moreover, the impulse responses for shocks to credit help to investigate the interaction of credit with the rest of the economy.

In order to compute impulse response functions I must first estimate contemporaneous coefficient matrix. After this, it is possible to use the structural option in impulse responses construction. This

[8] The E-Views software was used

matrix is estimated using the short-run restrictions described above by the maximum likelihood. The log likelihood is maximized by the method of scoring with a Marquardt-type diagonal correction, where the gradient and expected information matrix is evaluated analytically. Because the structural innovations have a diagonal covariance matrix, I divide each column of the contemporaneous coefficient matrix with the diagonal element in that column. The resulting G_0 matrix has ones on the main diagonal. The starting values for free parameters are drawn from standard normal distribution. I report the estimated coefficients of the contemporaneous coefficient matrix in the table 2 below.

Table 2. Estimated Contemporaneous Coefficient Matrix G_0 in the Structural Model

G_{IJ}	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	*1.000*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	*1.000*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	-1.568** (0.042)	*1.000*	0.000	0.000	0.000	-1.081** (0.009)	0.000	0.000
4	0.000	0.000	-0.613** (0.055)	*1.000*	0.000	0.000	0.000	0.000	0.000
5	-1.569* (0.892)	0.000	-1.587** (0.727)	-0.049* (0.0184)	*1.000*	-0.465 (0.384)	0.504** (0.203)	0.000	0.000
6	0.000	0.000	0.000	0.000	1.367** (0.465)	*1.000*	0.524** (0.018)	0.859* (0.542)	0.034* (0.019)
7	-1.034** (0.394)	0.000	-0.896** (0.318)	0.333** (0.108)	-0.199 (0.507)	0.678** (0.227)	*1.000*	0.000	0.000
8	-1.744** (0.811)	-0.072 (0.952)	0.144 (0.642)	-0.293* (0.149)	-0.125 (0.235)	1.285** (0.535)	0.180 (0.673)	*1.000*	0.908 (0.649)
9	-0.118* (0.078)	0.000	0.000	0.000	0.000	0.000	0.000	-1.511** (0.034)	*1.000*

The G_0 matrix has nine rows and nine columns. Note that there are ones on the main diagonal due to normalization and zeros in many places due to the exclusion short-run restrictions described in the previous section. All other numbers represent the estimated coefficients of this matrix with the numbers in the brackets being standard errors. Two stars and one star indicate that the coefficient is significant and marginally significant respectively. Some of the estimated values are positive and some are negative. For example, some of the coefficients in money supply equation (equation 6) are positive and significant at least marginally. This implies that the monetary authority increases interest rate when it observes unexpected increase in monetary aggregates and exchange rate. Looking at money demand equation (equation 5), I observe that the monetary authority uses the contractionary policy when faced with inflationary pressure (negative sign of CPI coefficient). Finally, when the monetary authority observes unexpected decrease in FFR and in exchange rate, it increases the volume of interventions to stabilize exchange rate.

The structural VAR is overidentified so I apply the usual LR test for overidentification. Under the null hypothesis that the restrictions are valid, the LR statistic has asymptotically chi-square distribution with 10 degrees of freedom. Our identifying restrictions are not rejected at 5% significance level (chi-squared (10) = 8.296, p-value = 0.214).

Estimation of the SVAR model enables to observe the impulse responses of included endogenous variables to the structural shocks. VAR studies often highlight the response of the real economy to monetary shocks. In this study, I assume that the monetary policy uses three main instruments, namely the interest rat, the exchange rate and the foreign exchange interventions. The impact of the shocks in these policy variables on the real seasonally adjusted GDP, on the monetary aggregate (CBD), on the credit variable and on the exchange rate are analyzed. Moreover, I look at external shock influence on main domestic variables (GDP, the interest rate, the credit variable, FX interventions and the Georgian Lari/US Dollar exchange rate). I compute the response standard errors both analytically and using Monte Carlo standard errors to check the robustness of the results. The results are quantitatively similar in both cases. The graphs with Monte Carlo standard errors are given in the appendix. .

First, let us discuss the impact of a shock in the interest rate on the main domestic macro indicators. Particularly, I am interested in the impact on the monetary aggregate, on the amount of credit given to the national economy, on the exchange rate and the real seasonally adjusted output looking at the 32 periods (quarters) after shock. From the Figure 1 it is seen that the positive shock in the interest rate has contractionary effect on output and it continuously declines in the whole period after shock. So the results are quite in line with the existing theory. An increase in the interest rate is followed by the slowdown of economic activity that is reflected in the contraction of output. The monetary aggregate also shows decreasing pattern during 32 quarters after positive shock to interest rate. The amount of credit decreases in first 5 periods as interest rate increases, but raises between 5 and 17 quarters. After 17 quarter the credit declines steadily. After 4 quarters, the exchange rate rises fast during the entire period. It means that the exchange rate responds to a positive shock in interest rate with a delay. The responses of the GDP, cross boarder deposits and the credit variable to the shock in the exchange rate have similar patterns as under the interest rate shock (Figure 2). The output and credit eventually decrease by the worth effect described in the first chapter. However, the change in variables is stronger after shock in the exchange rate, especially in the credit and the CBD variables. The interest rate falls almost immediately after shock, increases until 9^{th} quarter following the decline in the credit, and rises again as the amount of credit declines in the economy. Note, the exchange rate as a monetary policy instrument has a stronger effect on other variables than the interest rate does supporting the hypothesis that the exchange rate channel plays more significant role in the MTM in Georgia.

Now, I can compare these responses to the interest rate and the exchange rate shocks to the responses of the same variables to the forex intervention shock. The output stays almost at the same level in first 5 quarters. This can be explained by the lag in output behavior to this supplementary monetary policy instrument. After 5 quarter the output variable raises and reaches the peak in the 14 quarter and then begins to decline. The monetary aggregate responds immediately to the shock: it raises and falls before 24 quarter and steadily declines afterwards. The credit given to the national economy falls during 5 quarters after the positive shock to net interventions possibly reflecting the uncertainty

associated with increased NBG interventions. After 5 quarter it raises, reaches the peak at 17th quarter and falls again. It shows the tendency to return back to its baseline value after 32 quarters. The forex interventions positive shock has an immediate negative impact on the exchange rate that declines during the first three quarters. However, after 3 quarters the exchange rate increases reaching the baseline in 8 periods after the shock. This means that the increase in the net interventions has an immediate and long-lasting impact on the exchange rate and, thus, the interventions can be used to target some predetermined exchange rate level. It would be also interesting to look at the impact of the forex interventions on the volatility of exchange rate which is beyond the scope of this paper.

The impulse responses for the shock to credit help to highlight the interaction of the credit with the rest of the economy. The graphs are presented in the Figure 5 in the appendix. The positive credit shock leads to the increase in output after the first quarter. The monetary aggregate rises after first 5 quarters. As the amount of credit increases, the interest rate decreases (until 10 quarter) after a lag of three quarters. The exchange rate decreases only after 5 quarters following shock. So, all the variables respond to the positive shock in the credit variable with some delay but in line with an existing theory.

Finally, I consider the effects of US FFR shock on domestic economy (Figure 4). The FFR external shock may reflect the US monetary policy shocks or other structural shock (such as inflationary shock), since the FFR is contemporaneously exogenous in our system. As the federal fund rate increases, I can see the similar increase in the domestic interest rate after three quarters until 9^{th} period. This can be explained by the fact that the US is the large economy and higher interest rate in the US tends to increase interest rates in other countries. Also, the domestic monetary authority would respond to increase in the FFR by increasing domestic interest rate to avoid the inflationary effect of the devaluation of domestic currency after some lag. In a small country like Georgia, where the interest rate reacts strongly to the US interest rate, the output response is negative. The higher FFR reduces aggregate demand and has a tendency to reduce output. The resulting increase in the domestic interest rate is associated with an initial fall in credit to the national economy. The exchange rate increases steadily 5 quarters after shock in FFR.

3.5 Main Findings

From the estimation the SVAR model of the monetary transmission mechanism in Georgia the following main findings can be summarized. First, the estimated contemporaneous coefficients in the structural model are significant or at least marginally significant in most cases. The signs are consistent with basic economic theory. Second, the short-run identifying restrictions, which I impose with a-priory theoretical expectations, are not rejected at 5% significance level by the LR overidentification test. This fact allows computing the impulse response functions of endogenous variables to the structural shocks.

Considering the effects of monetary policy instruments on the main macro indicators, I find that the shock to the exchange rate in Georgia has the more sound impact on behavior of the economy than the shock to the interest rate and the forex interventions. This fact can be explained that the interest rate channel of MTM is less significant in Georgia than the exchange rate channel. Poorly developed financial markets and still high and volatile inflation weaken the interest rate channel. The exchange rate channel is more important in monetary transmission in Georgia. Moreover, foreign exchange interventions are found to be more important source of fluctuations in main domestic indicators than the conventional monetary policy (interest rate) shock. The response of output variable to the monetary policy shock in the interest rate is consistent with the existing theory; an increase in the interest rate leads to the contraction of the real GDP. Also, the credit channel, as an accelerator of the interest rate channel, is found to be significant and works in line with basic economic theory in Georgia.

Next, the external shock in the FFR has smaller and slower impact than the domestic interest rate shock. In both cases of positive shocks GDP declines, but the timing is different. In the case of the domestic positive interest rate shock, the output starts to decline after two quarters; while in the case of external (FFR) positive interest rate shock after five quarters. Moreover, the FFR shock induces smaller amplitude of output than the domestic interest rate shock.

Finally, the forex exchange interventions have strong and fast impact on the exchange rate level. Moreover, a shock to the forex interventions is more important source of fluctuations in the exchange rate level than a shock to the interest rate. This can be explained by the fact that the Georgian monetary

authority does not use directly the interest rate setting monetary policy to stabilize the exchange rate, but widely uses foreign exchange interventions. Thus, the interventions by the NBG can be viewed as an efficient instrument to target some exchange rate level.

Conclusion

The monetary transmission mechanism consists of the channels through which shock to the monetary policy affects the real sector of an economy. The theory identifies several key channels of transmission such as the interest rate channel, the exchange rate channel and the credit channel. It should be noted, however, that these channels are of different importance in different countries. The interest rate channel is the most significant one in most developed countries. While in transition countries, where inflation pressures are still high and financial markets are poorly developed, the exchange rate channel attains the particular significance. Moreover, the foreign exchange interventions can be considered as a supplementary monetary policy instrument.

This paper conducts an empirical study on the monetary transmission mechanism in transition CIS-7 Georgian economy. The paper bases its analysis on the SVAR model estimation using the quarterly data for the period of 1996-2006. The vector of the domestic endogenous variables consists of the output, CPI, the monetary aggregate (CBD), the interest rate, credit, the exchange rate and the foreign exchange interventions. To control for the changes caused by outside factors, the Russian real GDP and the US interest rate are included in the list of the external sector variables.

In order to recover structural shocks from their reduced form counterparts, the identifying restrictions consistent with economic theory are imposed on the contemporaneous coefficient matrix. In order to compute impulse response functions the structural factorization is estimated using these short-run restrictions by the maximum likelihood. The estimated coefficients of the contemporaneous coefficient matrix are significant at least marginally and have the signs consistent with basic economic theory in most cases.

By SVAR impulse response analysis, the paper analyzes the effect of the three domestic monetary policy instruments, namely the interest rate, the exchange rate and the forex interventions. Moreover, the effects of the US interest rate shocks on the domestic economy are studied. The exchange rate is found to be an efficient tool for influencing fluctuations in output, CBD and credit. The interest rate and the foreign exchange interventions are instruments of the monetary policy which are also of significant importance in the post-stabilization period in Georgia. The credit channel is found to be successful in Georgia, since the monetary policy causes significant variation in the credit variable. The domestic interest rate shocks have more sound impact on the Georgian economy than the US interest rate shocks. The foreign exchange interventions have stronger effect on the exchange rate level and on the real economy than the interest rate.

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APPENDIX

Figure 1

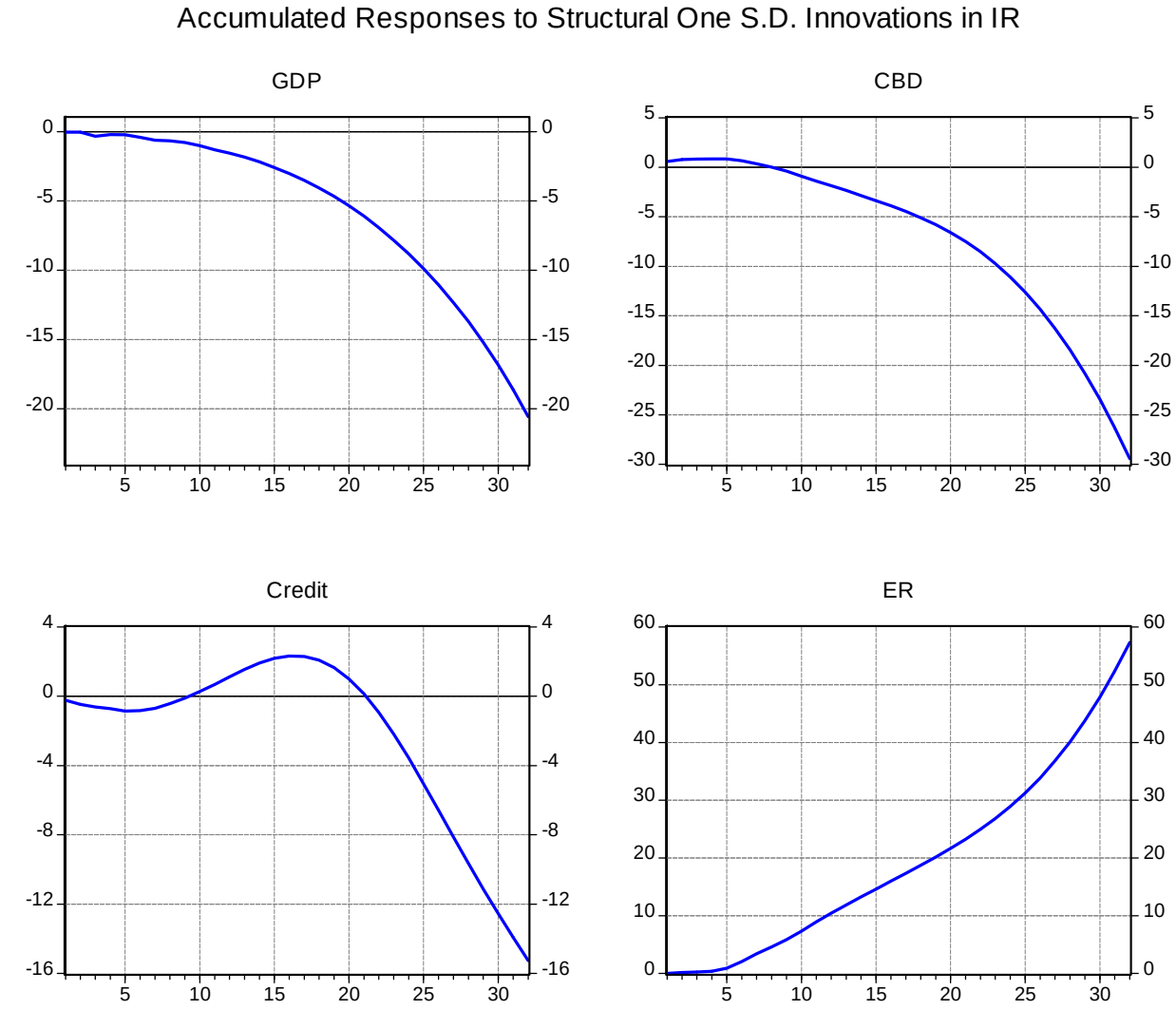


Figure 2

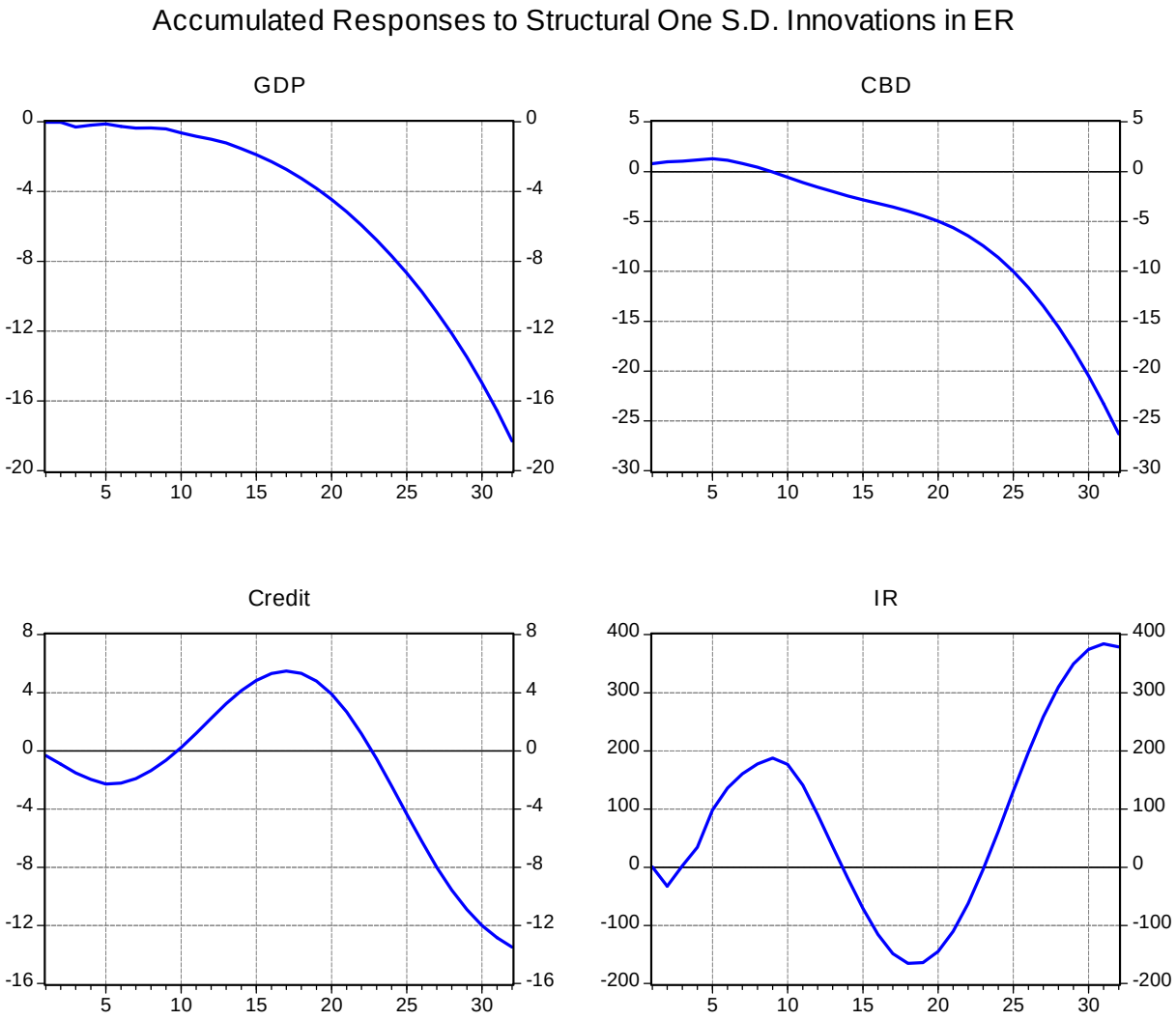

Accumulated Responses to Structural One S.D. Innovations in ER
GDP
CBD
Credit
IR

Figure 3

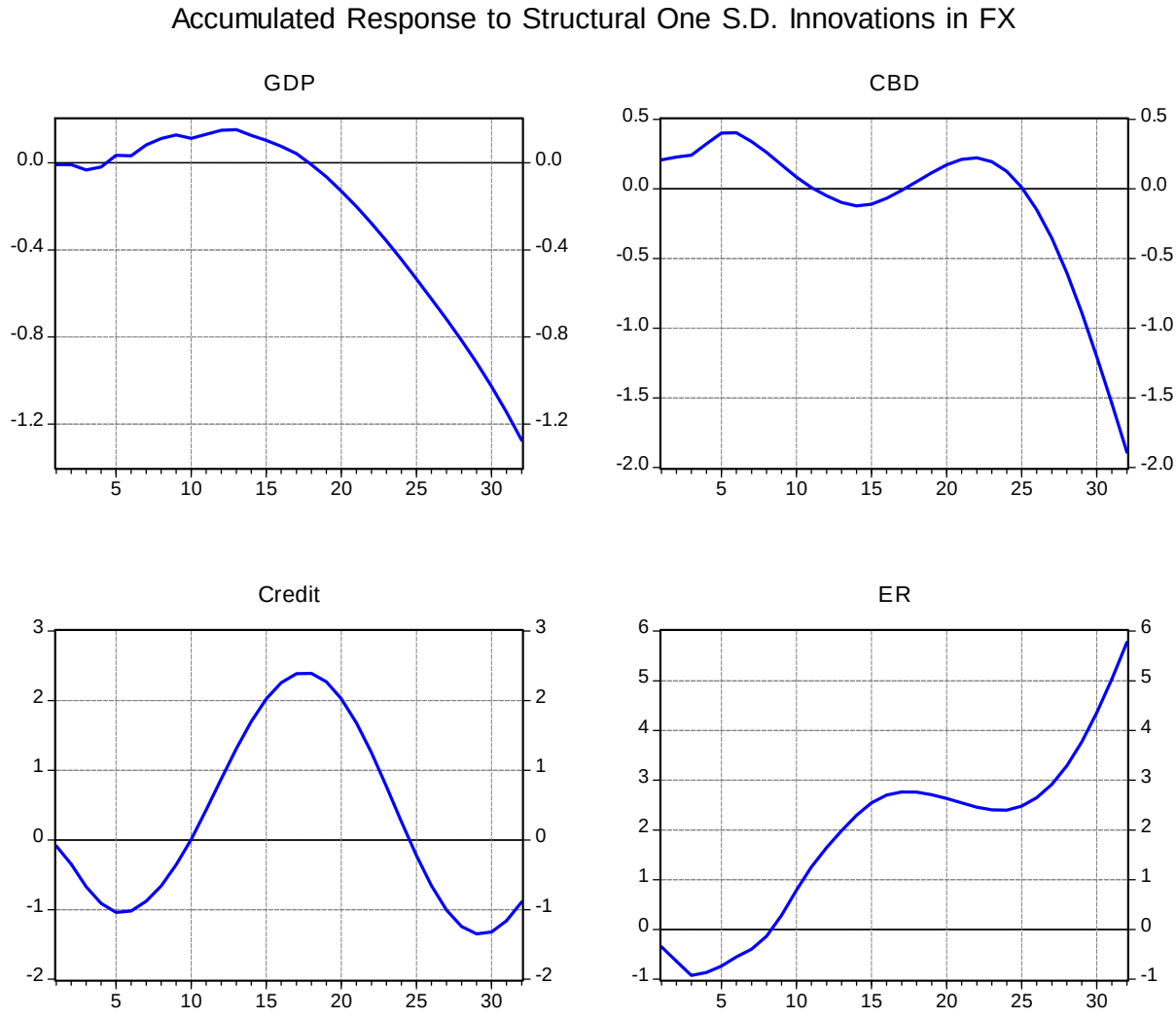

Accumulated Response to Structural One S.D. Innovations in FX
GDP
CBD
Credit
ER

Figure 4

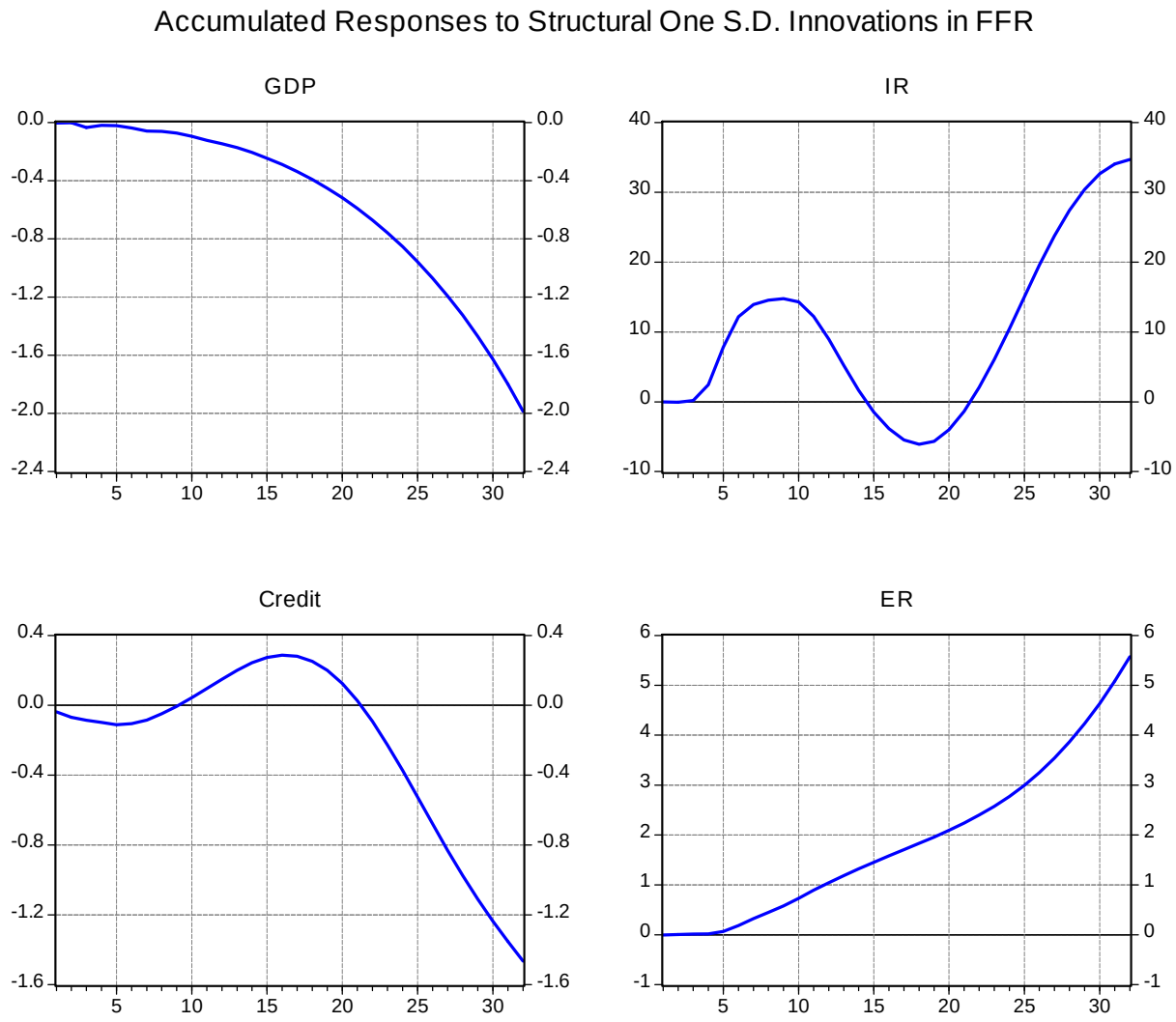
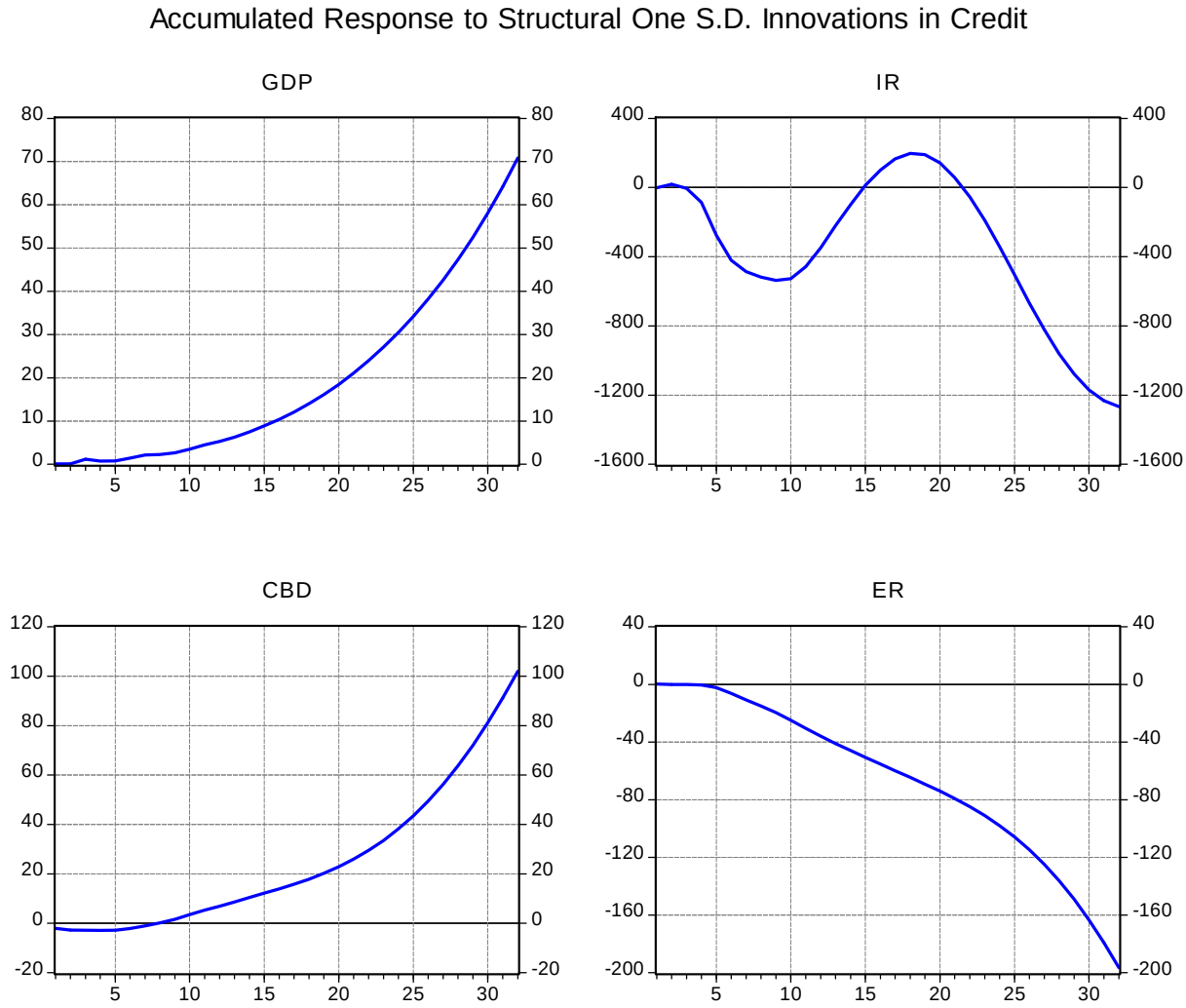

Accumulated Responses to Structural One S.D. Innovations in FFR
GDP
IR
Credit
ER

Figure 5


Accumulated Response to Structural One S.D. Innovations in Credit
GDP
IR
CBD
ER

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