

Charles University
Faculty of Social Sciences
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MASTER'S THESIS

Inflation Targeting Turns Ten in Georgia:
Assessment of the Experience

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Declaration of Authorship

The author hereby declares that she compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, January 4, 2018

Signature

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Abstract

The paper evaluates transition of the monetary policy in Georgia to inflation targeting and the record of the first years of experience with this policy. The inflation targeting was officially announced in 2009; nevertheless, the National bank of Georgia (“NBG”) was investigating and planning the transition since 2006. The NBG implemented new instrument the monetary rate – as a precondition for switching to the inflation targeting. The NBG has also improved the independence and transparency following its introduction.

Then, we assess the success of the policy change by investigating the efficiency of the monetary transmission mechanism using vector auto-regression models with alternative identification schemes, in particular, the Cholesky decomposition and sign restrictions approach. Our findings suggest that the monetary transmission mechanism works primarily via the Tbilisi interbank rate while the effects of changes in the newly implemented monetary policy rate are bit weaker. The maximum price decrease is achieved after about 15-17 months and it somewhat coincides with the NBG’s horizon (4-6 quarters). We have further established that the monetary policy supports the financial stability to a certain extent.

JEL Classification

E4, E52, P2

Keywords

Inflation targeting, Monetary Transmission
Mechanism, Vector Auto-regression Models

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Abstrakt

Předložená práce si klade za cíl zhodnotit zavedení a zkušenosti s inflačním cílováním v Gruzii. Inflační cílování bylo oficiálně ohlášeno v roce 2009, ale centrální banka směřovala k implementaci nového režimu již od roku 2006. Došlo k zavedení nového instrumentu měnové politiky, základní měnové sazby, zvýšení transparentnosti rozhodování a posílení nezávislosti centrální banky. Dopad inflačního cílování je posuzován za pomoci odhadu síly transmise měnové politiky za pomoci VAR modelu s několika alternativními identifikacemi (Choleského dekompozice a identifikace přes znaménkovou restrikcí). Výsledky naznačují že monetární transmise primárně funguje přes mezibankovní sazbu a efekt nově implementované základní měnové sazby je zatím spíše slabý. Maximální pokles cenové hladiny nastává po 15-17 měsících což koresponduje s horizontem měnové politiky centrální banky v délce 4-6 čtvrtletí. Měnová politika také reaguje a ovlivňuje finanční stabilitu v Gruzii.

Klasifikace	E4, E52, P2
Klíčová slova	Inflační cílování, VAR modely, monetární transmise
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Table of Contents

List of Tables	7
List of Figures:	8
Acronyms	9
Master's Thesis Proposal	10
Introduction	14
Literature review	16
I. Inflation targeting performance	21
1.1 Inflation targeting in practice	21
1.2 Inflation targeting framework	25
II. Economy in Georgia	27
2.1 Before inflation targeting	27
2.2 After Inflation targeting	29
2.3 Transparency, accountability and independence of the National Bank of Georgia	35
2.4 Dollarization in Georgia	39
III. Monetary Transmission Mechanism and Financial Stability in Georgia	42
IV. Empirical Analysis	46
4.1 Model description	48
4.2 Data Description and the results	53
V. Conclusions	66
VI. Bibliography	68
VII. Appendix	73

List of Tables

Table 1: Dates of some countries that adopted IT	22
Table 2: Explicit Inflation targets	30
Table 3: Central Bank Transparency and Independence index	37
Table 4: Measurements of Stability	61
Table 5: Granger causality test results, data range 1999-2006	64
Table 6: Granger causality test on single variables data range 2008-2016.....	65
Table 7 Granger Causality test credibility check	78

List of Figures:

Figure 1 Average inflation in inflation targeting and non-inflation-targeting emerging economies.	24
Figure 2 Money aggregate and Reserves in Georgian economy	29
Figure 3 Inflation and inflation targets.....	31
Figure 4 Dollarization level of loans (%) in economy	41
Figure 5 Monetary transmission mechanism in Georgia.	43
Figure 6 Visual inspection of dataset	55
Figure 7 Impulse Response Functions.....	57
Figure 8 Positive one standard deviation interest rate shock, Sign restrictions method	59
Figure 9 Spread between monetary rate and Tbilisi interbank rate	62
Figure 10 Positive one standard deviation spread shock, Sign restrictions method	63
Figure 11 CUSUM test results for Tibor.....	73
Figure 12 CUSUM Test results for MR	73
Figure 13 Model 1 Variance Decomposition Baseline VAR.....	74
Figure 14 Model 1 Forecasts of Variables generated by VAR.....	75
Figure 15 Real Values of the Variables.....	77
Figure 16 ACF of Residuals from reduced form VAR	77
Figure 17 Monetary rate shock, Sign Restrictions.....	78

Acronyms

CB	Central Bank
CBB	Central Bank of Brazil
CNB	Czech National Bank
CPI	Consumer Price Index
GDP	Gross Domestic Product
IT	Inflation Targeting
MTM	Monetary Transmission Mechanism
MPC	Monetary Policy Committee
MR	Monetary Rate
NBG	National Bank of Georgia
NER	Nominal Exchange Rate
NW	Normal -Wishart Prior
OLNBG	Organic Law on National Bank of Georgia
Tibor	Tbilisi Interbank Rate
VAR	Vector Auto-Regression

Master's Thesis Proposal

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Proposed Topic:

Monetary transmission mechanism in Georgia under inflation targeting regime

Motivation:

Inflation targeting was first introduced by New Zealand in 1990; thereafter number of developed and emerging markets followed its lead. Statistics show that none of the countries has dropped this policy. Owing to the fact that it has been a successful monetary policy for developed countries, many people deem IT is a panacea for their economy, others contend that less developed countries are not ready yet. It was debatable topic even in the U.S. until 2012 when the U.S. Federal Reserve Chairman Ben Bernanke set a 2% target inflation rate, bringing the Fed in line with many of the world's other major central banks.

Georgia introduced IT in 2009. It is country with political and economic instabilities, highly dependent upon exogenous factors. As opposed to developed countries (New Zealand, Canada, UK) which wanted to lock the low inflation rate after disinflation period, Georgia was facing constantly growing inflation rate. Thus, IT should have been an instrument to at first lower and

then lock inflation rate. In 2008's IMF paper, Bakradze and Billmeier assessed Georgian economy and concluded that reliable MTM is crucial prerequisite for successful IT regime. According to the authors, major weakness of previous monetary policy was *“lack of reliable interest rate that reflects the monetary stance.”* Now, almost ten years later, when the main goal of the National Bank of Georgia (NBG) is to maintain price stability and create valid inflation expectations for society, I am inclined to examine whether it managed to implement benchmark policy rate and improved monetary transmission mechanism under inflation targeting regime. I will try to indicate how NBG developed

Hypotheses:

- 1. Money aggregate effects on output and prices are still significant;**
- 2. NBG manages to create correct expectations, which means that the prices and output response to policy interest rate shocks are consistent with economic theory;**
- 3. The exchange rate channel is still very important.**

Methodology:

I will, in the first place, collect previous empirical analyses, collect data from the National Bureau of Statistics and the National Bank of Georgia. I intend to examine the manner whereby central bank of Georgia developed and what are the changes in monetary transmission mechanism. I am planning to use baseline VAR model and BVAR with sign restrictions method.

Expected Contribution:

I expect my contribution to be more or less meaningful as dearth of scientific research on today's Georgian monetary transmission. To my knowledge country lacks expertise on the policy at issue and the present paper will attempt to provide new insights on this matter and fill the gap.

Outline:

1. Introducing inflation targeting: I will review the framework, also advantages and disadvantages of inflation targeting;

2. Economy of Georgia: small history of monetary policy, how Central Bank developed and prepared for implementing inflation targeting; Examining transparency, accountability and independence.
3. Monetary transmission mechanism of Georgia;
4. Empirical analysis: I will explain how the data was collected and methods of my estimated model; discuss some results;
5. Conclusions

Core Bibliography:

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Author

Supervisor

Introduction

A well-functioned monetary transmission mechanism is essential for a stable economy. The inflation targeting (IT) – which is a recent trend – is inviting for many developing as well as already developed markets. Many central banks adopted the inflation targeting as a pragmatic response to the failure of other regimes. However, the question whether it also applies to emerging markets has been a matter of debate for a long time. Empirical evidence demonstrates that all countries which have implemented the inflation targeting are still following the policy. For some researchers, this already serves as a sign of success. Others contend that the inflation targeting is a great tool to curb a price level, but it is characterized by strict institutional requirements and, consequently, it might be inapplicable to emerging economies.

In this paper, we review the experience with inflation targeting in Georgia. We took two approaches: first, we collected all data about the NBG and tried to assess how they prepared for an important switch; second, we performed an empirical analysis which looks into the monetary transmission mechanism using different approaches.

The switch to IT was a necessary as the previously stable relationship between what the NBG was able to control (the monetary base) and the final objective (the inflation) broke down over time. One of the main steps towards successful policy was the creation of a monetary rate in 2008. It is a minimum interest rate on one-week refinancing loans provided to commercial banks. Currently, with the Tbilisi interbank rate, it is one of the main tools in ensuring the NBG mandate – i.e. the price stability – which also serves as a primary goal of the Central Bank of Georgia. Introduction of the new policy rate was crucial as they support short-term liquidity on the market and the NBG is the only supplier of national currency; especially considering the fact that the country is characterized with rather high level of dollarization. The decisions regarding monetary policy rate are made by Monetary Policy Committee but approved by the Governor of the Central Bank of Georgia, they depend on current and expected developments in the economy or financial market. Other institutional requirements, such as independence and transparency of the central bank is vital to create correct inflationary expectations.

The second part utilizes an econometric approach to study the policy change. This paper applies two types of vector autoregressive models. One of the methods used – i.e. sign restrictions – is rather novel and has never been used to study the Georgian economy. The choice of the model was motivated by vast literature on inflation targeting and monetary transmission mechanism. We apply Cholesky decomposition as a baseline VAR to follow the previous analysis about IT and Georgia from 2008 and employ the sign restriction method for sensitivity analysis and further insights. We investigate the shock effect of positive interest rate on Georgian economy and observe if output, prices and nominal exchange rate respond to tight monetary policy actions. The contribution of this paper can be meaningful. Despite already existing remarkably extensive literature concerning the inflation targeting, to my knowledge, there has not been done an empirical study evaluating the performance of the NBG and the monetary transmission mechanism of Georgia under inflation. This paper attempts to fill this gap.

The work is structured in the following manner: Chapter 1 investigates the inflation targeting in practice and provides a short overview of the policy framework; Chapter 2 studies Georgian economy prior to IT and discusses changes in the central bank structure and the preparatory process; Chapter 3 gives a short review of how the monetary transmission mechanism works in Georgia; Chapter 4 describes model, data that were utilized, and provides results and their economic interpretations, and further contains the sensitivity analysis; Chapter 5 includes a conclusion and further remarks. The references and the appendix (which contains additional tables and graphs used for checking and discussing specific topics, as well as the R code) can be found at the end of the paper.

Literature review

Inflation targeting was successfully introduced in 1990 in New Zealand, encouraging other developed or developing countries to follow its lead. Bernanke (2003) reckons that Germany was the pioneer as even in 1970-80s Bundesbank indirectly targeted inflation when it was computing money growth rate from desirable inflation (normally 2% a year). None of the countries has abandoned this pursuit, and some economists claim that the foregoing alone serves as an empirical evidence of IT's success. The numerical annual target for advanced countries still remains in a range of 1-3% for the consumer price index (CPI) or core CPI. According to Svensson (2010), differences in target do not seem to trigger any significant impacts.

However, there are sceptics who argue that developing countries with many exogenous factors affecting economy are not ready for the IT.

Inflation targeting is a policy that is more often used to lock in the low inflation; consequently, emerging markets have to decrease at first and then hover inflation rate. This, in some cases, may even be disadvantageous. The largest part of the debate is taking place in the empirical literature, on account of mixed results. Khan and Abdelhak (2001) believe that the threshold level of inflation that slows down the growth is estimated at 11%, and high inflation is linked to moderate gains in GDP growth. Brito and Bystedt (2010) regressed some models that showed a decline in output growth during IT adoption process. While, Ball and Sheridan (2005) found no evidence that proves IT's success in output growth, employment or other economic measurements for 20 OECD countries. Empirical analysis of Baxa, Plasil and Vasicek (2014) demonstrated that despite historical and structural similarities in the economies, the result of inflation targeting policy might differ. For instance, in Hungary and Poland, intrinsic inflation persistence has not decreased considerably to compare with other developed countries. Many economists claim that inflation targeting is the reason for the financial crisis. Jeffrey Frankel, who in 2012 said: "IT evidently passed away in September 2008", suggested that central banks which switched to this regime do not pay sufficient attention to asset-price bubbles, which could not be the strong argument as the United States officially switched to IT only in 2012.

The opponents of inflation targeting claim that policy is too focused on the price level, it tries to control inflation, therefore resulting in a sluggish growth rate of output and also higher volatility.

They criticize strict IT, however, in practice, all central banks follow flexible targeting which allows them to pay attention to different variables as well.

Proponents deem that IT is the best that a monetary policy can do to support the long-term growth of the economy with a view to maintaining price stability. According to Jahan (2012), major advantage thereof is a combination of “rules” and “discretion.” In work published by African Development Bank (2015), researchers demonstrated that IT indeed reduces the volatility of inflation and keeps it persistent, resulting in the stable economic environment, which is a major problem in emerging markets. Johnson (2002), on the other hand, analysed industrial countries and found that inflation targeting does not affect variability or forecast error. Fang, Miller and Lee (2009) affirm that IT is characterized by lower output growth in the beginning, but effect disappears in the long run. Mishkin (2005) measured the performance of IT and confirmed that countries following this monetary policy managed to decrease average inflation from 12.6 to 4.4 percent. Walsh (2009) describes the performance of IT as non-negative. Furthermore, he argues that policy has more contribution to lower rates and stable environment. Balima (2011) claims that developing countries, perusing IT have more “fruits” – price and output stability: “Indeed, monetary policy credibility has yet to be earned in these countries, such that a successful implementation of IT may help anchor inflation expectations more firmly and close the credibility gap.”

According to Ben S. Bernanke, a well-known IT advocate who co-authored book with Frederic S. Mishkin in 1997, discussions of inflation targeting in the American media are reminiscent of “the way some Americans deal with the metric system--they don't really know what it is, but they think of it as foreign, impenetrable, and possibly slightly subversive.” He describes IT as the best practice of constrained discretion and source to improve the discipline of a monetary system.

Some economists assert that inflation targeting itself is not enough and policy makers should also consider financial stability. For instance, Bank of international Settlements (BIS 2014) was actively promoting a new policy, so-called leaning against wind (or also referred to as leaning into the wind); central banks following this policy should consider assert price bubbles and credit

booms to try and avoid financial crisis; it can be achieved by higher policy rates and smaller probabilities of possible crises. Svensson (2017) describes it as a policy that has more costs than benefits as probabilities and magnitude of bubbles are really small.

Furthermore, the IMF and the Federal Open Market Committee have both suggested that the costs of ‘leaning against the wind’ exceed the benefits.

There are many stringent technical and institutional requirements countries should meet in order to implement the inflation targeting. Svensson (2010) describes it as a regime characterized by a trinity of a mandate for price stability, independence and accountability. Considering the nature of inflation targeting policy, Batini and Laxton (2007) developed basic pre-conditions for successful implementation: the independence of a central bank; a well-developed central bank infrastructure; a developed economic structure and a healthy financial system. However, after conducting the research, they found that none of the targeting countries satisfied all four conditions prior to the adoption. Furthermore, results showed that after the adoption, central banks often strive toward improving their institutional and policy framework which in the long run brings success. Balima, Kilama and Tapsoba (2017), trying to settle the debate regarding the inflation targeting, conducted the meta-regression analysis (MRA) to the literature on the macroeconomic effects of the inflation targeting; what they found was two types of bias in the published literature regarding IT. These reasons can be interpreted as a cause of mixed results. First, type I bias, where authors incline to choose and prefer most common views about IT and, second, type II bias, which refers to those editors who promote results that are significantly different from zero. All things considered, they assert that IT adoption has indeed more “fruits” for developing countries; however, a successful implementation requires pre-conditions.

On the whole, this gives rise to a question – are the pre-conditions inevitable or can country at first adopt and then try to improve institutional and economic conditions?

As stated in the paper about settling the debate on IT (Balima, Kilama and Tapsoba; 2017), the requisite preconditions are the following: a sound fiscal position, a deep financial system and a greater exchange rate flexibility.

According to Mishkin, developing countries without pre-conditions face some additional problems in the process of pursuing a new monetary policy. These challenges are the following:

-
- Weak fiscal institutions;
 - Weak financial institutions including government regulation and supervision;
 - Low credibility of monetary institutions;
 - Dollarization;
 - Vulnerability to sudden stops.

The research department of the monetary fund (Masson, Savastano, Sharma 1997) underlined additional problem – seigniorage, which remains to be an important source of financing for the foregoing markets. Countries with transition economies are deemed to have significantly important exchange rate channel, whilst the remaining channels are either underdeveloped or non-existent at all.

The Central banks have one main goal to achieve. On account of primary objectives, IT is considered as a sufficient policy to stabilize prices. To achieve that efficacy of monetary policy is crucial. Monetary policy affects aggregate demand; consequently, output and prices are also effected. Policy actions can be transmitted to the real economy in many different ways. Under the inflation targeting regime, a well-developed monetary transmission mechanism (MTM) and correct inflation expectations are of most importance.

In Georgia, MTM was first analysed by Gigineishvili (2002), who underscored the significance of an exchange rate channel and found that CPI elasticity to a depreciation of Georgian Lari against US dollar was 0.21. The Monetary transmission mechanism was again studied in 2007 by Samkharadze. Despite the fact that his findings were similar to previous results, the study further underscored the growing significance of other channels in Georgian monetary system.

Macdonald, Egert and Halpern (2204) contend that exchange rate channel is often the most important in the transmission of monetary impulses. National banks which follow the inflation targeting regime need that the whole transmission mechanism be strong and reliable – more importantly, expectations channel should work effectively. Nevertheless, even after policy

transition, the exchange rate channel remained to be most important one for Georgia (Machavariani 2012).

High level of dollarization has been another big challenge for Georgia. Bakradze and Billmeier (2007) argue that lack of trust in national currency has been an issue after several hyperinflations in Georgia and population developed a distaste for the rates beyond the single-digit.

They assessed the monetary policy of that time, checking whether the country was ready for the IT regime and published some recommendations for the NBG, which, amongst others, included the following: correcting some institutional weaknesses; bringing *de facto* practices in line with the institutional provisions; and developing its monetary operations framework and instruments which in the end will lead to a more stable monetary transmission mechanism. This paper will be our first guideline to compare the results as they are directly addressing inflation targeting and related issues.

I. Inflation targeting performance

1.1 Inflation targeting in practice

“Choice of selecting the monetary policy is like a marriage – you have to choose a perfect alternative”

Tomáš Holub, December 2016

When it first started in New Zealand, unlike other countries, they did not have any hindsight or experience, but the national bank gradually established credibility and anchored price level on target. How does the IT work? Central banks announce the explicit rate for the medium term to the public and, in so doing, they create inflation expectations. Why the inflation targeting? Because of the innovations and rising financial markets, the money demand becomes unstable; consequently, industrial countries pursuing money targeting prefer to switch to IT. Further, when monetary authorities are pursuing price stability, inflation targeting is a regime that gives a possibility to steer the ultimate object directly without any intermediate policy goal, like in the case of money growth and exchange rate targeting.

IT represents a relatively new practice as it was introduced as a monetary policy only in 1990; but at the same time it is characterized by increasingly widespread adoption. According to 2012's numbers, IT's share in the monetary policy regimes was 20%. IT's successes is obvious and can be proven only by the fact that none of the countries has abandoned it yet. It can also be explained by the rational expectations hypothesis.

The new regime is followed not only by developed countries (Canada, United Kingdom, USA, Japan), but by ones with emerging markets and small open economies as well. The policy is all about managing the expectations. When the country's economy is characterized by many exogenous factors and frequent shocks, together with underdeveloped monetary transmission mechanism channels, it becomes more difficult to achieve success. Creating a valid and feasible

Country	Date
New Zealand	1990
Canada	1991
United Kingdom	1992
Sweden, Finland, Australia	1993
Spain	1995
Israel, Czech Republic	1997
Poland	1998
Brazil, Chile, Colombia	1999
South Africa, Thailand	2000
Korea, Mexico, Norway, Hungary	2001
Peru, Philippines	2002
Guatemala, Slovakia	2005
Turkey, Serbia	2006
Ghana	2007
Georgia	2009
United States	2012
Japan	2013
Russia	2014
India	2016

Table 1: Dates of some countries that adopted IT

target is crucial, these states must realize that not only the overshooting is pricey, but undershooting targets leads to the same results. On the one hand, inducing positive inflation over the several years will significantly raise prices, while a negative target might in the end lead the economy to deflation – an increased value of debt generates a recession.

Another important barrier is whether central banks pursue price stability and are trying to achieve it, provided that they are not in conflict with other goals (for example: constant intervention in currency markets to stabilize the exchange rates, or trying to target other indicators, such as lower unemployment, higher wages, etc.).

Czech Republic has probably proven that IT can be acknowledged as a prosperous policy for emerging markets and small economies. It was a pioneer in the Central Europe when it adopted IT in 1997, but still somehow managed to at first lower the rate gradually and then lock it. One of the main reasons for Czech Republic's successful "journey" was that it emphasized the importance of transparency and independence of the Czech National Bank ("CNB"). The improvements Czech Republic achieved are evident, as nowadays the CNB is in the top 4 of the world's most transparent banks. Despite successes, there were some pitfalls in 2012 – when inflation was falling, Czech Republic induced zero lower bound 2-week repo rate, at the same time weakening the exchange rate to the level of 27CZK = 1euro, avoiding further revaluation of the national currency.

Many other emerging markets were enthusiastic initiates: Israel switched to IT in 1997, following Chile in 1999 together with Brazil and Colombia. Brazil's case can be considered as the most rapid transition – the Central Bank of Brazil ("CBB") managed to adopt and implement a full-fledged inflation targeting within four months after the appointment of the new president of the CBB in 1999. He indeed brought Brazil in line with other industrialized countries and had initial success, maintaining inflation below 10%, but also some breaches due to a "deep-rooted fiscal policy." After 2014, their inflation rate had an increasing trend which changed in second half of 2016. Chile, Colombia and Israel had both the target inflation and exchange rate bands for several years after the adoption. Facing conflicts in achieving their goals, these countries switched to the floating exchange rate regime and implemented a full-fledged IT.

The United States and Japan started to announce explicit targets and joined other countries only in 2012 and 2013 respectively. However, the Federal reserve system ("FED") has been announcing desirable targets even before the official adoption. It was Ben Bernanke, the U.S. Federal Reserve chairman and a long-time IT advocate, who set the target at 2% in 2012.

Empirical evidence demonstrates that even though inflation targeting requires stringent institutional changes, eventually it proves to be successful in developing countries:

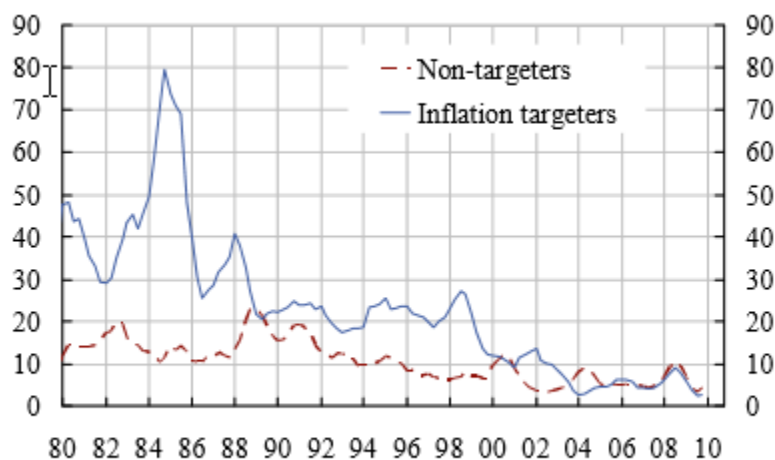


Figure 1 Average inflation in inflation targeting and non-inflation-targeting emerging economies.

Inflation targeters: Colombia, Chile, Indonesia, Israel, Mexico, South Africa, Philippines and Thailand;
 Non-targeters: China, Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, India, Malaysia, Morocco, Nigeria, Pakistan, Panama, Tunisia, Singapore and Taiwan.

Source: Svensson 2010

The figure shows that the new monetary policy was adopted by countries with very high inflation, however the prices came down faster than for non-targeting countries. Furthermore, if we compare phase and the speed of decrease, it was almost the same for OECD targeting and non-targeting countries. This again confirms that overall, IT has improved macroeconomic performance amongst emerging markets, it is a flexible and resilient monetary-policy regime.

Furthermore, according to Svensson (2010), central banks never follow strict IT, despite the existence of the primary goal, they still give some weight to different economic variables – like, for instance, an output gap that is a gap between actual and potential outputs.

We see the fashion towards IT adoption, but what are other factors that should influence a policy maker's decision to pursue IT? Goncalves and Carvalho (2008) attempt to summarize reasons: first, when the actual policy (money or exchange rate targeting) does not work; second, when countries are hit by external shocks, as IT can deliver stronger credibility (was proved during

financial crisis); third, countries with high political turnover; and finally, the countries with flexible exchange rate in need of finding a new nominal anchor.

1.2 Inflation targeting framework

Switching period to IT may vary as well as the process and the results thereof, but somehow central banks (with similar market conditions) gradually converge to policy framework.

What are the main characteristics of inflation targeting?

- **Explicit numerical target**

One of the main requirements that central banks have is the introduction of a mandate – the price stability. To achieve their primary goals, central banks create expectations by announcing explicit targets. Usually, the targets are announced for several subsequent years which helps economic agents in decision-making. The essential instrument for central banks are interest rates. As the inflation and interest rates move in opposite directions, the actions of central banks become more transparent.

National banks forecast the inflation rates and then set a feasible and appropriate target. Difference between these two numbers shows how much the policy needs to be adjusted.

- **Medium-term focus**

The primary goal of IT is, of course, the inflation; however, it is not the only objective. In order to achieve stable prices, the monetary policy tries to decrease the volatility of an output and obtain an optimal degree of stabilization. As opposed to a strict IT, this approach is used in practice by central banks and is referred to as a flexible inflation targeting. The level of current interest rates does not matter as much as the level of future policy rates, which have a greater effect on current decisions of most economic agents. Hence, policy horizon is a medium (or long) term which is explicit. Typically, it means a 2- or 3-year horizon.

Some researchers claim that the horizon itself is defined by an actual inflation. According to Armas and Grippa (2005), countries that are in a disinflation process (Brazil, Colombia, and the Philippines) set their inflation targets for one or two years. The Countries that have already anchored inflation to lower targets, attempt to maintain it considerably at that level and set horizons for a medium term. The inflation target level in the second group of states is between 2% and 3%. This means that central banks have a long-run target inflation, and once it is achieved, they usually stop revising the target and reach long-run stability for saving and investment decisions.

- **Transparency, independence and accountability of a central bank**

The transparency and accountability of central banks could be a decisive factor in pursuing the inflation targeting. Central banks must manage expectations; therefore, building a trust in public, commitment to their primary goal and trustworthy actions are indispensable. Typically, national banks of the targeting countries publish regular policy reports. According to Svensson (2009), reports must include the forecasts of inflation and other variables as well as the motivation of policy decisions and the summary of analysis behind the forecast.

Emphasizing high degree of accountability is also essential for central banks. Having an explicit target and being committed to the primary goals is now prevalent in the inflation targeting countries. For the purposes of a greater accountability, CBs are disclosing information about their financial situations; furthermore, in some of those countries central bank officials are required to provide explanations to the parliament and also to the general public on any deviations above 1% point from the target.

Independence helps central banks to make unbiased decisions and be fully devoted to the mandate. Independence of a central bank can at times also reflect on a speed of transmission; further, more independent central banks result in stronger transmission. (Havranek, Rusnak 2012)

II. Economy in Georgia

2.1 Before inflation targeting

The road to today's economy was very slow and difficult – especially in the beginning, when there were zero resources and lack of expertise in Georgia. The dearth of experience made it impossible to determine and manage structural changes which, on the other hand, resulted in uncertainty, constant shocks, hyperinflation and rising unemployment. Furthermore, the country was suffering from internal armed conflicts and other political or social issues. The recession started in 1990 and the GDP declined by 78% in 1995. Albeit there was a boom in 1997 (GDP growth rate reached 10,7%), the fairy-tale did not last long as the “Russian Flu” proved to be highly contagious for Georgia (Russian financial crisis started in 1998). Since then, shadow economy was rising and the government was unable to collect taxes. The country was involved in bribery and crime. During 1997-2001, the 6% of the population was living below the poverty line, getting less than 1.25\$ per day. Despite the fact that since the very beginning (after the collapse of Soviet Union) the aim was to switch to a market economy, it was only achieved after the “Rose Revolution” in 2003. Drastic changes that were made by the new government resulted in fast improvement. The highest rate of growth i.e. 12.3% was recorded in 2007. Nonetheless, a happy ending was not awaiting the people of Georgia because of the armed conflict with Russia in August 2008 and the global financial crisis.

The road was burdensome for the NBG as well. The first central bank existed in Georgia already in 1919; however, the NBG in its current form was established in 1991, after the Soviet Union collapsed and the country regained its independence. The Russian central bank stopped supplying Rubles in Georgia in 1993; consequently, the first important task for the NBG was to create a temporary monetary unit – the coupon. The 1995 was an important year, as the Parliament of (by that time) the Republic of Georgia adopted a new Organic Law¹ which

¹ The Constitution of Georgia (adopted on 24/08/1995, the date of access: 30/12/2017) sets forth matters which must be regulated by an organic law, including, the activities, rights and obligations of the National Bank of Georgia

guaranteed independence of the National Bank of Georgia while implementing policies or supervising banking sector. Also, they introduced a new currency – Georgian Lari into the economy – during the same year. The coupon was replaced at a rate of one million to one. The National Bank of Georgia also established exchange course 1.3GEL/1USD.

At that time, the National Bank of Georgia had 3 objectives: price stability, stable national currency and safe financial system. They were targeting money supply by monitoring reserves, cash in circulation and broader money in the economy. Trying to achieve a price stability and, at the same time, maintain the purchasing power of Georgian Lari was incompatible.

A floating exchange rate regime is essential for the targeted countries as well as for open, small-size economies like Georgia since it absorbs external shocks. Therefore, under a floating exchange regime, external shocks have a relatively smaller impact on economic growth and employment. A floating exchange rate should assure stable employment and the stability of incomes in the national currency, while low and stable inflation guarantees the purchasing power of incomes. However, it has been cumbersome to maintain the purchasing power of Lari. Since 1990, the importance of USD rose, population developed distrust in national currency and dollarization peaked at 86% in 2003. Some economists even call that period the 2-stage currency system. As in most of the financial deals or investments, only the USD were acceptable. Ironically, even until 1 July 2017, if one needed to buy a house or a car, the prices were still in the USD. Furthermore, the Russian crisis of 1998 affected the purchasing power of Lari which lost its value significantly and reached 2,451GEL/\$1 in 1999. The record of a historical minimum of depreciation was “improved” in December 2016 when the exchange rate became 2.8GEL/\$1.

Additionally, because of currency crisis, there was a drop in foreign currency reserves in 1998. Thus, the NBG had to intervene on the market and rebuild the stock. Change in the government and stringent transformation of Georgian economy made it easier for the NBG to meet its

(Article 95(4) of the Constitution). An organic law has a higher threshold for adoption compared to an "ordinary" law and is considered to be adopted if it is supported by more than the half of the members of the Parliament (Article 66(2) of the Constitution). Under the hierarchy of normative acts, the organic law takes precedence over an "ordinary" law (Article 7(2) of the Law of Georgia on Normative Acts, adopted on 22/10/2009, the date of access: 30/12/2017).

objectives. Reserves almost doubled in 2004, which was a consequence of better relations with the trading sector and increased investments. Overall, the economy started to recover.

During this period, the main tool for the NBG was targeting the money supply which was gradually increasing since 1995. Nevertheless, amount of money starts to rise faster in 2004. This can be the reason of the unsterilized intervention which entails purchase of the foreign currency without changing (adjusting) the monetary base. This rising trend persisted until the political and financial crisis of 2008.

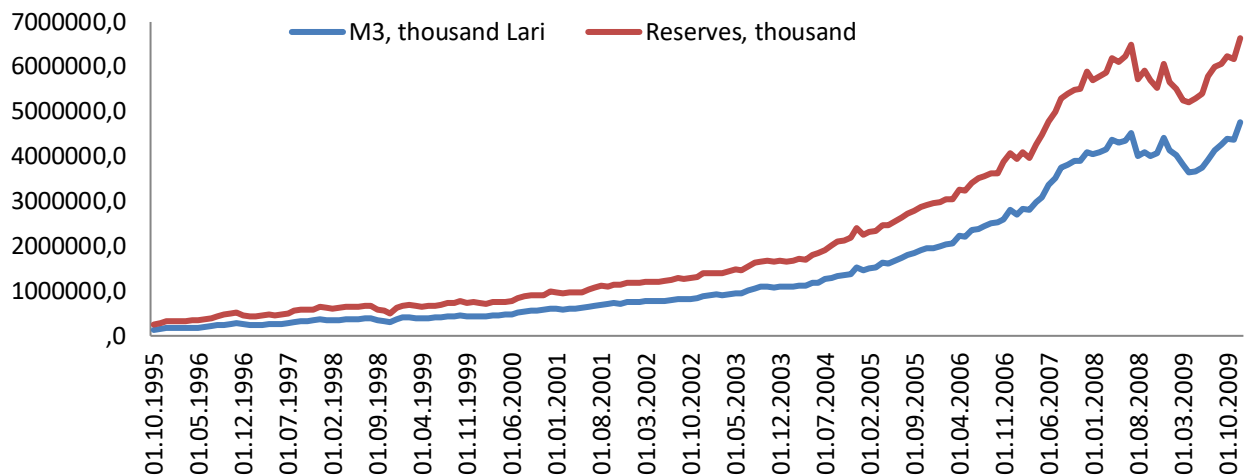


Figure 2 Money aggregate and Reserves in Georgian economy

Source: NBG

2.2 After Inflation targeting

The NBG strategies are guided by the aforementioned organic law and resolutions of Georgian Parliament; furthermore, it is directed by “Main Directions of Monetary and Exchange rate Policies.” Decisions on monetary policy are made by the Governor of the NBG who takes

recommendations from the Monetary Policy Committee. (“Consists of 12 members. It includes the Governor, the two Vice-governors, and heads of appropriate divisions and departments”.)²

In 2009, after 3 years of preparation, the NBG decided to switch to the inflation targeting. Following the adoption of IT, the Committee focuses on inflation targets and monetary policy rates which are main operational tools that affect the economy. The decisions on refinancing rates are made by the Monetary Policy Committee and approved by the Governor.

The change of regime was determined by the fact that targeting money aggregate was growing rapidly and did not support stable prices anymore; furthermore, interest in IT among emerging countries across the world was rising

Each year policy makers publish the report of “main directions,” where they announce a target inflation rate for a medium term – i.e. for 3 subsequent years, which is then approved by the Parliament of Georgia. When setting the target level of inflation, the NBG takes into account the country’s growth rate and productivity changes in different sectors. (Georgia is characterized by more volatile tradable sector with inflation at around 2% which is common for emerging markets.)

Year	Target %
2010	6
2011	6
2012	6
2013	6
2014	6
2015	5
2016	5
2017	4
2018	3

Table 2: Explicit Inflation targets

² Source: National Bank of Georgia.

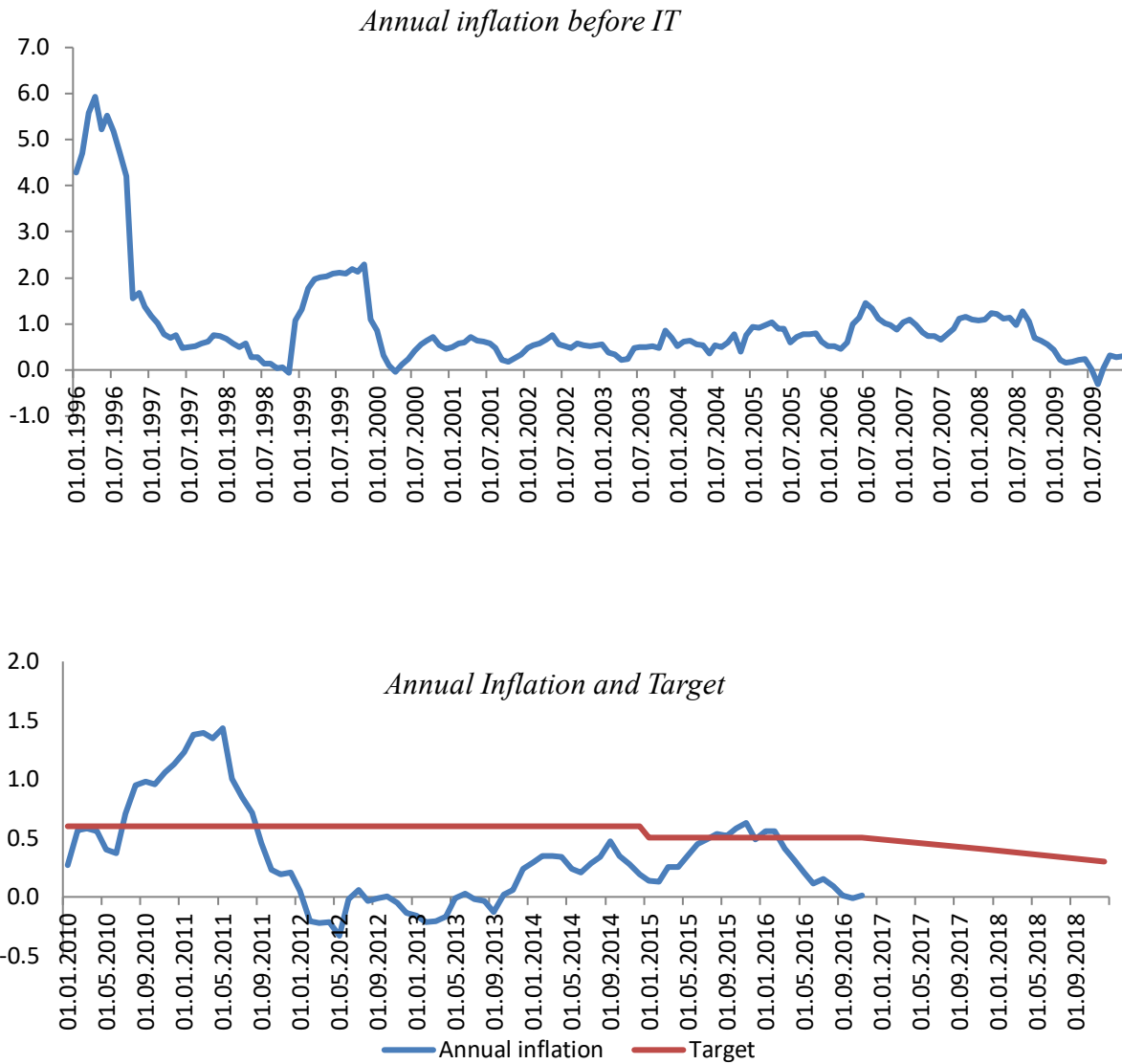


Figure 3 Inflation and inflation targets

As opposed to most developed countries which wanted to lock the low inflation after a disinflation period, Georgia was facing very volatile inflation rate before IT. Reaching the all-time high of 14.5% in July 2006 (there was a hyperinflation at 59.31% in April 1996 but it is not relevant for this analysis), followed by 2007-2008 crisis period.

Inflation targeting was introduced in Georgia in 2009 and it was to serve as a tool to at first lower and then steer inflation rate – in particular, to decrease the volatility and maintain stable price level. As it was already mentioned, main tools for maintaining the target inflation are the short-term monetary rate on refinancing loans as well as the 7-day Tbilisi interbank interest rate. Changes in these short-term interest rates are subsequently transmitted into long-term interest rates.

Since the adoption, the NBG has struggled to meet the target. Inflation started to increase again and peaked at 14% in May 2011. Policy-makers started to increase refinancing rates and curb price level. Response to tight monetary policy was very quick as following a year, in May 2012, the inflation dropped below zero and reached -3.3%, (expected target of 2012 was 6%). Despite the deflation, the NBG continued lowering down the monetary rate throughout 2012 and continued to do so even in 2013.

The monetary rate was gradually declining in 2009, ranging between 8%-5%; however, the trend was opposite in 2010 and the interest rate reached 7.5% by the end of the year. Albeit 2011 started with a high rate (8%), throughout the year it fell at 6.75. During 2012-2013 there was a decreasing trend and the interest rate even reached its historical minimum – 3.75%. While in 2014 it remained at 4%, monetary committee decided to raise it to 8% by the end of 2015. This should have been the consequence of the prevailing currency crisis which started at the end of 2014 and forecasted high variance of inflation expectations.

Georgia operates a floating exchange rate regime which is one of the main pre-requirements under the inflation targeting. It does not share optimal currency with partner countries, consequently, currency fluctuations are high as they absorb exogenous shocks. During those shocks, the changes in exchange rate can reduce the impact on a real economy and protect stable prices. To stimulate the FX market development, the NBG has implemented the exchange rate reform. The Tbilisi Interbank Foreign Exchange was replaced by foreign exchange auctions that currently represent the sole instrument for intervention on the FX market.

After introduction of this new instrument, the need for the NBG interventions on the foreign exchange market and the NBG's share in market turnover have both decreased considerably.

This new policy has resulted in an increase in short-term exchange rate flexibility that is important feature of FX market. As a consequence, the exchange became less predictable in the short-run, eliminating incentives for destabilizing speculation, and so improving the stability of the GEL in the long run. Foreign exchange policy of the NBG implies minimum intervention in the foreign exchange market. The main goal of FX auctions is to smooth out excessive short-term volatility in the exchange rate due to temporary surges in inflows or outflows of foreign capital and to partially balance the private and government FX financing gap. In the long run, the NBG intends to further reduce foreign exchange interventions and eventually to eliminate them.³

Even though the Lari reached its historical maximum in 2016, the GDP growth rate was below its potential and demand side pressure on prices was weak, in light of prevailing circumstances at the end of the year, the Monetary Policy Committee decided to defer its monetary policy actions and found it reasonable to retain the refinancing rate at 6.5%. This decision was partly associated with the improvement of the monetary policy transmission mechanism. Apace with decreased interest rates, loans in GEL increased significantly which had an additional monetary policy easing effect.

The target for 2017 was 4%; however, the actual annual inflation was 6.9% according to November 2017. Inflation rate was triggered by the hike in oil prices which reached 40% as well as one-time factors, such as increased tax rates for certain goods and services.

During its last meeting on 13 December 2017, the Monetary Committee decided to increase the monetary interest rate by 25 basis points which means that it will reach 7.25%. According to the existing forecast, inflation should start declining already in the beginning of 2018, provided that there are no unpredictable shocks.

The decision was based on the high inflationary expectations corresponding the macroeconomic variables from October and November. Another reason was the depreciation of the national currency which was rather high after the last meeting was held.

Next steps of the MPC will depend on how this particular change will be transmitted into the economy and whether the NBG will be able to decrease the pressure of nominal exchange rate on prices.

³ Source: NBG.

Other indicators of economic growth illustrate that overall aggregate demand is increasing. In October 2017, the preliminary growth rate amounted 5.7%; the average annual growth rate of first ten months is 4.9% which exceeds the NBG expectations. The positive dynamic also affects national goods and services and tourism sector. November also showed that the total amount of remittances is increasing. Although export has performed well, import was also growing. The NBG reckons that the deficit of current balance will improve by the end of this year. Next meeting of the monetary policy committee is planned on 31 January 2018.

While it is hard to say anything about inflation or monetary rate persistence with certainty, explicit target is decreasing after 2015. For now, the NBG takes 3% as a long-run target; however, with the passage of time and Georgia converging with economy of developed countries, the optimal inflation target will also decline. As the experience of inflation targeting countries shows, declining trend in expectations may be considered as the first sign of policy success. This is also consistent with Svensson's (2010) empirical evidence from developing markets, where target now is few percentage higher than 2%.

Furthermore, according to the NBG data, IT has already improved the efficiency of monetary policy. After the adoption of policy instruments, money markets in national currency have deepened, the interest rate fluctuations have also decreased. Now, commercial banks can manage liquidity better and have higher resources in national currency. (In fact, they started to increase the threshold allowance amounts in GEL in 2014.) As a result, liability Larization has increased considerably.

2.3 Transparency, accountability and independence of the National Bank of Georgia

While pursuing inflation targeting, central banks should develop key features: independence and transparency. Many reforms were implemented in these fields with a view to improving performances.

Determining the level of independence, accountability and transparency is not an easy undertaking. Different authors use different criteria for measurement. As far as independence is concerned, the most commonly used method was developed by Cukierman, Webb, and Neyapti (1992). They underline 4 factors – namely, it should be assessed whether:

- 1) The governor is appointed by the board of the central bank and not the government;
- 2) The government somehow impacts the decisions of Central Bank;
- 3) The Central Bank states its primary goals;
- 4) There are limits for governments on the ability to borrow money.

Independence of the NBG is ensured by the Constitution of Georgia and the Organic Law of Georgia on the National Bank of Georgia (“OLNBG”). However, independence alone does not really mean anything if it is not supported by transparency and accountability. Independence (also referred to as “autonomy”) entails that policy-makers are afforded freedom in goal-setting, decision-making and the use of their policy instruments; further, they are neither controlled nor influenced by other institutions. According to the OLNBG (Article 7(7)), the Governor is nominated by the board of the NBG, but is appointed or dismissed only by the President of Georgia. Members of the board of the NBG are nominated by the President of Georgia, but appointed by the Parliament of Georgia for the term of 7 years (Article 7(4) of the OLNBG).

The central bank officials able to apply a monetary policy, make decisions, set objectives, exchange views and, most importantly, explain the policy objectives. They should disclose information on financial statements.

According to the NBG report, management is responsible for the preparation and fair presentation of financial statements in accordance with IFR; moreover, for the purposes of an internal control that the management considers due, responsible for enabling the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

The last report on auditing, performed by independent auditors' states:

*"These financial statements have been prepared in accordance with International Financial Reporting Standards ("IFRS"). The presentation of these financial statements is framed within an economic and accounting framework that fairly reflects the financial position of the Bank, and at the same time, contributes to the economic analysis of the Bank's operations. For this reason, the economic concepts of international reserves and monetary policy are shown under the captions international reserve and monetary policy instruments, respectively. The presentation principle according to the latter concept has been first applied in 2014."*⁴

The transparency, with the benefit of experience, is the main "tool" to meet the target and carry out tasks. It decreases information asymmetries which are the cause of inefficiencies and shocks in the economy. When managing expectations, central banks must develop monetary discipline, make sure their steps and decisions are understandable to the public. Furthermore, they must publish regular reports on expectations, forecasts and, should any deviation occur, explain what went wrong. In so doing, central banks prove that they are indeed fully committed to mandate and people can assess their actions. The transparency is one of the key factors in expectations channel development. In case of high inflation, if people do not trust Central Bank's actions, the situation may get worse as their expectations regarding inflation will rise despite the tighter monetary policy.

Another important aspect is how well people perceive actions – for these purposes, the NBG should develop and implement new reforms with the aim of raising awareness.

According to its webpage, the NBG publishes different types of reports:

⁴ Report on Auditing 2016; source: NBG

Annual report – should be prepared and published no later than May 1st, it is presented on closest parliament hearing and consists of the following items: "Report on Conducting the Monetary and Foreign Exchange Policies"; the "Report on the Condition of the Economy"; the "Report on the Operations State of the Affairs for the Reporting Year"; and "Financial Reporting". The latter is supervised by auditors;

Monetary policy report – published on a quarterly basis. Focuses on forecast inflation and contains the Monetary Policy Committee decisions on interest rates, furthermore, it identifies other exogenous and endogenous variables that may affect dynamic changes in prices;

Financial stability report – each year the NBG used to publish reports that contained information on major risks and analysis of Georgian bank system. This information has not been updated since 2011;

The NBG also provides monthly balance sheets and information about legal regulations. All of the above considered, is it sufficient to manage expectations?

Christopher Crowe and Ellen E. Meade (2010) constructed the measure of transparency which mainly focuses on how often, how fast and how precise are central banks publishing the information. Dincer and Eichengreen used similar criteria and published results in 2010. According to this index, the NBG has been gradually improving its transparency during 2004-2011.

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Index	3	3	3	3	3	4	4	4	4.5	5.5	6.5	7.5	7.5

Table 3: Central Bank Transparency and Independence index

Source: N.N. Dincer and B. Eichengreen

In 2015, authors updated data which indicates that since 2011, the NBG has not improved transparency at all.

Year	2011	2012	2013	2014
Index	8	8	8	8

Table: 3 Central Bank Transparency and Independence
Source: Berkeley Economics

However, in 2016 and 2017, the NBG took some additional actions towards improvement.

For instance:

National strategy of Financial Education – which will raise the awareness of the benefits of financial education, protect consumers and make it easier for economic agents to perceive the NBG’s actions;

Analytical report – rather novel approach, implemented in 2017 with the aim of improving communication with the public and increasing transparency. It contains information about short- and long-term macroeconomic analysis, consequently facilitating decision-making for economic agents.

In 2016, the NBG actively started to use media channels as communication tools. The Governor of the NBG began holding press conferences to announce the MPC’s decision on the monetary policy rate on a quarterly basis (every second meeting of the MPC). During these conferences, the Governor of the NBG explains the MPC’s decision and reviews the current economic stance, inflation level and factors that affect prices.

In May 2016, the NBG made a transition to a new phase of its monetary policy communication by starting to publishing its forward monetary policy path. Furthermore, in order to increase the degree of the analytical communication processes, the NBG will additionally start publishing reports on the trends of macroeconomic and financial indicators in 2017.

The NBG kept developing new legislative amendments in 2016 with a view to implementing the recommendations made by “Financial Stability Assessment Program” (“FSAP”) launched in 2014 within the framework of the joint mission of the International Monetary Fund and the World Bank as well as with the aim of complying with directives set forth by the EU-Georgia Association Agreement. Adopting qualitative amendments to certain laws under a package of legislative initiatives will filter the supervisory framework and stimulate its convergence with international practices. Such legal initiatives included updating the “Law of Georgia on Activities of Commercial Banks” and the “Organic Law on the National Bank of Georgia”. These changes should enhance the NBG’s authority to monitor and supervise banking groups on a consolidated level, to appoint temporary administration and to exercise risk-based supervision more effectively, including the process of licensing and purchasing significant shares of commercial banks.

The NBG was trying to extend its statistical information system “SebStat” throughout 2016.

*“The main aim is to create an aggregate information base and produce new statistical products that will be advantageous during monetary and supervisory management processes. Moreover, consumers of the NBG’s statistics will have access to a better informational environment regarding current developments in the financial and external sectors.”*⁵

2.4 Dollarization in Georgia

Another big issue for emerging markets is a high level of dollarization. Underlying reasons of this problem are different, amongst others, the distaste of national currency because of historical factors (Bakradze and Billmeier 2007); high level of inflation; fluctuations on the currency market; underdeveloped financial markets and important share of remittances in the national economy. Georgia was “blessed” with all these issues – hence, the problem is rather significant. Citizens of Georgia have not yet developed right reactions – despite growing deposit rates in GEL, level of deposits in USD for individuals approached 79%, and for business sector – around

⁵ Source: NBG financial stability report

56%. These numbers are unsurprising as the most recent currency crisis started in 2014 and fluctuations remain active still. USD reached its historical maximum price in December 2016 when GEL lost its value by almost 50% and is still struggling to reinstate to its previous point. Consequently, it is unsurprising that people of Georgia have lost their trust in Lari. The credit side is even more dramatic: dollarization level was 73.7% in 2010. Some people just preferred to get loans with a fixed interest rate in USD despite the fact that their income was in GEL. Others were obliged to take mortgages in foreign currency because of the limits (which still exist) on loans in GEL.

The risk of default is rising as GEL continues to lose its value. The interbank interest rate may increase to prevent a significant domestic currency depreciation from triggering the balance sheet effect, undermining economic activity and the solvency of the financial system.

There are different incentives to fight dollarization. The NBG, with the help of European Bank for Reconstruction and Development, issued bonds in Lari for financing business sector in May 2016. Furthermore, the NBG is receiving appeals to impose limits on credits in foreign currency. The new president of the NBG, Mr Koba Gvenetadze, claims that setting limits on loans in USD for banks is a popular strategy; however for people who do not trust national currency it can be too risky as they may take loans from non-banking sectors. But despite the fact that the NBG avoids direct interventions, policy makers think that is very important to change the actions of financial agents. This is why the required reserves on foreign currency increased (20%) and for national currency decreased (7%) in 2016. The Government of Georgia further announced that dollarization is hampering economic growth and Larization was their primary goal in 2017. In fact, the NBG has developed a strategy that consists of 3 main points:

- **Increased access to the long-term loans in national currency** – the NBG will increase the flexibility of transmission mechanism and broaden the list of possible collaterals. Liquidity coverage ratio will be based on Basel III; policy makers will also stimulate capital markets to issue long-term bonds in GEL and implement the Pension Reform.

- **Adequate sharing of FX Risks** – in order to protect the borrowers from currency fluctuations, small loans⁶ are being issued only in Georgian Lari since January 2017. The Government of Georgia, together with the NBG, will help people who were hit by currency depreciation the most and are still holding some mortgages. Under certain conditions and with financial aid provided by the Government, borrowers are able to convert loans in USD into GEL.

- **Pricing in Lari** – as it was already mentioned, the most real estate prices were in US dollars; consequently, borrowers preferred to take mortgages also in USD. Under the new amendment on OLNBG and it became mandatory to price all goods and services in Lari.

By the end of the 2016, the loan dollarization reached 65.2% and deposit dollarization – 71.4%.

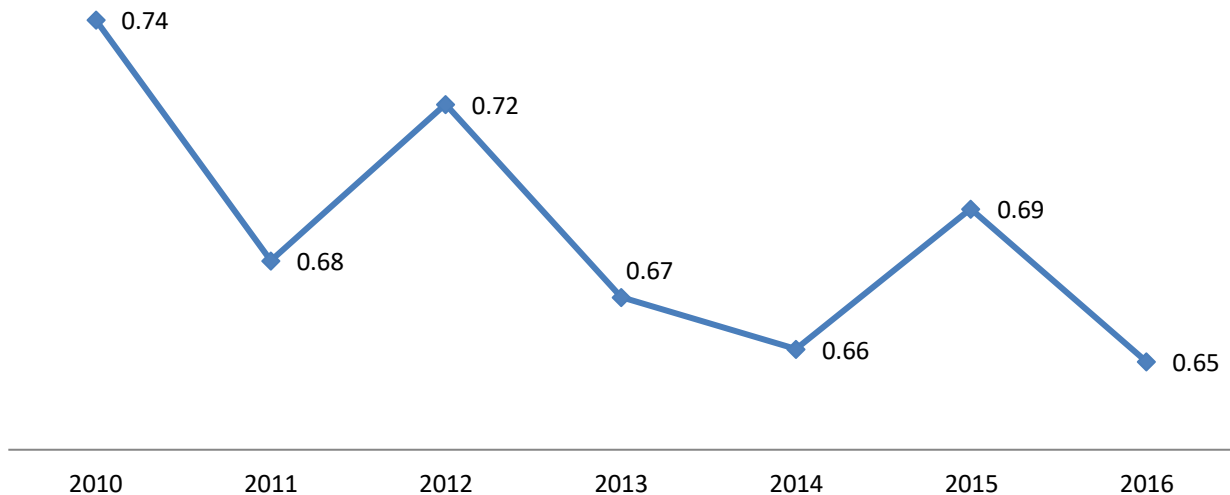


Figure 4 Dollarization level of loans (%) in economy

Source: NBG

⁶ According to a new amendment the personal loans in foreign currency will be allowed if the amount exceeds 100 000GEL.

III. Monetary Transmission Mechanism and Financial Stability in Georgia

The Central bank has three main tools: money supply, exchange rate and interest rate. They are used as instruments to affect demand side of the economy. Monetary transmission mechanism (“MTM”) describes how the changes in these instruments are transmitted and how they affect key macroeconomic variables. Every central bank dreams of having direct and effective channels but, in fact, the transmission is a very complex process.

Importance of each channel depends on the type of a market. For example: interest rate channel is more effective in developed countries, while exchange rate channel is dominating in the emerging markets. As for asset price and credit channels, they build upon the country’s financial system – in particular, whether it is asset-based or bank-based, respectively.

Monetary transmission mechanism in Georgia operates with a time lag, usually of around 4-6 quarters. The economy is affected by 4 channels:

- **Exchange rate channel** – all else unchanged, increase in interest rate raises demand on money market instruments which leads to the appreciation of the national currency; it then makes imported goods and services cheaper; the effect is opposite during currency depreciation, however, similar size of currency devaluation results in a larger increase of price level.
- **Interest Rate Channel** – a rise in the NBG policy rates will have an effect on short-term interest rates in bank sector, changes in then transmitted to long-term rates; the NBG can only influence on deposits and loans on national currency;
- **Credit Channel** – when policy changes are transmitted into long-term rates, raising rates will result in decreased aggregate demand;
- **Expectations channel** – describes how the changes in policy interest rates affect aggregate demand; if people trust the NBG’s action, tightened monetary policy should decrease inflation

and help the NBG anchor the target; however, if there is a distrust, inflationary expectations can still increase, despite the interventions.

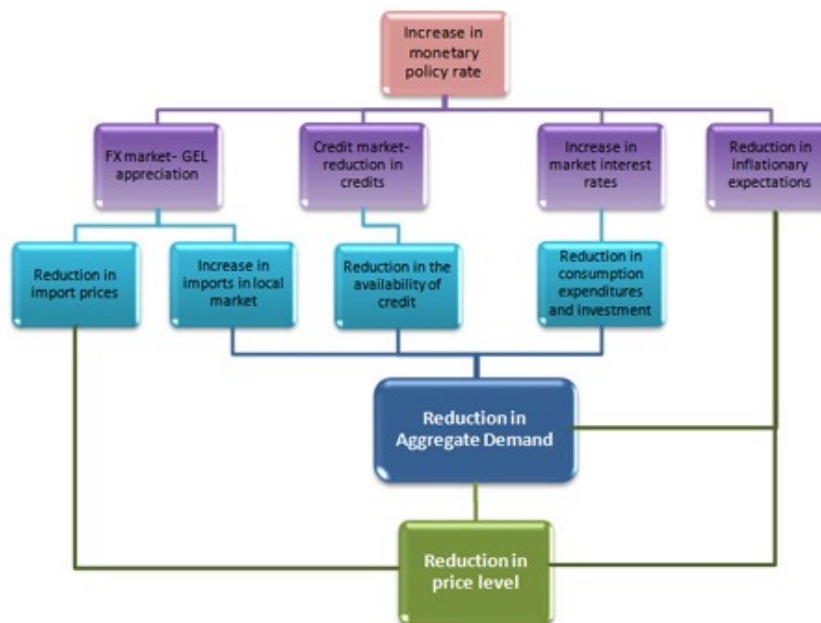


Figure 5 Monetary transmission mechanism in Georgia.

Source: NBG

Past analyses show that the exchange rate channel is the strongest in Georgia. The Exchange rate channel works through the net export: currency appreciation decreases prices on import goods, while depreciation has an opposite result. Analyses further demonstrated that interest rate and credit channels are developing. When pursuing inflation targeting, it is important to have stable interest rate channel in order to carry on policy tasks effectively. As for expectation channel, it purely depends on the image and performance of the NBG: if people trust the NBG, they develop right expectations. So, all factors considered, was Georgian economy ready for IT?

Bakradze and Billmeier in 2007 paper examined MTM and published results, their main findings included: powerful monetary shocks which were caused by the cash in circulation; reserve shocks have significant and persistent effect on CPI and negative effect on output which does not

last for a long period of time; moreover, authors were not able to evaluate the expectations channel and monetary policy rate shocks. They also provided some recommendations for the NBG. Despite reforms that were implemented and the NBG's commitment to its mandate, so far it fails to anchor inflation on target.

Another important factor for central banks is the time in which their policy actions are transmitted into economy, the delay between action and maximum effect on the economy is called transmission lag.

In the meta-analysis published by Havranek and Rusnak(2012), authors emphasize the importance of transmission lags. Their findings includes that "use of monthly data instead of quarterly makes researchers report faster transmission." Another important factor is country specifics. The level of the economic growth of a country highly influences transmission lag. The authors claim that emerging markets are characterized by rather low lag length than developed countries with a sound financial system and ability to hedge risks better. For instance, France, Italy and the United Kingdom have 12-20 lags, while ten new EU countries exhibit lag between 1 to 10 quarters.

Inflation targeter countries usually, choose 12-24 months as horizons, the NBG sets horizon for 4-6 quarters.

The financial sector plays an essential part in the economic development of the country. It is the most effective intermediary between creditors and borrowers. In Georgia, main players on the financial market are commercial banks who accept deposits and transfer them into loans. The banks are also main providers of non-cash transactions.

In 2009, the NBG took responsibility to regulate and supervise not only the commercial banks but other members of the market as well – in particular, credit unions, micro-financial organizations, money remittance units and currency exchange bureaus. The NBG regulates the activities of qualified credit institutions. This includes *inter alia* the following: registrations and cancellation of registrations; establishing eligibility criteria; risk disclosure; determining minimum capital requirements; establishing liquidity and additional requirements; setting controls, restrictions and sanctions. The NBG conducts 2 types of supervision: banking and non-banking.

According to the NBG, 16 commercial banks were operating in the Georgian banking sector by 31 December 2016. At that time, 86% of bank assets and 84% of stockholders' equity was owned by foreign investors. During the year, JSC TBC Bank acquired 100% ownership of JSC Bank Republic and, as a result, a merger of the two entities were carried out. As of 31 December 2016, other financial institutions in Georgia comprised 11 credit unions, 81 microfinance organizations, 1,200 currency exchange bureaus and 118 monetary remittance units.

The banking supervision and regulation is guaranteed by the Article 95 and Article 96 of the Constitution of Georgia as well as by the OLNBG. The banking sector is also monitored according to Basel principles. For the purposes of better transparency and less asymmetric information on the market, commercial banks are obliged to regularly (usually in every quarter) publish balance sheets. As of June 2017, the Governor of the NBG implemented new pillar (Pillar 3) which – within the frameworks of Basel III⁷ – also requires the inclusion of additional information on a bank's regulatory capital elements, risk weighted assets, remuneration of senior management and other material issues. In light of the problems identified over recent years, the Rules on “Disclosing Essential Information to Consumers when Providing Services by Commercial Banks” was updated to better respond to existing challenges. It now applies not only to commercial banks but also to all financial sector representatives.

According to the NBG report, the Central Bank of Georgia continued assessment of the quality of commercial banks' data and, at the same time, audits of their information systems throughout 2016. Furthermore, given the supervisory requirements of 2017, the NBG mandated that commercial banks conduct penetration tests.

Non-banking regulation implies supervision of the rest of the market. The main reason in this case is to guarantee the steady functioning of credit unions and micro financial organizations. The money remittance units and the currency exchange bureaus are checked against illicit incomes and money laundering.

⁷ Basel III is an internationally agreed set of measures developed by the Basel Committee on Banking Supervision in response to the financial crisis of 2007-09. The measures aim to strengthen the regulation, supervision and risk management of banks. (Source: Bank for International Settlements).

The Money Laundering Inspection and Supervision Department implemented risk-based supervision of micro-finance organizations, securities registrars, broker companies and credit unions in 2016 with a view to increasing the compliance of financial institutions with anti-money laundering legislation. Risk-based supervision implies early identification of problematic institutions or internal risks facing institutions and the implementation of adequate supervisory measures. (Source: the NBG)

IV. Empirical Analysis

This paper attempts to investigate IT as a monetary policy in Georgia. We are inclined to study the certain channels of monetary transmission mechanism through impulse response functions and compare the results to previous papers.

The macroeconomic policy can be expansionary or tight. The former tries to expand the money supply and encourage economic growth; the central bank, in this case, lowers policy rates or decreases required reserves for commercial banks. The latter, on another hand, tries to curb inflation and consequently, the Central Bank decides to increase policy rates.

The contractionary monetary policy should be exercised carefully as it might lead an economy into recession. In this paper, we examine effect of a money on output and prices and effect of a positive interest rate shocks on GDP, CPI and Nominal exchange rate.

The economic theory suggests that rising an interest rate makes borrowing less appealing, lowers inflation rate, increases the value of the national currency, decreases consumer spending and business production, which overall declines aggregate demand.

However, Horvath and Borys (2009) underline two types of puzzles often met in the literature examining monetary contractions:

First, labeled as price puzzle describes the situation when the prices rise; economist have different explanations, some claim that it is just a model misspecification and can be corrected with the help of adjustments, others indicate that answer depends on output and price

movements; if both of them fall, it means that monetary policy is effected through the demand channel; conversely, rising prices with falling output is common for the supply or cost channel; Second type of issue concerns the nominal exchange rate. Usually, after tight monetary policy actions, the NER should appreciate and then gradually depreciate. Some authors find rather persistent increase in value of national currency, so called “delayed overshooting”, whilst others report exchange rate depreciation, which also is referred as exchange rate puzzle.

Another problem that might occur is a liquidity puzzle. It arises when the researcher fails to find negative correlation between policy rates and money aggregates. Some authors (Kelly; Barnett and Keating) claim that in most of cases monetary aggregates exhibit significant measurement errors.

Hypotheses:

1. Money aggregate effects on output and prices are still significant;

In the last paper about inflation targeting in Georgia that was published in 2008, authors used data range 1999-2006, built baseline VAR model and found the high significance of currency in circulation shocks on output. The inference was not surprising, as a country was following money targeting.

We attempt to check if this is still true and if money aggregate has still some power forecasting output or prices; For this hypothesis, our research is based on previous paper from 2008, we follow similar steps but take M3 money aggregate as a broad money aggregate and use Granger causality test to check prediction power.

2. NBG manages to create correct expectations, which means that the prices and output response to policy interest rate shocks are consistent with economic theory;

As it was already mentioned, inflation targeting is all about managing the expectations. For this, central banks have to create right expectations and build trust in the public.

We will examine impulse response functions of output and prices on different policy rates and compare the results; check for any type of puzzles;

3. *The exchange rate channel is still very important.*

For most emerging markets exchange rate channel remains to be most important. We are inclined to use the impulse response functions to check how big and how fast does the nominal exchange rate respond to changes in policy rates and observe whether the exchange rate puzzle is present.

4.1 Model description

As it was already mentioned, all empirical studies were conducted on short sample due to the structural breaks and changes in Georgian economy. Thus, we refrain from performing a more thorough analysis of long-run cointegrating relationships and we are using different types of vector autoregressive (“VAR”) models to depict and describe the monetary system.

There has been extensive research to assess whether it is a correct model to investigate a monetary system or just a “data-driven” approach. Results generated by VAR depend on a specific order of the variables. However, VAR analysis is the most popular approach when it comes to monetary transmission mechanism and has been developed and improved after it was first introduced by Sims in 1980. He claimed that in the world of the rationale and forward-looking agents, no variable could be deemed as exogenous. Furthermore, he proposed that macroeconomic data could be modelled without imposing stringent restrictions.

Havranek and Rusnak (2012) in a their meta-analysis quantitatively study 67 published papers, corresponding 30 different countries that utilize different types of VAR approaches in order to determine the average transmission lag of monetary policy. Horvath and Morgese Borys (2009) also use different families of VAR models to assess Czech monetary policy under inflation targeting with rather short data sample.

Del Negro and Schorfheide (2011) asserted that VAR models appear to be “key empirical tools in modern macroeconomics”. Nowadays, imposing probability distributions on the coefficients of VAR can be a better solution; thus, Bayesian approach is more applicable. Sims (2012)

provided some evidence on the use of the Bayesian method by central banks to check and implement monetary policy.

The VAR method has been used in many cases to measure the effectiveness of monetary policy and its macroeconomic effects. In the paper by Jacobson, Jansson, Vredin and Warne the vector autoregressive framework is described as a flexible tool to analyze also the small open economy. The authors describe the method as a statistical tool, which at the same time can be interpreted economically and used for forecasting reasons. Furthermore, VARs permits dynamic relations and allows us to set restrictions.

VAR models are generalized AR processes used for multivariate time series. The purpose of using the VAR models can be structural analysis or/and forecasting. They are structured in a way that each endogenous variable is a linear function of past lags of itself and past lagged values of the other variables. Basically, it is a system of multiple equations designed to capture the joint dynamics of multiple time-series. In general, for a VAR(p) model, the first p lags of each variable in the system would be used as regression predictors for each variable.

VAR that utilizes two time series with one lag will have following structure:

$$\begin{aligned} y_t &= a_0 + a_1 y_{t-1} + a_3 z_{t-1} + e_{1t} \\ z_t &= b_0 + b_1 z_{t-1} + b_3 y_{t-1} + e_{2t} \end{aligned}$$

Where e_{1t} and e_{2t} are the error terms with unobservable zero mean, serially uncorrelated and independent over time. The VAR models should be parsimonious – utilizing lowest possible number of parameters and also stable which can be achieved by inducing stationarity or testing for structural breaks. The lag length for vector autoregressive models can be determined by using selection criteria. These are information criteria which must usually be minimized.

Minimization of information criteria is calculated by using the following formula:

$$AIC = T \log|\Sigma| + 2m$$

$$HQ = T \log|\Sigma| + 2(\log(\log T))m$$

$$SIC = T \log|\Sigma| + (\log T)m$$

Where T is the number of observations, $|\Sigma|$ refers to the determinant of variance-covariance matrix of residuals and m is the number of parameters in all equations. According to Sims(1980), “the AIC criterion asymptotically overestimates the order with positive probability, whereas the BIC and HQ criteria estimate the order consistently under fairly general conditions if the true order p is less than or equal to p_{\max} .”

We use impulse response functions to interpret relationships. These functions identify the responsiveness of one variable when the unit shock (usually one standard deviation) is applied to other variable. However, Cholesky factorization arises some issues. For this type of VAR models, effect of shocks to economic variables depend on their position in the orthogonalization ordering. Any changes in order of variables will change the results significantly.

In order to detect lack of identification, Bayesian estimation adopts prior information, allowing the “shrink” of a model to enable utilization of larger models. Furthermore, it transforms model parameters into conditional probabilities with fixed values. The Bayesian theory also recognizes theoretical knowledge about economy and provides an opportunity to incorporate prior information into the model. Bayesian inference in VAR models was introduced by Doan et al. (1984) and Litterman.

Generally, Bayes' theorem suggests that for inference of the validity of hypothesis H and given the data (evidence, E):

$$P(H|E) = [P(E|H) * P(H)]/P(E)$$

The $P(H|E)$ denotes the posterior probability of hypothesis given data, $P(H)$ is the prior, $P(E|H)$ is likelihood and $P(E)$ is the unconditional sample density i.e., for given sample, the same for all hypothesis constant and it serves as a normalizing constant.

Given all of the above:

$$posterior \propto likelihood \times prior = P(H|E) \propto P(E|H).P(H)$$

All three are probability distributions and do not have any true parameters.

Bayesian inference is sensitive to priors, which is non-data information or estimated from the data. Whilst the likelihood, which is a compatibility of the evidence with given hypothesis, in most models is Ordinary Least Squares OLS estimate.

On a second stage, this analysis introduces further innovations with regard to previous empirical literature on the monetary policy of Georgia.

The technique of sign restrictions helps to identify monetary shock responses and avoid puzzles. It is still rather novel method which includes restricting the sign of certain responses and identifying structural shocks. Furthermore, it allows us to set a period of restriction and, consequently, measure the persistence of the shock on variables (in this case positive interest rate shocks on prices and output). Uhlig (2005) attempted to measure the effects of monetary policy but the rejection technique was used by many authors to identify different types of shocks as well, for instance: technological, financial, oil prices and etc. R studio has already implemented package which uses Uhlig's rejection method and estimates Bayesian vector autoregressive model with a flat Normal inverted-Wishart (NW) Prior.

The NW prior is very common within Bayesian applied econometrics – it has two main advantages: it is easy to interpret and to calculate since the posterior distribution follows the same parametric form as the prior distribution and therefore the prior information can be interpreted in the same way as likelihood function information. Moreover, the conjugate prior allows us to overcome the assumption of a fixed and diagonal variance-covariance matrix of the error terms solving the two main weaknesses in the Litterman prior: the posterior independence between equations and the fixed residual variance-covariance matrix. (Migliardo 2010)

The sign restriction utilizes only a preferred shock with the size of one standard deviation; the method of Markov chain Monte Carlo algorithm is based on sampling and constructs distribution when enough draws that satisfy sign restrictions are found (or stops when maximum number of draws are reached without success).

Identification in R studio:

If we introduce reduced-form VAR (1) model with n endogenous variables:

$$y_t = Ay_{t-1} + \varepsilon_t \text{ For } t = 1, 2, \dots, T$$

where y_t is $n \times 1$ vector of variables, A is a $(n \times n)$ matrix of coefficients, and ε_t is a set of errors with mean of zero, zero autocorrelation, and variance-covariance matrix

$$\Sigma = E \{ \varepsilon_t \varepsilon_t' \}$$

$E \{ \varepsilon_t \varepsilon_t' \}$ is usually computed via OLS estimates;

$$B\varepsilon_t = e_t$$

B is a $(n \times n)$ matrix of structural parameters and e_t reflects structural shocks that in this case follow NW distribution with zero mean and a unit variance.

$$BB' = \Sigma = E \{ \varepsilon_t \varepsilon_t' \}$$

Recovering the structural shocks from $\hat{\varepsilon}_t$ requires identification of B . Since B contains n^2 unknown elements, identification of B requires at least $n(n-1)/2$ restrictions to uniquely identify the elements of B .

Steps:

1. Run an unrestricted VAR in order to get \hat{A} and $\hat{\Sigma}$.
2. Extract the orthogonal innovations from the model using a Cholesky decomposition. The Cholesky decomposition here is just a way to orthogonalise shocks rather than an identification strategy.
3. Calculate the resulting impulse responses from Step 2.
4. Randomly draw an orthogonal *impulse vector* α .
5. Multiply the responses from Step 3 times α and check if they match the imposed signs.

6. If yes, keep the response. If not, drop the draw.
7. Repeat Steps 2-6.⁸

4.2 Data Description and the results

This section provides the description of the dataset. Series start from 2008, as there is not data for monetary rate from previous years. Our series spans from 2008:1 until 2016:12. We refrain from using already published data from 2017 for two reasons: first, they are available for only two quarters and are only preliminary statistics; second, we attempt to check how well our baseline model forecasts fit the real values. The source of our data is the NBG's public dataset as well as National Statistics Department of Georgia which provided public as well as non-published datasets.

The analysis is estimated in the closed economy for two reasons: first, due to the fact that sign restrictions method utilizes endogenous variables without bias; second, it is hard to determine full set of exogenous variables, furthermore it gives us opportunity to avoid puzzles in the model.⁹

Not including the external variables in the model might lead to a biased error variance-covariance matrix and identification may not be plausible. Carrillo and Elizondo (2015) tested two simple VAR models, one with only endogenous variables and second one that was enlarged with a set of exogenous variables. The same models were also utilized with a sign restrictions approach. Authors found out that simple VAR with only internal variables failed to deliver correct identifications, which was corrected only by the right set of exogenous variables.

⁸ VARsignR package in R; author Christian Danne.

⁹ Due to many political factors in neighboring countries (Russia and Turkey) and based on other papers which in order to avoid other puzzles in analysis, the VAR exercise has been estimated in a closed economy framework. (C.Migliardo 2010)

More interestingly, sign restrictions method did not show a significant difference between 2 models - model with exogenous variables delivered bit more precise responses but the response path qualitatively was the same. This implies that sign restrictions approach can correct bias and provide impulse response functions that are appropriate and consistent with economic theory, with only endogenous variables. According to authors, sign restrictions use the economic theory that provides additional information in the form of auxiliary identifying matrices, which helps to eliminate the bias generated by the omitted exogenous variables. The requirement for this is to check whether reduced form VAR residuals are white noise. The method is useful when the full set of exogenous variables is not known or observed.

Variables in model:

lgdp – Real Gross domestic product, available only in quarterly frequency which was seasonally adjusted and then interpolated using cubic spline method;¹⁰

lcpi – consumer price index 100=2010 with monthly frequency;

MR – monthly monetary rate;

Tibor – the 7-day Tbilisi interbank rate which was adjusted to monthly frequency;

lm3 – M3 monetary aggregate with monthly frequency;

Spread – difference between monetary rate and interbank rate with monthly frequency;

lner – nominal exchange rate index with monthly frequency.

¹⁰ Cubic spline interpolation is a special case for [Spline interpolation](#) that is used very often to avoid the problem of [Runge's phenomenon](#). This method gives an interpolating polynomial that is smoother and has smaller error than some other interpolating polynomials.

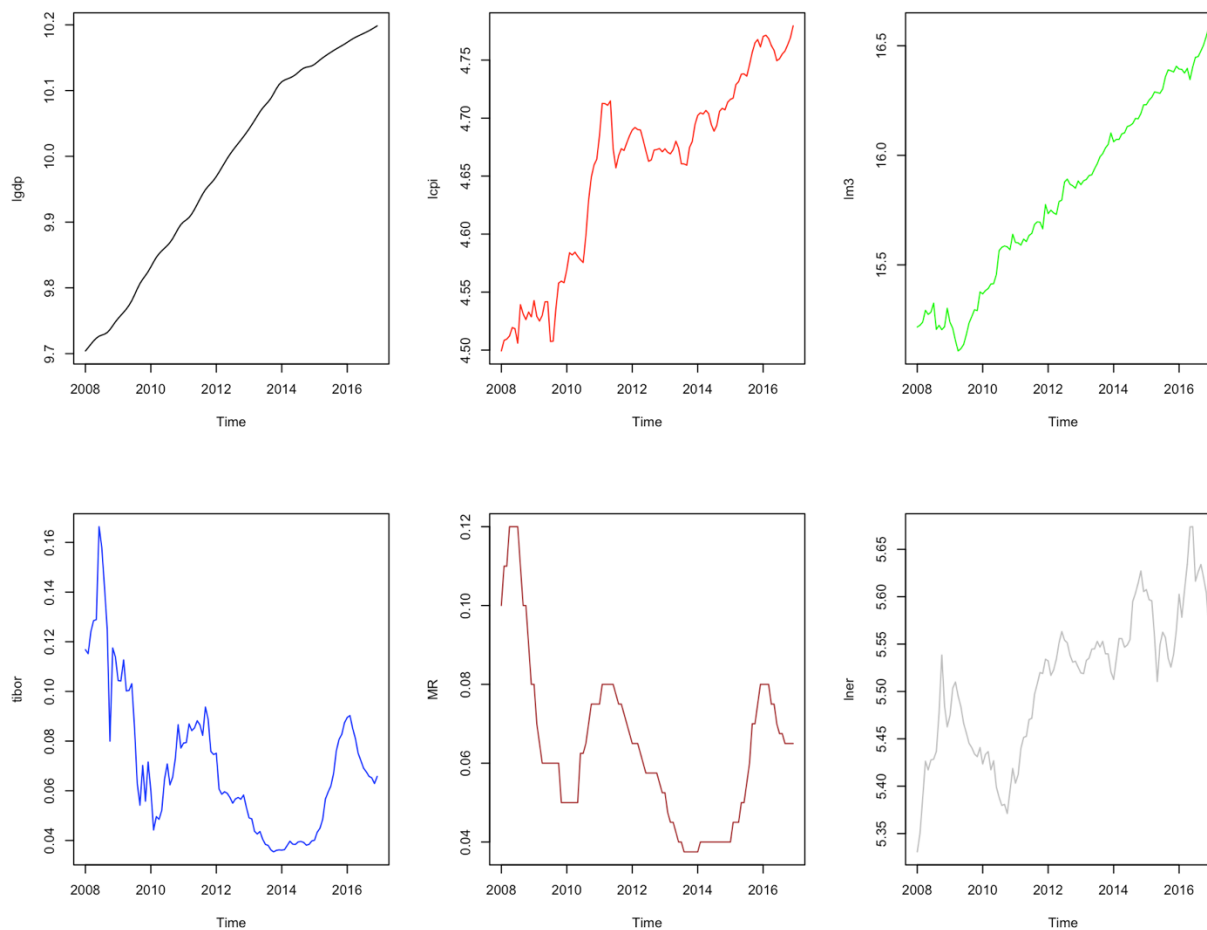


Figure 6 Visual inspection of dataset

The choice of variables as well as the method of transformation were motivated by previous analyses (Bakradze and Billmeier 2008) and similar papers with short datasets (Horvath and Borys 2009). Interest rates were maintained in levels while the rest of variables were transformed into logarithms.

Following VAR estimation, we do not induce stationarity – the assumption is based on an idea of many researchers who assert that stationarity is not inevitable as long as model as a whole is stable. (Sims 1980) Stability was checked with CUSUM test.¹¹

Our baseline model utilizes four variables: Real GDP, Price level, the Tbilisi interbank rate, Nominal exchange rate. The rest of the variables were used in order to check model sensitivity and robustness. As it was already mentioned, order of variables is crucial. Consequently, we utilize:

$$\text{Model 1: } y_t = (lgdp_t; lcpit; tibor_t; lner_t)$$

$$\text{Model 2: } y_t = (lgdp_t; lcpit; MR_t; lner_t)$$

The specification is based on a principle that monetary variables should be ordered last as they respond to the changes in economy faster. Non-policy variables (output and prices) react within some lags, therefore they are placed on top. Real GDP is the first, followed by prices which are assumed to react faster. Analysis is mostly based on impulse response functions obtained from different VAR models.

Given the short time series, the low lag length is crucial. Thus, the choice of lag length was determined according to Schwartz Criterion: VAR(4) and BVAR(2).

Simple VAR model was checked by test for stability.¹²

¹¹ Chris Brooks (2014) also claimed that “*purpose of VAR estimation is purely to examine the relationships between the variables, and that differencing will throw away the information on any long-run relationships between the series.*”

¹² Stability check by CUSUM test results: P – value for the Tbilisi interbank rate is 0,8951; whilst for monetary rate it equals to 0,4177. For both models p-value is greater than 0.05 which does not allow us to reject null hypothesis and thus, implies that parameters do not differ across the time. Visual inspection can be found in [appendix](#).

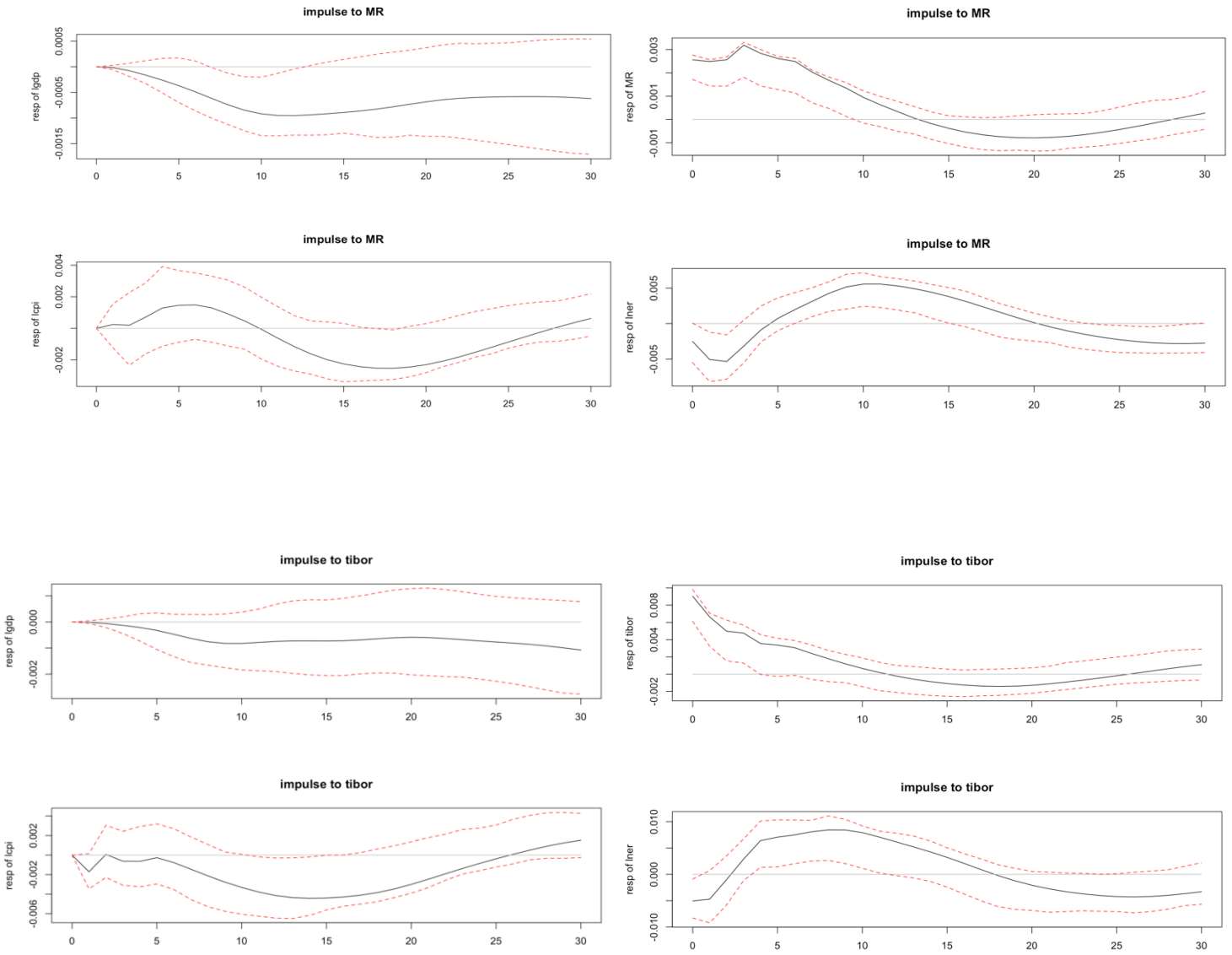


Figure 7 Impulse Response Functions

95% interval estimates, 100 runs

Figure 7 represents impulse response functions indicating how monetary transmission mechanism is working under inflation targeting regime. Responses are consistent with economic theory which gives us an opportunity to assume that monetary transmission mechanism has started working under inflation targeting. We found that Real GDP drops gradually for 10 periods and response on interbank rate shock is persistent. The output response is a bit bigger on interbank rate shock; however, the time to maximum effect is almost the same.

Prices respond faster on one standard deviation shock in the Tbilisi interbank interest rate and it decreases the log of prices by 0.006%; at the same time, a maximum drop of log of prices on one standard deviation shock in monetary rate is only 0.002%. The transmission lag length - time to maximum decrease - is 15 months in case of tiber shock and time in which shock is eliminated is about 12 months. The total length of the response of the prices on tiber shock is 27 months.

The response of prices on monetary rate also differs in transmission lag length, it takes a bit longer for the economy to respond to policy rate shock; thus, the lag length, in this case, is approximately 17. Furthermore, we face price puzzle in the beginning.

Transmission lag lengths are consistent with the NBG's horizon (4-6 quarters). The results also follow a trend investigated by Havranek and Rusnak (2012) about transmission lags of monetary policy. According to the paper, an average transmission lag length is 29 months. Average time to maximum decrease for Hump-shaped response is about 15 months. The low lag length (between 10 to 20 months) underlines the fact that Georgian economy is still financially underdeveloped and risks are not sufficiently hedged. Thus, the response is immediate, unlike large developed countries, "where they have more possibilities to be prepared for the surprises in economy stance, which eventually implies delays in transmission of monetary policy." (Havranek, Rusnak 2012)

Next, the results show sign of a "delayed overshooting" in the exchange rate, the currency appreciation raises demand on the money market which then leads to cheaper import; The nominal exchange rate responds almost the same to both interest rate shocks. The difference is in size where tiber effect is bigger and in case of monetary rate small exchange rate puzzle is present in the beginning. The figure presents an increase in the value of the domestic currency which lasts for some months and then gradually depreciates. It takes nominal exchange rate to reach the maximum in 8 months in case of tiber rate shock and approximately 10 months in case

of MR. The longer time for depreciation can be a sign of uncovered interest parity theory which assumes that difference in interest rates is equal to expected changes in currency.

The effect on the exchange rate is still highest in both cases (0.010% and 0.005% increase in a log of nominal exchange rate index) and it is also characterized by lowest transmission lag length which allows us to surmise that exchange rate channel is still very important, which is very common in developing countries.

Furthermore, we used variance decomposition diagrams and already published data from 2017 to compare the forecast from models to real values in order to check the model fitting.¹³

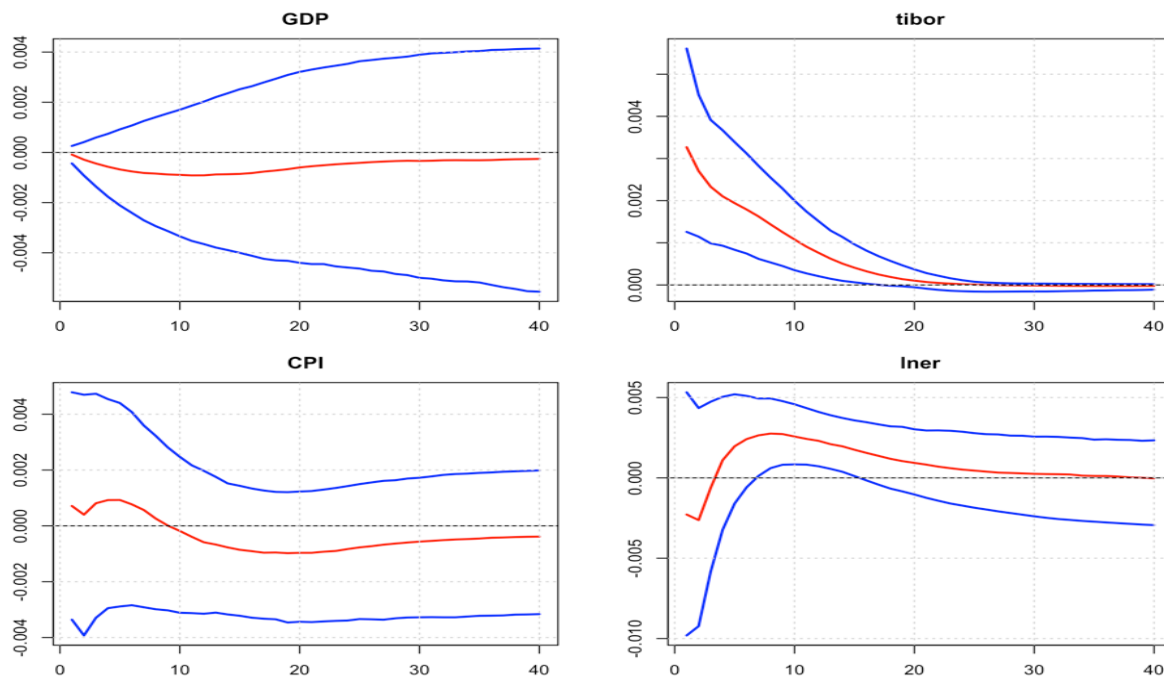


Figure 8 Positive one standard deviation interest rate shock, Sign restrictions method

with maximum horizon of restriction 6 months. The error bands from VAR posterior draws produced by BVAR.

Figure 8 shows the responses to positive interest rate shock inference with sign restrictions. As it was suggested in the paper (Carrillo and Elizondo; 2015) we investigate residuals of reduced

¹³ Variance decomposition diagram and plots of model forecasts and real values can be found in [appendix](#).

form VAR and make sure they look like white noise and are not correlated.¹⁴ Despite the fact that confidence intervals on output are rather wide – which may limit the interpretation of the results – they are in line with economic theory. The only restriction in this model was applied to the Tbilisi interbank interest rate and the horizon was chosen for maximum of 6 periods(months). Results are in line with previous findings from VAR, but we were not fully able to eliminate the small price puzzle.

The results also show that drops in output as well as in prices and exchange rate appreciation are persistent beyond the horizon of imposed restriction ($K=6$). There is no delay in responses but it takes a while even for small effects to die out. Moreover, the analysis demonstrated that the Tbilisi Interbank rate still has a bit higher effect on output and prices, while the monetary rate responses are almost insignificant. This method once again underscored the importance of exchange rate channel, where policy changes are transmitted faster and the strongest.

The sign restrictions again allowed us to show that policy rate has more or less short-term effects which is consistent with the NBG's horizon.

The fact that Tibor shocks are conveyed to economy faster can be explained by high level of dollarization, as monetary rate is new and is used only for refinancing loans in national currency.

Nowadays, there has been constant debate whether monetary policy should also consider financial stability. According to current empirical evidence, the answer is no – prediction of possible bubbles and alerting monetary policy can turn out to be too costly. This type of regime is characterized by high inflation and low output in the short term; however, in medium term, risks are mitigated and benefits can be materialized. Despite facts mentioned above and due to the recent financial crisis, the topic is a key priority for the international monetary fund. (IMF 2015)

The NBG has recently started to emphasize the meaning of financial stability and soundness of banking system. As it was already mentioned, the NBG has started to publish reports on stability. Furthermore, it implemented a strategy that should help consumers to understand the NBG's

¹⁴ Autocorrelation function (ACF) is provided in [appendix](#).

actions and avoid possible risks. It also puts a big weight on Larization because of the high exchange rate volatility and lack of tools that affect credit channel.

It is difficult to define or measure financial stability. Gadenecs and Jayaram (2009) provide some benchmarks measurements, amongst them in monthly inflation.

<i>Variable</i>	<i>Frequency</i>	<i>Description</i>
<i>Inflation</i>	<i>Monthly or Annual</i>	<i>High levels of inflation would signal structural weakness in the economy and increased levels of indebtedness, potentially leading to a tightening of monetary conditions. Conversely, low levels of inflation could potentially increase the risk appetite in the financial markets.</i>

Table 4: Measurements of Stability

Source: Gadenecs and Jayaram (2009)

It is also assumed that the spread between monetary rate and interbank lending rate can also reflect financial stability. If spread widens, it can hint at possible financial crisis and alert economy. The Figure 9 shows the spread between monetary rate and the Tbilisi interbank rate which was very wide during 2008-2009. Such a high tibor rate in the beginning can be explained by newly developed financial market as well as political factors that put a question mark over the solvency of banks. However, trend has been towards decrease since 2012, which can be first sign of stability and lower risks.

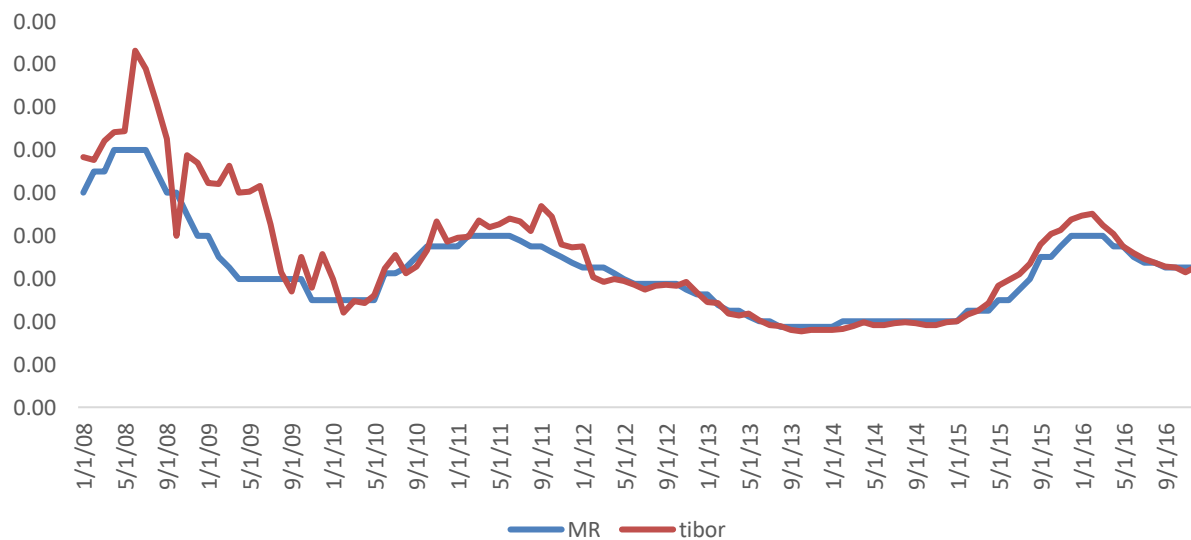


Figure 9 Spread between monetary rate and Tbilisi interbank rate

In order to check whether monetary policy supports financial stability, we use enlarged model and check how variables behave on positive shock of interest rate spread. The assumption is that responses of the variables should not differ and, more importantly, we should not face price, liquidity or exchange rate puzzle on contractionary monetary policy shock.

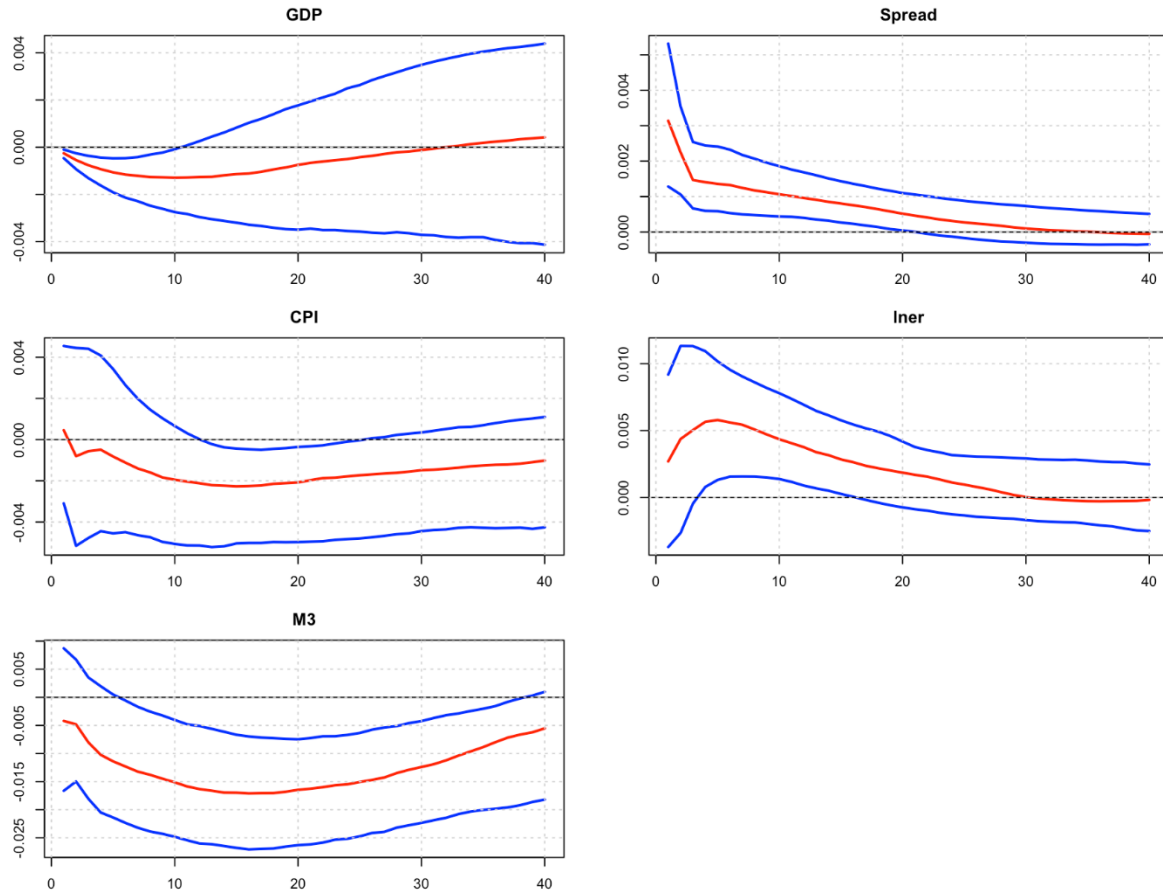


Figure 10 Positive one standard deviation spread shock, Sign restrictions method

with maximum horizon of restriction 6 months. The error bands from VAR posterior draws produced by BVAR.

Figure 10 shows impulse response functions with sign restrictions method. As main variable of interest is price level, we also impose negative constraint on output response in order to get smooth impulse response functions. The results show that responses to positive interest rate spread shock are similar to the models discussed earlier and consistent with economic theory. Absence of price, exchange rate and liquidity puzzles allows us to surmise that monetary policy at some extent also supports financial stability, but there can be some glitches.

To test first hypothesis and check whether money aggregate effect on prices and output is significant, we follow previous analysis by Bakradze and Billmeier who use Granger causality test within VAR model.

Currency in circulation effect on	P-Value
Output – Real GDP (quarterly)	0,0010***
Prices – consumer price index (quarterly)	0,45389

Table 5: Granger causality test results, data range 1999-2006

*Baseline VAR, data range 1999-2006 Analysis is based on WALD test, **** denotes as rejection at 1% level;*

Source: Bakradze and Billmeier (2008) .

Authors claim that prior to the inflation targeting – when the NBG was targeting money – currency in circulation had a significant explanatory power only on output. (This could also be a reason why NBG decided to switch to IT.)

The test is constructed in a way to check not just correlation but measure ability to predict future value of dependent time series by using prior values of independent series. It creates 2 models where in the first one X is regressed on its own lagged values, whilst in the second model it also includes past values of Y.

$$(1) = x_t = \beta_0 + \beta_1 X_{t-1} + \dots + \beta_k X_{t-k} + e$$

$$(2) = x_t = \beta_0 + \beta_1 X_{t-1} + \dots + \beta_k X_{t-k} + e + \alpha_1 y_{t-1} + \dots + \alpha_k y_{t-k} + e$$

The residual sum of squared errors is then compared to check which model is better. Then usually F-test, t-tests or, in this case, Wald test is used to check hypotheses:

$$H_0: a_i = 0 \text{ for each } i \text{ of the element } [1, k]$$

$$H_1: a_i \neq 0 \text{ for at least 1 } i \text{ of the element } [1, k]$$

Essentially, if we are able to reject null hypothesis $p\text{-value} < 0.05$, we assume that second model is better and Y granger causes X.

The Granger test requires stationary data. Thus, for this particular part of analysis, we induce stationarity by transforming variables and conducting an augmented Dickey–Fuller test (ADF) test. According to the test results, we are not able to reject null hypothesis which leads to the conclusion that M3 money aggregate has no explanatory power neither on output nor on price level.

M3 money aggregate effect on	P-value
Output - Real GDP	0.4839
Prices - CPI	0.05993

Table 6: Granger causality test on single variables data range 2008-2016

Based on WALD test;

It should also be noted that test was conducted in a reversed manner, partly in order to test its credibility.¹⁵

¹⁵ The results of cross check for Granger Causality test are shown in the [appendix](#).

V. Conclusions

The paper gives short summary of Georgia's journey through inflation targeting.

The independence and transparency of the NBG has improved following the introduction of the inflation targeting. This reconfirms the theory that central banks can implement the monetary regime and then strive towards better performance. (Batini and Laxton 2007)

The independence of the NBG is guaranteed by the law and the NBG is required to publish monthly reports regarding activities and expectations for accountability and transparency purposes. Furthermore, according to Dincer and Eichengreen (2014) – who created a special index to measure the transparency – the NBG has significantly improved in this field since 2006. It is still enhancing transparency in 2017 by implementing new reports and strategies.

All things considered, according to different models we applied, the average transmission lag for price level is 15-17 months. The immediate reaction and low lag length once again underlines the fact that the Georgian economy is being currently developed and risks are not fully hedged. The transmission lag length is also in line with the NBG's horizon 4-6 quarters. Furthermore, we have observed that it takes almost a year for a price shock to die out. Conversely, the output shock is smaller; however, it is more persistent.

The main goal of our paper was to assess the correct impulse response functions. The findings point out that the Tbilisi interbank rate has bit larger and faster effect on prices and output than the newly developed monetary rate. It can be explained by rapidly growing banking sector and high level of dollarization. The sign restrictions method demonstrated that shock on the inflation as well as the real GDP is more persistent compared to an induced horizon.

Analysis also evidences the “delayed overshooting” domestic currency after positive interest rate shock which is followed by gradual depreciation. It again underscored the importance of the exchange rate channel and revealed that although the NBG is able to manage expectations, the effects are not very significant qualitatively.

Furthermore, we found that money aggregate has no explanatory power neither on prices nor on output anymore, which might justify the switch to IT.

The new approach in monetary policy suggests that a regime should also consider a financial stability. Although the Georgian financial market is very small, the analysis evinced the importance of the Tbilisi interbank rate. We observed spread fluctuations and used an enlarged model with difference between interest rates to investigate the stability to a certain degree. First, visual inspection demonstrated that the only time when the spread was wide was during 2008, which is not surprising due to economic and political reasons; second, despite some additional restrictions, the results from the new impulse response functions did not exhibit significant difference, price, liquidity or exchange rate puzzles and, therefore, we surmise that there is no potential risk of a financial instability.

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VII. Appendix

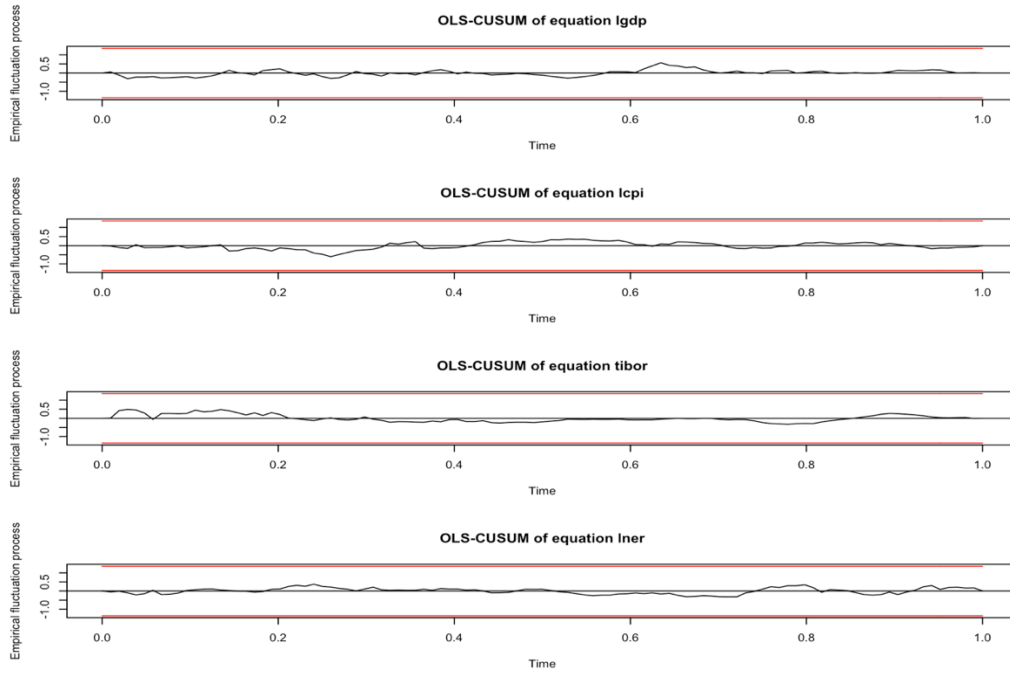


Figure 11 CUSUM test results for Tiber

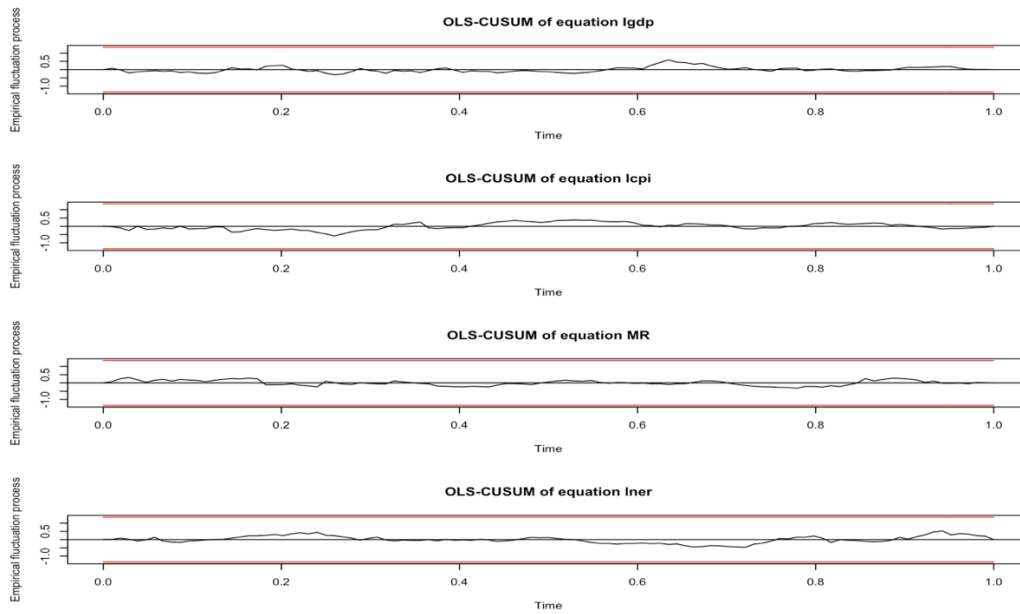


Figure 12 CUSUM Test results for MR

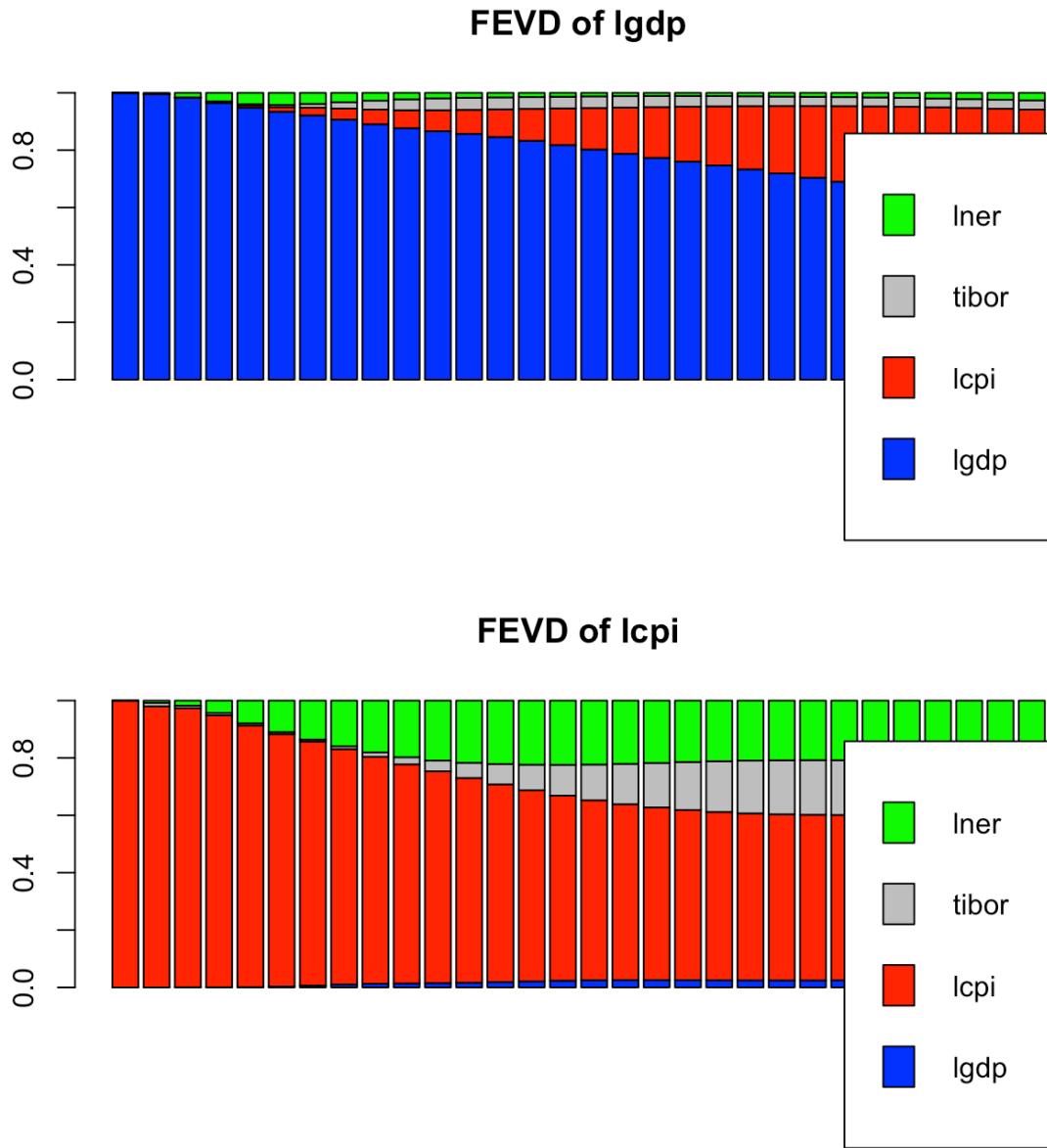


Figure 13 Model 1 Variance Decomposition Baseline VAR

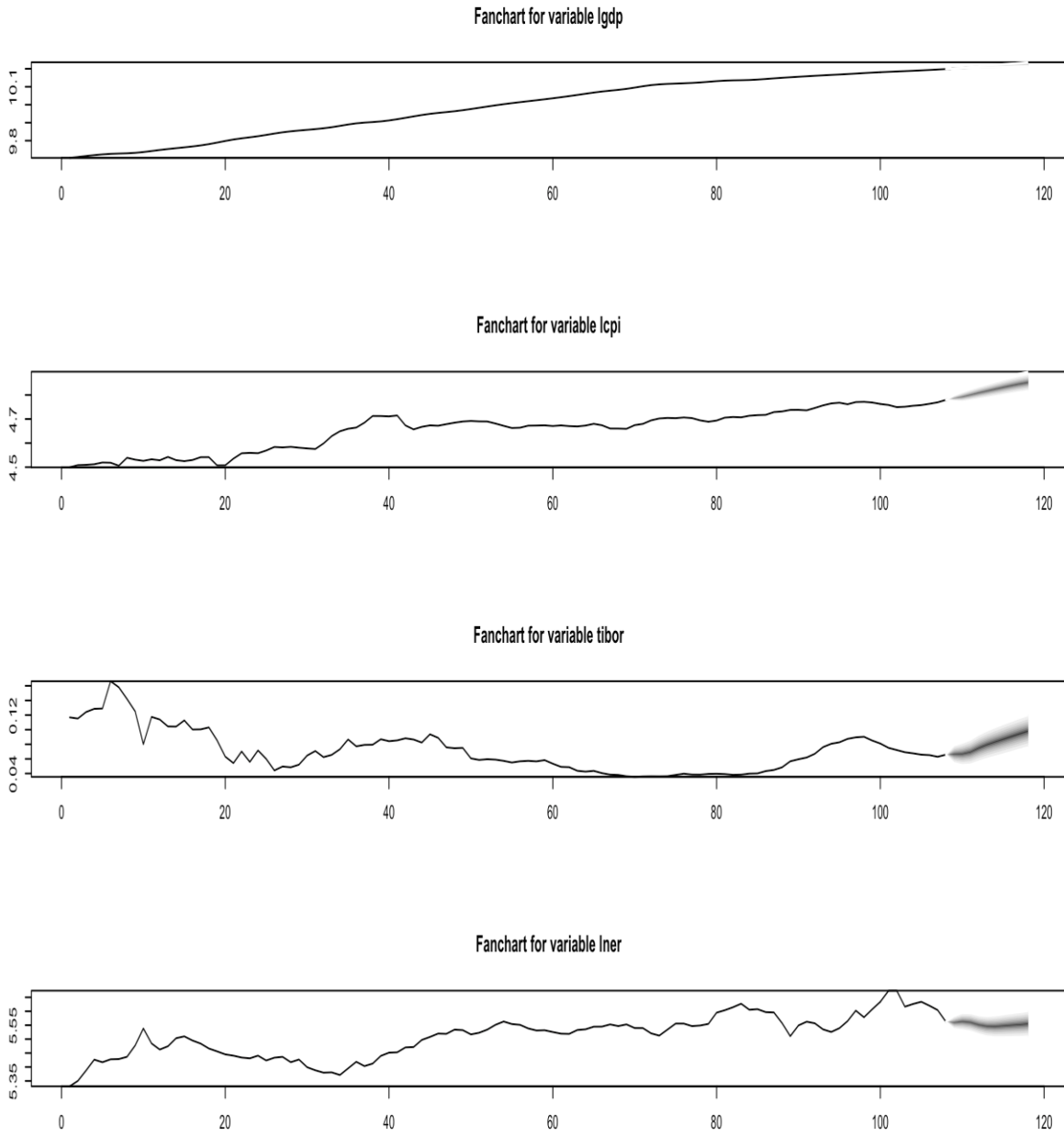
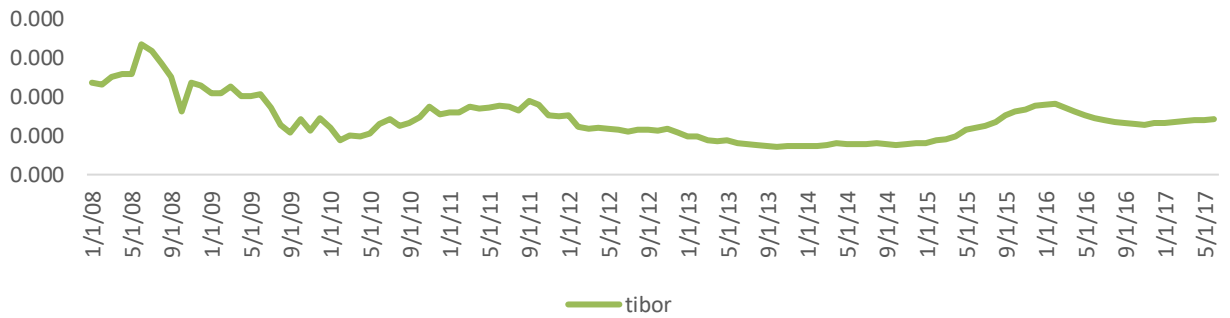
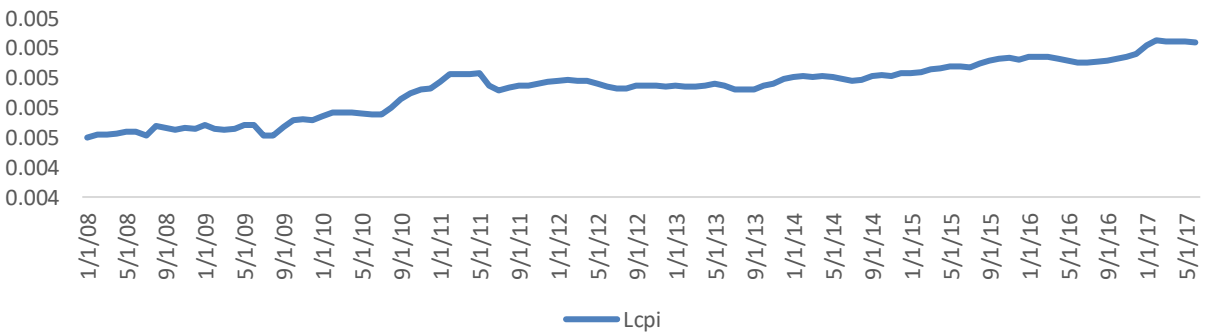
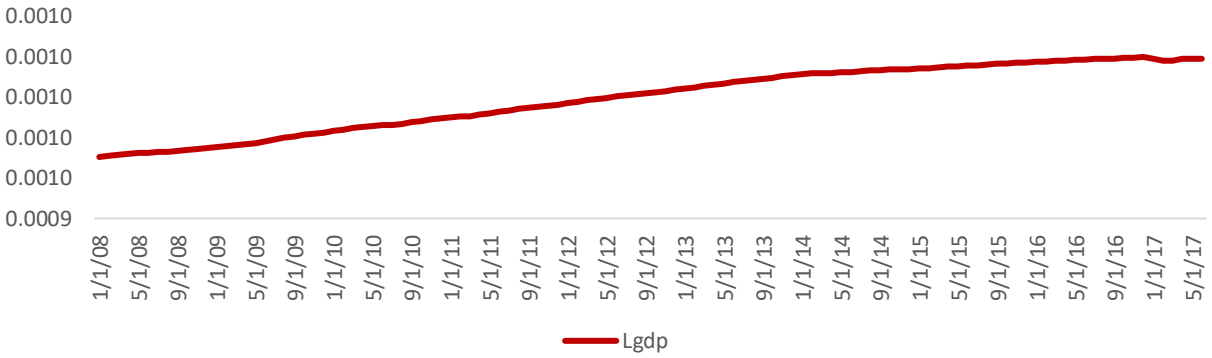


Figure 14 Model 1 Forecasts of Variables generated by VAR



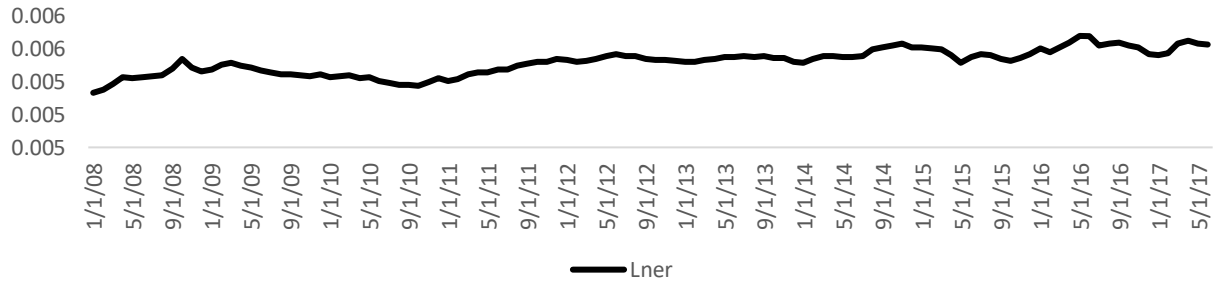


Figure 15 Real Values of the Variables

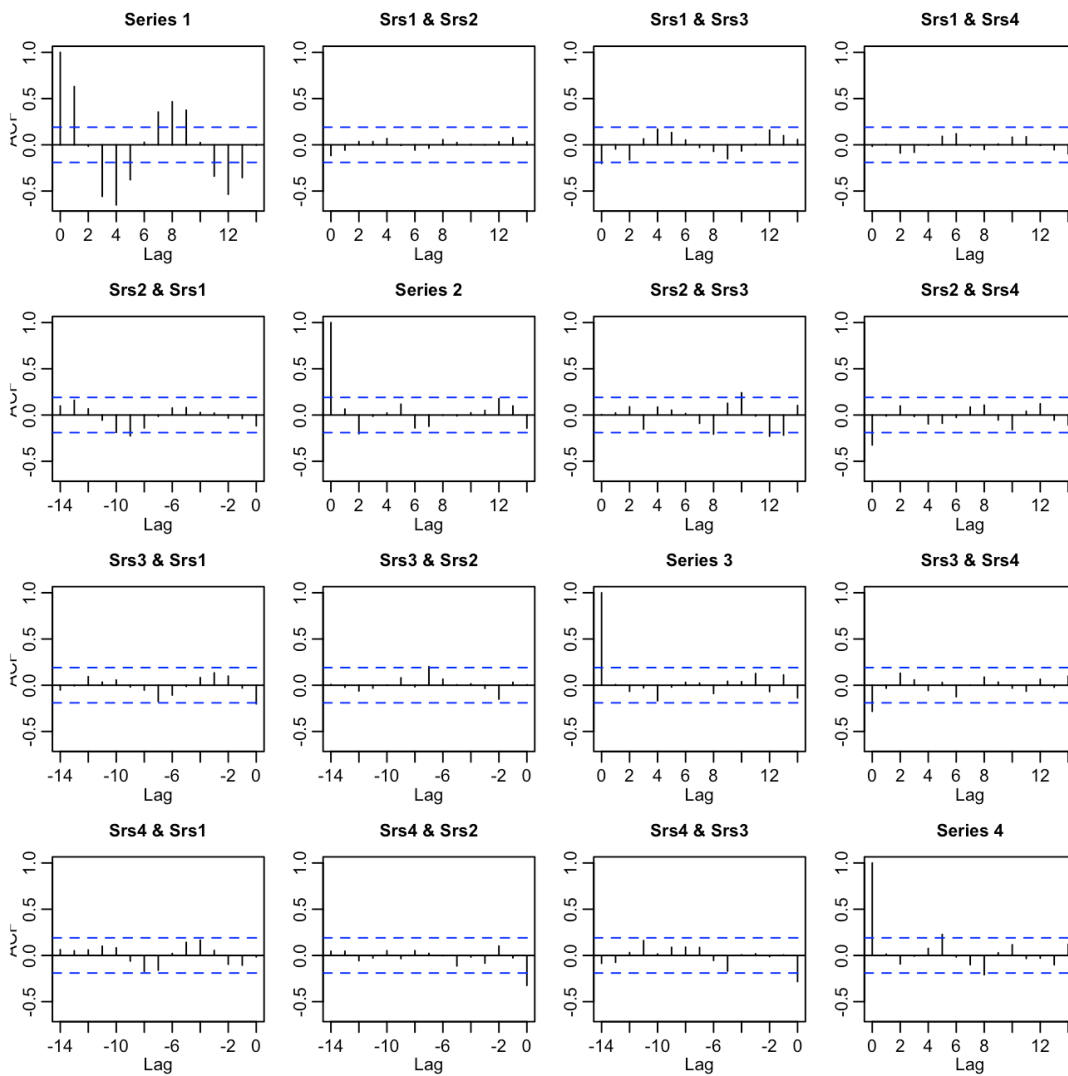


Figure 16 ACF of Residuals from reduced form VAR

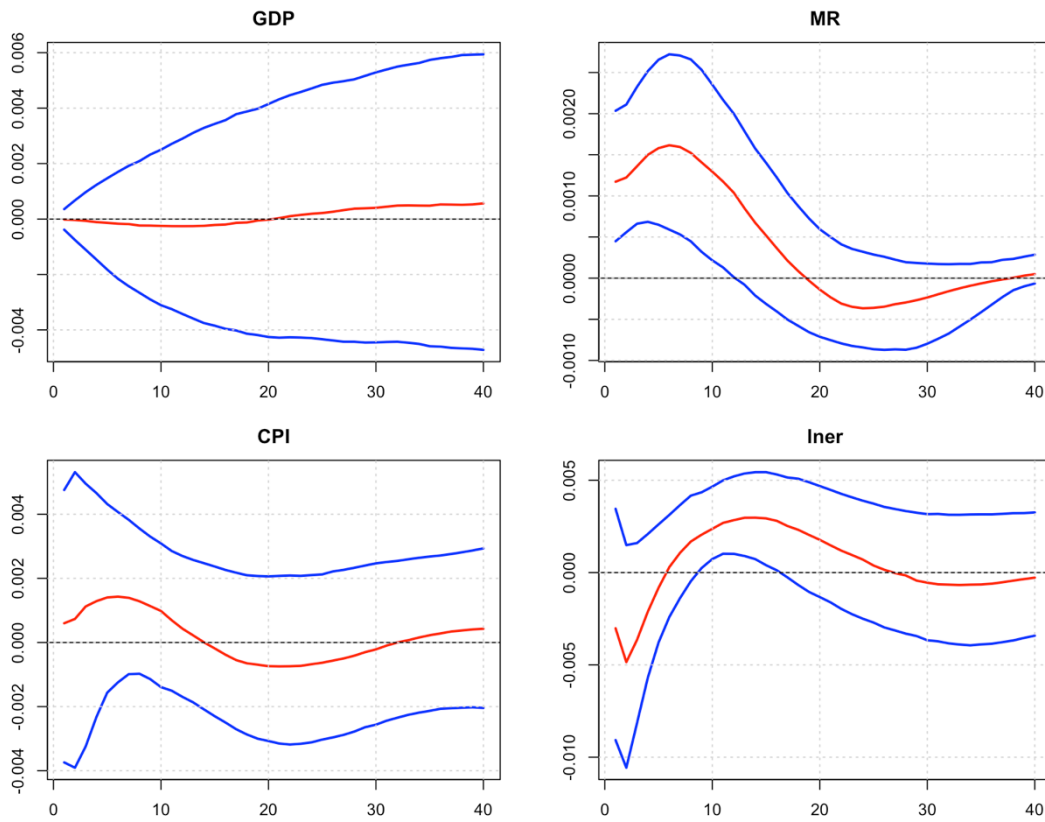


Figure 17 Monetary rate shock, Sign Restrictions

Money is affected by	p value
GDP	0.3483
CPI	0.3069

Table 7 Granger Causality test credibility check

R Code

```
####model with tiber and exchange rate
#### Importing data

library(tseries)
library(zoo)
library(forecast)
library(lmtest)
library(vars)
library(readxl)
data <- read_excel("~/Desktop/data.xlsx",
                  sheet = "Model", col_types = c("blank",
                                                  "numeric", "blank", "numeric", "numeric",
                                                  "numeric", "numeric", "numeric"))

#### VARIABLES
GDP <- ts(data$`Real GDP`, start= c(2008, 1), frequency = 12) #already interpolated
CPI <- ts(data$cpi, start= c(2008, 1), frequency = 12)
M3 <- ts(data$M3, start= c(2008, 1), frequency = 12)
tiber <- ts(data$tiber, start= c(2008, 1), frequency = 12)
MR <- ts(data$MR, start= c(2008, 1), frequency = 12)
NER <- ts(data$NER, start = c(2008, 1), frequency =12)

summary(data)

####transormation of variables into ln keeping interest rates in levels
lgdp <- log(GDP)

lcpi <- log(CPI)

lner <- log(NER)

lm3 <- log(M3)

par(mfrow=c(2,3))
plot.ts(lgdp,col = "black")
plot.ts(lcpi, col = "red")
plot.ts(lm3, col = "green")
plot.ts(tiber, col = "blue")
plot.ts(MR, col = "brown")
plot.ts(lner, col = "grey")
```

```
#####stationarity needed only for Granger causality test

##Hypothesis 1
#####Granger causality
#where null hypothesis states that past values of independent variable do not cause dependent
variable
## only for this test we use stationary data
llgdp <- diff(diff(lgdp))
llcpi <- diff(log(CPI))
llm3 <- diff(log(M3))

adf.test(llgdp)
adf.test(llm3)
adf.test(llcpi)
##granger causality test when y is explained by x

grangertest(llm3, llgdp, order = 12)
grangertest(llm3, llcpi, order = 12)

##testing opposite to avoid spurious regression

grangertest(llgdp, llm3, order = 12)
grangertest(llcpi, llm3, order = 12)

#####VAR Analysis

#####VAR with Tibor

MVAR <- cbind(lgdp, lcpi, tiber, lner)
data.frame(lgdp, lcpi, tiber, lner, check.rows=TRUE)
#VAR selection

var.select <- VARselect(MVAR, lag.max =12, type = "both")
print(var.select)

#suggested lagged value from all three methods differ,
#I choose 4 as number of parameters matter
var.mod <- VAR(MVAR, p = 4, type = "both")

#IRF default package
```

```

nAhead <- 30
irfRes <- irf(var.mod, n.ahead = nAhead, ci = 0.95,
             cumulative = F, boot = T, ortho = T)
plot(irfRes)

# new code for IRF
par(mfrow=c(2,1))
cn <- colnames(MVAR)
divv = rep(1,length(cn))
if (seeSD == 1){divv = (diag(summary(MVAR)$covres))^(1/2)}

for (ii in 1:length(cn)){
  lev <- irfRes$irf[[ii]]
  upp <- irfRes$Upper[[ii]]
  low <- irfRes$Lower[[ii]]

  for (jj in 1:length(cn)){
    ylimm = c(min(low[,jj],lev[,jj],0),
              max(upp[,jj],lev[,jj],0))/divv[jj]
    plot(0:nAhead,lev[,jj]/divv[jj],type = "l",ylim = ylimm, ann=F)
    title(ylab = paste("resp of", cn[jj]),
          main=paste("impulse to", cn[ii]))
    lines(0:nAhead,(0:nAhead)*0, col="gray")
    lines(0:nAhead,low[,jj]/divv[jj],lty = 2, col="red")
    lines(0:nAhead,upp[,jj]/divv[jj],lty = 2, col="red")
  }
}

#variance decomposition for own code

for (ii in 1:length(cn)){
  barplot(t(fevd(var.mod,n.ahead = 30)[[ii]]),
          col=c("blue","red","gray","green"),
          legend = cn, ann=F)
  title(main=paste("FEVD of", cn[ii]))
}

##forecasting
fanchart(predict(var.mod))

#cusum test for stability H0: parameteres differ

```

```
library(strucchange)

var.mod.stabil <- stability(var.mod,type = "OLS-CUSUM", h = 0.5, dynamic = FALSE, rescale
= TRUE)
plot(var.mod.stabil)
sctest(var.mod, type = "OLS CUSUM")

### VAR with monetary rate
MVAR1 <- cbind(lgdp, lcp, MR, lner)

data.frame(lgdp, lcp, MR, lner, check.rows=TRUE)
#VAR selection

var.select1 <- VARselect(MVAR1, lag.max =12, type = "both")
print(var.select)

#suggested lagged value from all three methods differ, I choose 12
var.mod1 <- VAR(MVAR1, p = 4, type = "both")

#IRF default package
nAhead <- 30
irfRes1 <- irf(var.mod1, n.ahead = nAhead, ci = 0.95,
              cumulative = F, boot = T, ortho = T)
plot(irfRes1)

# new code for IRF
par(mfrow=c(2,1))
cn <- colnames(MVAR1)
divv = rep(1,length(cn))
if (seeSD == 1){divv = (diag(summary(MVAR)$covres))^(1/2)}

for (ii in 1:length(cn)){
  lev <- irfRes1$irf[[ii]]
  upp <- irfRes1$Upper[[ii]]
  low <- irfRes1$Lower[[ii]]

  for (jj in 1:length(cn)){
    ylimm = c(min(low[,jj],lev[,jj],0),
              max(upp[,jj],lev[,jj],0))/divv[jj]
    plot(0:nAhead,lev[,jj]/divv[jj],type = "l",ylim = ylimm, ann=F)
    title(ylab = paste("resp of", cn[jj]),
```

```

    main=paste("impulse to", cn[ii])
    lines(0:nAhead,(0:nAhead)*0, col="gray")
    lines(0:nAhead,low[,jj]/divv[jj],lty = 2, col="red")
    lines(0:nAhead,upp[,jj]/divv[jj],lty = 2, col="red")
  }
}

#variance decomposition for own code

for (ii in 1:length(cn)){
  barplot(t(fevd(var.mod1,n.ahead = 30)[[ii]]),
    col=c("blue","red","gray","green"),
    legend = cn, ann=F)
  title(main=paste("FEVD of", cn[ii]))
}

fanchart(predict(var.mod1))
var.mod.stabil <- stability(var.mod,type = "OLS-CUSUM", h = 0.5, dynamic = FALSE, rescale
= TRUE)
plot(var.mod.stabil)
print(var.mod.stabil)
sctest(var.mod)

#### all variables have same length of vectors

y <- data.matrix(cbind(lgdp, lcp, tbor, lner))

####BVAR
#### Lag selection

library(MSBVAR)
var.lag.specification(y, lagmax = 12)

#### checking residuals for correlation for valid sign restrictions inference
macro.RVAR <- reduced.form.var(y, p=2)
x <- macro.RVAR$residuals
acf(x)

##### sign restrictions

####better to run the code from the beginning

```

```
rm(list = ls())
set.seed(12345)
library(VARsignR)

Data <- cbind(lgdp, lcp, tior, lner)
# this sets sign restrictions. the first element indicates shock into the 3rd variable,
constr <- c(+3)
#estimate the model
modell <- uhlig.reject(Y=Data, nlags=2, draws=1000, subdraws=500, nkeep=1000, KMIN=1,
KMAX=6, constrained=constr, constant=FALSE, steps=40)
# returns an object containing the posterior draws of the coefficients of the model
# (BDraws), the variance-covariance matrix (SDraws), as well as posterior draws
# for the impulse response functions (IRFS), forecast error variance decompositions
# (FEVDS), and the implied shocks (SHOCKS) of the model.
# nkeep ensures that the routine stops, once a sufficient number of accepted draws
# is reached. In case the number desired draws is not reached before the maximum
# number of draws is reached, the routine stops when the maximum number of draws
# is reached and issues a warning.
summary(modell)
irfs1 <- modell$IRFS
#extract the impulse responses
vl <- c("GDP","CPI","tior", "lner") #sets variable names for graph
irfplot(irfdraws=irfs1, type="median", labels=vl, save=TRUE, bands=c(0.16, 0.84), grid=TRUE,
bw=FALSE)
#variance decomp
fevd1 <- modell$FEVDS
fevd.table <- fevdplot(fevd1, table=TRUE, label=vl, periods=c(1,6,10,12,30))
print(fevd.table)

###sign restriction with spread between rates
s <- tior - MR
print(s)
Data2 <- cbind(lgdp, lcp, lm3, s, lner)
# this sets sign restrictions. the first element indicates shock into the 4th variable,
# so the variable with shock has to be presented first. other elements state that
# the response shall be negative
constr <- c(+4, -1)
#estimate the model
modell2 <- uhlig.reject(Y=Data2, nlags=2, draws=1000, subdraws=500, nkeep=1000, KMIN=1,
KMAX=6, constrained=constr, constant=FALSE, steps=40)
summary(modell2)
irfs2 <- modell2$IRFS
#extract the impulse responses
```

```
vl <- c("GDP","CPI","M3","Spread", "Iner") #sets variable names for graph
irfplot(irfdraws=irfs2, type="median", labels=vl, save=TRUE, bands=c(0.16, 0.84), grid=TRUE,
bw=FALSE)
#variance decomp
fevd1 <- model1$FEVDS
fevd.table <- fevdplot(fevd1, table=TRUE, label=vl, periods=c(1,6,10,12,30))
print(fevd.table)
shocks <- model1$SHOCKS
ss <- ts(t(apply(shocks,2,quantile,probs=c(0.5, 0.16, 0.84))), frequency=12, start=c(2008,1))
plot(ss[,1], type="l", col="blue", ylab="Interest rate shock", ylim=c(min(ss), max(ss)))
abline(h=0, col="black")

lines(ss[,2], col="red")
lines(ss[,3], col="red")
```