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Channels of Monetary Transmission in the CIS¹

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Abstract

Twenty years have passed since the breakdown of the Soviet Union, and it is time to draw a concluding line for monetary policy efficiency in the Commonwealth of Independent States (CIS). We propose a comprehensive treatment of the subject for nine members of the CIS for the period of 2000-2009. Four transmission channels are investigated: interest rate channel, exchange rate channel, bank lending channel, and monetary channel. First, we design a VAR framework for each CIS member-state and investigate the short-run dynamics of the impact of each of the four transmission channels on domestic output and inflation. Second, we construct Auto Regressive Distributed Lag Models (ARDL) in order to study the country-wise efficiency of transmission channels in the long run. Finally, we employ a panel data fixed effects method to show how the CIS behaves as a region. Our short-run individual country analysis yields highly heterogeneous results. In the long run, however, it's apparent that broad monetary base (M2) is the most influential determinant of aggregate output. Inflation is affected the most by the refinancing rate and the flow of remittances. For both output and inflation, exchange rate plays a role of a supporting channel.

Keywords: CIS; Monetary Transmission; VAR; ARDL Cointegration; Panel Data

JEL: E4; E52; O53

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1. Introduction

1.1. The Channels of Monetary Transmission: an Overview

The proposition that policy interventions can affect macroeconomic behavior has become a leading line of thought among both researchers and practitioners. It is said that policy-makers are able to influence the flow of events in the real economy by targeting specific economic aggregates of interest. They achieve this by calibrating certain policy variables – those over which they have direct power and control. An intervention into the policy variable then, in theory, transmits its innovation into the real economy via a certain channel. While policy interventions and end-of-the-day effects on the real economy are largely known and measurable, the dynamic that occurs in the transmission channel is quite challenging to assess and to measure. The channels of monetary transmission are often called a “black box”, suggesting that we know that monetary policy does influence real economic aggregates, but we don’t always know how exactly (Bernanke and Gertler, 1995).

Policy makers typically have two major tools for economic control at their disposal: fiscal and monetary policy. Fiscal policy has never been consistently viewed as a reliable variable for macroeconomic stabilization (Mishra, Montiel, and Spilimbergo, 2010). The fiscal channel often operates slowly, inefficiently, and usually aggravates situations by acting as a pro-cyclical catalyst of any exogenous shock. It’s not to say that the fiscal arm is completely useless, but fiscal policy must be almost universally accompanied by a credible and congruent stance from the national central bank. In short, much due to the imperfections associated with the fiscal dimension of policy making, monetary policy often takes on the lead role in economic stabilization and control.

It has become conventional to believe that monetary policy indeed affects lives of economic agents, although sometimes in an undirect way (Mishkin, 1996). The transmission channels through which monetary policy is conducted are often subtle and complex. While the aim has always been to target a real variable such as aggregate output or employment, the selection of the correct channel of monetary transmission in order to execute the desired plan is often impeded by the structural issues of a given economy’s internal context. The story of the channels of monetary transmission, although without doubt built upon certain fundamental theoretical blocs, is an empirical issue. The workings of each monetary transmission channel (and there are several of them) depend on a plethora of factors, ranging from the overall stage of macroeconomic development to the nuances of micro-structures of domestic financial markets (Checetti, 1999). Those factors differ tremendously in different regions and regimes of the world, thus necessitating differentiated and/or regional approaches to the study of monetary transmission channels.

1.2. Description of the Channels of Monetary Transmission

There are at least seven channels of monetary transmission that we can distinguish: interest rate channel, exchange rate channel, bank lending channel, balance sheet channel, asset price channel, monetary channel, and expectation channel. Empirically, it has been proven that the interest rate channel is the most dominant one for the case of developed economies with high-quality financial markets. In general, the interest channel is built on a Keynesian view that monetary policy can affect real costs of borrowing by changing nominal interest rates. Because

prices are sticky and require time to adjust, nominal interest rate differentials transform into a corresponding adjustment in the real interest rate, which in turn affects spending and investment decisions in the economy.

Contrary to the interest rate channel, the exchange rate channel is usually viewed as the most important monetary transmission channel in developing countries (Coricelli, Egert, and MacDonald, 2005). By performing direct interventions into the foreign exchange market, monetary policy makers can achieve a desirable level of the exchange rate. The exchange rate will in turn affect aggregate production via the current account channel, by influencing the costs of imported and exported goods and their relative price-based trade competitiveness. In addition, in countries where domestic agents tend to hold debt denominated in foreign currency (as is the case with most developing nations), exchange rate fluctuations can have a substantial effect on the agents' debt portfolios and thus their overall balance sheets. Finally, particularly in developing and transition economies, remittances (finances flowing from abroad) are usually the forgotten factor in the analysis of monetary transmission. In light of the inclusion of remittances into the picture, we believe that the exchange rate can carry an additional significant "wealth effect" on domestic aggregate demand via the flow of the typically dollar-denominated remittance.

The bank lending channel functions on the premise that there exists a pool of bank-dependent loan seekers, who wish to obtain funds for various investment and consumption purposes. Monetary intervention can alter the amount of bank reserves, thus changing the total amount of money that is available for banks to lend out. The restriction on the total amount of loanable funds in turn affects the potential of aggregate domestic investment and consumption. Of course, this channel operates with a strict assumption that borrowers do not have other sources of funding such as government bonds for bank credit (Walsh, 1998).

The balance sheet channel is an extension of the bank lending channel, in which we assume that borrowers, in order to obtain credit funds from the bank, are forced to pay an interest-rate premium over the risk-free rate. That risk premium is based on the borrowers' own balance sheet composition, such as a portfolio of securities on hand and real estate in possession (Mishkin, 2001). Monetary policy is able to affect the prices on the real estate market and/or the prices of stocks via open-market interventions targeting the interest rate. This way a monetary policy move can affect the borrower's collateral potential, and thus the overall quantity of credit that banks will be willing to lend out against that collateral. Also, from the point of view of Modigliani's life cycle hypothesis, monetary policy can affect aggregate domestic consumption through the prism of financial wealth of domestic constituents, which is in turn governed by the interest rate dynamics and arbitrage.

The asset price channel, similar in its logical foundations to the balance sheet channel, allows monetary policy makers to affect the total wealth of domestic economic agents. Agents, in turn, are able to adjust their purchasing and saving decisions according to their changing wealth holdings. This idea can be applied to firm-level investment and to the real estate market. The asset price channel matters only if the non-bank financial sector is considerably developed, and if market financing is reasonably important on the macro-scale (Dabla-Norris and Floerkemeier, 2006).

The monetary channel is not a traditional inclusion into the discussion on channels of monetary transmission. We found that there was a gap in the classifications of the channels since neither the monetary base nor the domestic wage level are consistently included into the analysis. The former aggregate is usually viewed as an indirect measure of monetary policy. National banks rarely target monetary base as an end goal, but rather tweak money supply in order to achieve the desired break-even interest rate via open-market operations. Still, broad money should be perceived as an indirect predictor of real economy variables, or at least theoretically. Whether this is the case empirically for the CIS region we will discover later in the paper.

Wages, or more concretely – the growth rate of wages – represents the cost, or the supply side of the nominal economy. We acknowledge the fact that neither the minimum wage nor the nation-wide growth rate of the wages is typically in the hands of monetary policy makers. However, it's important to keep wages in the list of potential determinants of inflation and aggregate output more as a representative measure of the supply side of the economy, something which will make our analysis more complete.

Wages, broad monetary base, and remittances are the variables not always considered in empirical investigations of the monetary transmission channels. We believe that these three variables will add some originality in the perspective on the traditional approach to monetary transmission literature. Overall, we will analyze 4 channels of monetary transmission in this study: exchange rate channel, interest rate channel, bank lending channel, and the monetary channel. Detailed description of the variables used in each channel is available in Section 3.1.

1.3. The Case of CIS

After the Soviet Union collapsed in the early 1990s, hundreds of millions of people were left very much in chaos and disorder on all levels of governance. In order to preserve the unity that existed in the Soviet times, the Commonwealth of Independent States was established by Russia, Ukraine, and Belarus, and the supranational organization now includes 10 official and 1 unofficial member. It is still unclear whether the CIS plays any effective role as a governing body on a daily basis and carries any significant impact on legislation and/or polit-economical directions of its constituents. However, member-states of this group do resemble each other in their dynamic of development and nation-building in the past 20 or so years, and thus it has become common to view CIS as a distinct economic unit.

One of the traits that is shared by most if not all of the CIS countries is the fragility of legislation and the rule of law, the decrease that has plagued the region for much of its independent existence. Our interest lies in the economic and financial aspects of legal governance, and on that front, although much has indeed been accomplished (like the de jure sovereignty of the national banks), incomplete and outdated legal codes coupled with inefficient execution on the low and medium administrative levels contribute to an economic and financial environment without a solid, complete legal foundation.

Furthermore, with the imperfections in legal governance of the financial sectors of CIS states naturally comes the problem of the large informal sectors of the economy. Corruption and the shadow economy are a problem for the CIS, but to be fair that is an ongoing issue for all developing economies and countries in transition of this world. With the presense of a large nformal economy, formal sources of funding like the ones which will be discussed in this paper

lose their marginal superiority over the informal routes. As a result, channels of monetary transmission can not possible measure (at least not fully) the impact that the informal economy has on real macroeconomic aggregates. This implies that some if not most of transmission channels are not operational in the CIS due to the presence of alternative and unregistered sources of funding. We can also not discard the importance of remittances that for some of the CIS member states are in the highest ranks in the world, such as Tajikistan and Armenia. Remittances are not necessarily illegal, but they do represent a somewhat informal channel of financing, and they are typically denominated in foreign currencies.

On the monetary front, CIS member-states almost uniformly confronted years of very high inflation (and some countries exhibited textbook examples of hyperinflation) following the Soviet Union breakdown. Inflation came as a result of two dominant factors. First, national governments in the CIS region were deeply in debt, with the obligations spiralling out of control. In order to finance the debt, national banks were required to effectively print more money and buy out those government debt obligations. This eventually debased national currencies, forcing some states to adopt fixed-exchange or semi-fixed currency regimes; either with respect to the American Dollar or to the Russian Ruble. The second factor which caused hyperinflation in the CIS was backward wage indexation which was unchanged since the Soviet era (Botric and Cota, 2006). Extremely rapid wage elevation and a poor system of managing that growth led to exploding incomes and opulence of money, which at the end of the day carried less and less marginal value. Hyperinflation, by and large, is an issue of the past for members of the CIS. However, certain countries like Belarus still have dangerously high inflation rates, ranging from 20 to 30% annualized.

Consequently, following the collapse of trust in national currencies due to hyperinflation and relative debasement, populations in the CIS began using foreign currencies such as the Dollar in their everyday operations. The famous notion of “dollarization” paralyzed monetary policy makers in the region, who were not able to effectively perform their duties due to the enormously large amount of foreign currency in domestic circulation. Dollarization is still a relevant problem for some of the CIS members, however due to managed exchange rate regimes, monetary governing bodies have been considerably successful with stabilizing the system and enforcing monetary policy at least on some of the available channels.

Perhaps the most urgent of all problems for today that CIS countries are facing is the development of financial markets and the financial sector in general. On many layers, financial sector in the CIS is deficient and lagging behind not just the industrialized states but also the developing countries in Eastern-Europe and Asia. First, the overall infrastructure of financial intermediation is in need of reform and strengthening. The overall levels of monetization and financial intermediation are low, which causes aggregate demand in CIS states to respond little to credit or deposit rates. Second, the region is very high in terms of quantities of foreign currency-denominated loans to the private sector. Thus, financing decisions are not affected to large extent by the interventions into domestic interest rate markets. Third, the banking sectors in almost all CIS states suffer from low levels of competition (consolidation of leading national commercial banks into groups of “Top-5” or alike).

It has also become common for many CIS commercial banks, and many economic agents in general for that matter, to obtain capital through external financing, thus leaving them indifferent to the performance of domestic monetary and financial indicators. Further, the nonbank financial

sectors are practically non-existent for most CIS states. Absence of serious stock and debt markets, mortgage markets, insurance industries, hampers the the probability of either the asset price channel or the balance sheet channel to work appropriately. In addition, most if not all CIS countries must still address the issue of capital account liberalization, since capital mobility in certain countries of the region is considerably low (Jamilov, 2012). This is partially explained by active policies to prevent currency depreciations in the region (Keller, Richardson, 2003). Finally, qualitatively speaking, poor human capital expertise on the fronts of risk management, credit risk assessment, and accounting further influence the workings of monetary transmission channels in quite a negative way.

All in all, CIS is a region in transition with its member-states showing signs of great resemblance, both in terms of historical development, and also in the types of problems that they are facing nowadays. Incomplete legislative foundations, informal sectors and shadow economies, dollarization, noncompetitiveness and consolidation in the banking sectors, capital account immobility, underdevelopment of the capital markets, and a growing need for transparent governance are among the primary challenges for the CIS now and going forward. While analyzing the issue of monetary policy transmission in the CIS, we must look at the issue through the prism of the region's peculiarities which were just mentioned. In light of these factors, we expect that the channels that we will measure (interest rate, exchange rate, bank lending, and monetary) will not always behave in a way that theory or evidence from industrialized states would predict.

Indeed there have been many papers, both theoretical and empirical in nature, in the field of monetary policy transmission. There have been also some studies, both on individual country-basis and on the CIS as a group, on the channels of monetary transmission for the case of CIS. However, the originality of this paper is that nobody, to the best of our knowledge, has performed such a comprehensive country-wise and regional analysis employing 3 distinct econometric methodologies. We will present the behavior of 4 channels of monetary transmission for 9 member states of the CIS over the period of 2000-2009. We will analyze the dynamics of monetary transmission channels in the short run using a VAR framework and in the long run using an ARDL approach to cointegration. And we will also provide evidence on how the CIS performs as a distinct unit via fixed effects panel-data analysis. In the end we will highlight the best and the worst performing channels of monetary transmission, and provide policy-relevant recommendations and conclusions.

The rest of the paper is structured as follows. In Section 2 we provide a review on the channels of monetary transmission literature. Section 3 describes the data and the countries used in our analysis, and lays out the econometric methods which were employed. Section 4 reports the short-run and long-run individual country as well as the CIS panel data results. Section 5 offers a discussion of our findings. Finally, Section 6 concludes.

2. Literature Review

Boivin et al. (2011) suggests to categorize the monetary transmission channels into neoclassical and non-neoclassical groups. To the former category belongs the path that the interest rate takes to the real economy through investment and consumption. The non-neoclassical channels function through the change in the supply of credit and how the bank balance sheets respond to

credit innovations. The relative efficiency of these two channels depends on the degree of development of the domestic financial system.

Mishra, Montiel, and Spilimbergo (2010) provide arguments in favor of the bank lending channel as the prime route for monetary policymaking. They argue that apart from the bank lending channel, the interest rate channel, the asset channel, and the exchange rate channel are limited in their scope and ability by a set of negative factors: absence of well-functioning markets for fixed-income securities and equities, weak real estate markets, heavy central bank intervention in the foreign exchange markets, and by the very imperfect connections with the international capital markets. See (Keller, Richardson, 2003) for the discussion of exchange rate regimes in the CIS economies. In addition to the bank lending channel, the balance sheet channel is predicted to operate as a financial accelerator through the increased external finance premium (Mishra, Montiel and Spilimbergo, 2010).

Moreover, the bank lending channel is often regarded as the key channel of monetary transmission (Cetorelli and Godberg, 2008). Presumably because banking is always among the largest non-energy sources of growth generation in developing economies, and also because banks are still the prime channel for obtaining funds. The channel tends to work differently for large and for small banks, with the difference typically rationalized by the higher substitutability of deposits as sources of funding for the larger institutions. Small banks, on the other hand, have a smaller chance of obtaining funds through alternative means. Thus, the bank lending channel operates in a discriminative manner with respect to size, balance-sheet wise. (Kashyap and Stein, 1995, 2000). With respect to the case of CIS, the a priori expectation on the working of the bank lending channel is ambivalent: on hand hand, the banking sectors in most CIS countries are considerably consolidated, so this particular channel of transmission should not work because of the presense of larger banks. In the meantime, it's improbable that many banks in the CIS are global in nature, with most institutions holding assets either domestically or outside the country but still relative close to the home region. The lack of a global nature of CIS banks therefore suggests that the bank lending channel should be operational (Cetorelli and Goldberg, 2008).

Further with regards to the bank lending channel, the path from monetary policy aggregates to the real economy lies through the availability and cost of bank credit. If the link between monetary policy interventions and the availability and the cost of credit is low, then the banking sector is not competitive enough and the real cost of bank lending is actually very high due to a poor institutional environment. If the link between the availability and the cost of credit and the real economy is low then the formal sector of the economy is too small. Note that both bank sector non-competitiveness and the dominance of the informal financial sector are two factors very much expected in the case of CIS. Therefore, it's possible that the pass-through from monetary policy actions onto the real economy will be weak on both paths.

Kabundi and Nonhlanhla (2011) provide interesting evidence on the importance of the channel of confidence in the case of monetary transmission in South Africa. They built a FAVAR framework and concluded that confidence in addition to the interest rate channel play the biggest role of explaining the real economy and prices. Also for South Africa, Ncube and Ndou (2011) claim that the wealth effect and the credit channel should be targeted for conducting anti-inflation policies.

Channels of monetary transmission should not be just operational on a technical side. They must also be controlled by a credible monetary policy center. Mohanty and Turner (2008) argue that credibility and credible monetary policy frameworks are essential in strengthening the efficiency of the interest rate channel of monetary policy transmission in the emerging market economies (EMEs). Mukherjee and Bhattacharya (2011) conclude that for the case of EMEs, the interest rate channel impacts private consumption and investment. They also decomposed their results for the scenarios of with and without inflation targeting, and proved that presence of the inflation targeting regime does not alter the main conclusion.

Another work for the EMEs highlights the importance of having a developed domestic financial system (Bhattacharya, 2011). Weakness in the system coupled with a large informal sector in the economy leads to weak performance of the traditional channels of monetary transmission. In this paper, the most powerful transmission channel was found to be the exchange rate channel, while the interest rates had no significant impact on aggregate demand.

Dollarization in the context of monetary policy has been addressed in Acosta-Ormaechea and Coble (2011). They argue that in Chile and New Zealand the traditional interest rate channel is more important, while in Peru and Uruguay the most significant channel is the exchange rate channel. Horvath and Maino (2006) believe that dollarization has a negative effect on the efficiency of the independent interest rate channel of monetary transmission.

Dollarization, as discussed in the previous section, is also a serious issue for the countries of the CIS. Korhonen and Wachtel (2005) claim that domestic prices reflect the changes in the exchange rate very quickly; in other words, the speed of adjustment to long-run equilibrium is fairly high. They argue that this signals the high level of dollarization in most CIS countries. See (Balino, Bennet, Borensztein, 1999) and (Sahay, Vegh, 1995) for the discussion of monetary policy in a highly-dollarized economies.

Mohanty (2012) provide an extensive treatment of the monetary transmission channels for the case of India, but derive conclusions that are applicable to a much general pool of countries. Namely, they argue that deregulation of interest rates, government-led auction-based market borrowing programme, development of the short-term money markets, reduction in statutory reserve requirements, among other reforms have contributed to the development of the interest rate based indirect instrument for monetary policy management.

Isakova (2008) conducted a VAR analysis for three Central Asian countries (Kazakhstan, Kyrgyz Republic, and Tajikistan). Results of this study show that policy rates passed through to money market interest rates without much trouble. However, inflation and aggregate output are not significantly affected by the innovations in the policy rates. They conclude that the bank lending channel is weak in the case of these three countries.

Dabla-Norris and Dloerkermeier (2006) analyzed the interest rate pass-through in Armenia and concluded that monetary policy rates transmitted well into the market interest rates. However, the market rates did not affect the real economy or price dynamics. Also for the case of Armenia, but with far-reaching implications for literature in general, Bordon and Weber (2010) decomposed the time series into two regimes, one with a highly dollarized economy and the other with a low degree of dollarization. They have demonstrated that dollarization negatively affects the interest rate channel of monetary policy transmission, since policy rates did a far

greater job of affecting inflation and output in a low-dollarization regime. Thus, for the traditional monetary transmission channels to work, it's possible that the countries of the CIS will have to de-dollarize their domestic economies first.

Bakradze and Billmeier (2007) and Samkharadze (2008) show that aggregate output does not respond well to the innovations in the monetary policy variables in the case of Georgia. Similarly, inflation is also not affected by monetary policy shocks. The bank lending channel appears to be functioning in the correct manner, however bank interest rates do not impact aggregate output in a statistically significant way.

Agayev (2011) conducted a panel data analysis for 10 CIS countries in order to determine the factors which explain the region's inflation dynamics. They found that wages and exchange rate innovations do the best job of explaining inflation in the CIS in the long run. In the short run, however, changes in the bottom-line monetary base is the best explaining factor of price movements. Overall, the exchange rate and the monetary channels seemed to be the best at predicting inflation in the CIS.

With regards to methodologies used in monetary policy transmission studies, most have resolved to the traditional VAR framework (Sims, 1980; Blanchard and Quah, 1989; Bernanke and Blinder, 1992; Cristiano and Eichenbaum, 1992). Others have used SVAR approaches (Aslanidi, 2007), and panel data structures (Agayev, 2011). A relatively novel method of studying the pass-through of monetary policy channels involves an ARDL approach to cointegration (Crespo-Cuaresma et.al., 2004). Some researches devised structural, DSGE-like models explaining macro-dynamics of countries involving numerous policy and market variables (Golinelli and Rovelli, 2002). But all in all, VAR analysis seems to be the most preferred method for short-run analysis, VECM (if the variables are non-stationary) for long-run investigations, ARDL for the case of variable stationarity (which is common for small samples), and panel fixed and random effects for a look at a group of several countries.

Mishkin (1996) presented an exhaustive explanation of all existing channels of monetary transmission. Egert and MacDonald (2006) provided an excellent literature review on many empirical studies on monetary transmission in developing economies.

3. Data Description and Econometric Methodology

3.1. Data Description

For this study we are using annual data for the period of 2000-2009 for 9 countries of the CIS. Our data selection has been driven by the availability of reliable information for some members of the region. We have compiled the data set for Armenia, Azerbaijan, Belarus, Moldova, Russia, Kazakhstan, Kyrgyzstan, Tajikistan, and Ukraine. Turkmenistan and Uzbekistan have been omitted due to data non-existence. For interpretation purposes, most series have been transformed using a natural logarithm. Overall, data was obtained from such sources as CIS Stats, OECD, World Bank, St Louis Reserve Bank, Statistical Offices and National Banks of the member states of the CIS. The variables were chosen with respect to their theoretical belonging to a particular channel of monetary transmission. For example, the refinance rate is part of the interest rate channel analysis, while remittances are included into the exchange rate channel

discussion. Consult Table 1 in the Appendix for a thorough description of the series used in this paper.

3.2. Econometric Methodology

3.2.1. Short-Run Analysis Using VAR

As noted in the previous section, we will use a VAR framework to demonstrate the short-dynamics of the responses of our macroeconomic variables (CPI and GDP) to innovations in the various policy variables.

A VAR in the level form will be estimated ala Jamilov (2011). The VAR system in this paper will take the following form:

$$Z_t = A_1 Z_{t-1} + A_2 Z_{t-2} + \dots + A_n Z_{t-n} + BX_t + \varepsilon_t \quad (1)$$

where, Z is a vector of n variables, X – vector of deterministic variables; ε – vector of innovations. For example, if we want to build a VAR model for the interest rate channel of Ukraine, we will use GDP, CPI, and the refinancing rate of Ukraine as endogenous variables, with the addition of the federal funds rate as a deterministic exogenous variable, plus the constant and the error term. In similar fashion, we will build VARs for all 9 countries and for each of the 4 channels of monetary transmission.

The preliminary VARs are required to determine the correct number of lags in the model, to ensure that there is no autocorrelation in the error terms, and that the residuals follow the pattern of a normal distribution. With the right number of lags, we construct the final VAR model in order to get impulse response functions and variance decompositions of the variables of interest.

In the preliminary stage, a set of unit-root tests must be carried out to ensure that variables in our models have unit roots. Should a variable have a unit root in the level form, stationarity is obtained usually by first-differencing. If variables are non-stationary, then we will achieve a long-run equilibrating equation by constructing a traditional Vector Error Correction model (VEC). Otherwise, we will have to adopt an Auto Regressive Distributed Lag model (ARDL) approach to cointegration, since this method doesn't require the variables to be non-stationary in level form.

As a brief theoretical note, a one-time movement in a policy variable will affect not only the real economic aggregates but also the future values of the policy variables via the so-called feedback effect. It is important to account for these feedback effects if we want to estimate the monetary transmission models correctly. Therefore, an econometric method of vector auto regressions (VAR), not a conventional OLS, should be employed. A VAR model and impulse response functions would take the feedback effects into account.

Overall, we have 9 member-states of the CIS, 4 channels of monetary transmission, with 2 macro variables (CPI and GDP) and at least 1 and sometimes more policy variables in every channel. We will also use the federal funds rate, oil prices, and remittance flows as exogenous variables in certain VAR set-ups. In total, we have run 36 VAR models in order to obtain short-run coefficients for each country and for each channel of monetary transmission.

3.2.2 Long-Run Analysis Using ARDL

There are several reasons why we have decided to use the ARDL approach to cointegration (developed by Pesaran et al., 2001) as opposed to the more common VECM to study the long-run behavior of monetary policy transmission channels. First, this method solves the problem of variable endogeneity and the inability to test hypotheses on the estimated coefficients. Second, ARDL is far more superior than multivariate cointegration methods in the case of small samples, which is important in our case (Narayan, 2005). Second, ARDL models do not require the regressors to be non-stationary, and most of our variables will be indeed stationary in level form.

We now present how one of our channels of monetary transmission (we will use the example of the interest rate channel) would be represented in the ARDL form:

$$\ln GDP_{i,t} = \alpha_0 + \sum_{j=1}^m \alpha_{1i} \Delta \ln GDP_{i,t-j} + \sum_{j=0}^m \alpha_{2i} \Delta RR_{i,t-j} + \sum_{j=0}^m \alpha_{3i} \Delta FFR_{t-j} + \alpha_4 \ln GDP_{i,t-1} + \alpha_5 RR_{d,t-1} + \alpha_6 FFR_{f,t-1} + \nu_t \quad (2)$$

where m means lag length, $\ln GDP_{i,t}$ is the ln-transformed GDP of country i at time t , RR is the refinancing rate of country i and time t , and FFR is the US Federal Funds Rate. Similarly, we could have built an ARDL representation for CPI with the RR and FFR as model variables. Altogether, we will build 2 long-run models for each macro variable (GDP and CPI), for each country (9 CIS member states), for each channel of monetary transmission (4 channels). Overall, we have run 72 ARDL regressions in order to achieve long-run coefficients for each country and for each channel of monetary transmission.

As noted above, it is not necessary to test our variables for unit root processes. Instead, we can proceed with testing for cointegration. The ARDL approach achieves this by presenting an F-statistic which tests the null hypothesis of no cointegration ($H_0: b_5=b_6=b_7=b_8=0$) against the alternative hypothesis ($H_1: b_5 \neq 0, b_6 \neq 0, b_7 \neq 0, b_8 \neq 0$). For every significance level there are two sets of critical values. If the F-statistic exceeds the upper-bound critical value, then the null hypothesis is rejected. If the F-statistic is below the lower-bound, then the null is accepted and we have no cointegration. Finally, if the F-statistic is between the two bounds then the test has no conclusive result. There is another way of testing for cointegration, which is looking at the error correction term in the ARDL's short-run representation (Kremers et al., 1992). If the error correction term is statistically significant and negative, it implies that the variables are quick on approaching their long-run stabilizing conditions.

3.2.3. Panel-Data Analysis Using Panel Fixed Effects

Apart from attempting to investigate the channels of monetary transmission on individual-country basis, we have also devised a panel set-up for the period of 2000-2009, consisting of our 9 member-states of the CIS. We wish to find out how the CIS performs as a region with regards to monetary transmission. First, we have to test our panel data for the presence of a unit root. We will achieve this by running the Levin, Lin, and Chu (LLC, 2002) panel unit root test. This test is different from the individual unit root testing that we proposed in section 3.2.1. on individual-country VAR modeling.

If variables in our panel set-up are non-stationary, then we will have to resort to advanced panel cointegration techniques for non-stationary data. Otherwise, we will employ a long-run panel fixed-effects model of the following form:

$$\ln GDP_{it} = \alpha_{it} + \beta_{1,it} RR_{it} + \beta_{2,it} LR_{it} + \beta_{3,it} DR_{it} + \beta_{4,it} WG_{it} + \beta_{5,it} \ln M2_{it} + \beta_{6,it} \ln ER_{it} + \beta_{7,it} \ln REM_{it} + u_{it} \quad (3)$$

Consider that in a similar fashion we will devise the panel fixed-effects regression for inflation, with CPI as a dependent variable. Note that for the regression of CPI we will also add $CPI(-1)$ – the lag of inflation, which will represent inflation inertia, to the list of independent variables. Overall, there will be 2 panel fixed effects regressions, for each of the two macroeconomic variables (GDP and CPI), which will determine which of the variables is best at explaining inflation and output in the CIS.

4. Results

4.1. Short-run Results for Individual Countries

We begin to present our short-run individual country results based on the VAR models. All the impulse response functions are available in the Appendix. Note that in our VAR set-up, the Federal Funds Rate (FFR), oil price (OILP), and remittances (REM) are treated as purely exogenous. Thus, an IRF representation for them will not be possible. Also consider that our small sample size limits the interpretational importance of the 5% statistical significance. Some of the responses will indeed be significant for several periods, and it will add more robustness for inference, but we are interested more in the general direction of each response and whether a given country will demonstrate any systematic evidence for efficiency in a particular transmission channel

4.1.1. Interest Rate Channel

Short-run individual country evidence for the interest rate channel is reported in the Appendix, under Figures 1 through 9. The primary policy variable for this channel is the refinancing rate. The US federal funds rate was taken as an exogenous variable. GDP and CPI are the macroeconomic aggregates by default.

The response of aggregate output to innovations in the refinancing rate in the case of Armenia is strongly negative and statistically significant up to the 6th period (Figure 1). Armenian GDP declines following a one standard deviation increase in the country's refinancing rate, which suggests that the interest rate channel is operational. The effect of the refinancing rate on inflation is almost negligible and not significant. For Azerbaijan, both GDP and CPI do not seem to be responding in a noticeable manner to refinancing rate innovations (Figure 2). The same conclusion could be applied to Belarus: there is no evidence that the interest rate channel is effective (Figure 3).

For Kazakhstan, the path of the response of both output and prices to the refinancing rate is highly unstable, although GDP seems to demonstrate the presence of a price effect in the short

run as output rises slightly, but then falls until its long-run equilibrium below the pre-innovation level (Figure 4). Again, the dynamic is too unstable. For Kyrgyzstan, inflation shows behavior similar to the case of Kazakh CPI: unstable and insignificant (Figure 5). However, output seems to be increasing following a positive innovation in the refinancing rate, which is surprising from the theoretical point of view.

CPI of Moldova has a significant positive response to the refinancing rate up to the 2nd period (Figure 6). Moldavian GDP, similarly to the case of Kazakh GDP, increases slightly following an intervention into the refinancing rate market. For Russia, although the effect is not significant, the refinancing rate carries a theoretically correct effect on aggregate output, since it declines when the interest rate is raised (Figure 7). Russian CPI movement is correlated with the direction of refinancing rate innovations, although in a very insignificant manner. For Tajikistan and Ukraine, we cannot detect any noticeable trend in the response of either output or inflation to the refinancing rate (Figure 8 and 9).

Overall, only for the cases of Armenia and Russia, domestic output seems to be determined by fluctuations in the refinancing rate. Inflation in none of the CIS states, according to our calculations, can be managed via the interest rate channel.

4.1.2. Exchange Rate Channel

Short-run individual country results for the exchange rate channel are presented in the Appendix under Figures 10 through 18. The primary policy variable for this channel is the exchange rate between the national currency and the US dollar. Remittances and price of oil were selected as exogenous variables. Again, GDP and CPI are indicators of the broad macro-economy.

Armenian GDP responds positively and significantly to an innovation in the national exchange rate up to the 5th period (Figure 10). Inflation on the other hand seems to be unresponsive to the exchange rate fluctuations. In case of Azerbaijan, aggregate output rises as the exchange rate depreciates for one standard deviation; domestic prices do not react in any noticeable way (Figure 11).

Belarusian domestic aggregate output shows a slight short-run hike following an exchange rate devaluation, while inflation suffers a temporary decline (Figure 12). Both variables return to their pre-depreciation levels by the 4th period. GDP and CPI of Kazakhstan are not responsive to the country's exchange rate movements (Figure 13). Domestic output of Kyrgyzstan is equally unaffected by the ER innovations; the Kyrgyz inflation, however, rises slightly due to one standard deviation depreciation (Figure 14).

In the case of Moldova, both aggregate output and inflation exhibit a significant positive short-run response to a depreciation of the Leu (Figure 15). Interestingly, after several periods inflation declines and even falls below the pre-devaluation level. GDP of Russia increases following a currency devaluation, and the effect is significant for 3 periods. Russian CPI falls in response to the depreciation, also in a significant way up to the 2nd period (Figure 16).

Tajikistani GDP does not seem to be responsive to domestic exchange rate innovations (Figure 17). Inflation, however, has a significant negative short-run response to a one standard deviation fall in value of the somoni. In the long run, the exchange rate remains practically unchanged and

returns to the initial equilibrium. For Ukraine, neither GDP nor CPI react in any substantial way to interventions into the exchange rate.

Overall, the exchange rate channel of monetary transmission, according to our calculations, is visibly operational in Armenia, Azerbaijan, and Moldova. Certain degrees of effectiveness are observed in Russia and Belarus.

4.1.3. Monetary Channel

Short-run individual country results for the monetary channel are available in the Appendix under Figures 19 through 27. GDP and CPI are the default indicators of domestic demand and inflation respectively. M2 and WG are the policy variables of the domestic supply of broad money and the average annualized growth rate of nominal wages, respectively.

Armenian GDP shows a positive response to an increase in wages, but not to M2. The effect is not statistically significant though (Figure 19). Inflation does not seem to be affected by WG, while for M2 the dynamic is too unstable and inconclusive, although there is a statistically significant price spike in the short run following the increase in the monetary base. For the case of Azerbaijan, neither wages nor money seem to be effective at influencing GDP or inflation (Figure 20).

Gross Domestic Product of Belarus displays a significant positive response up to the 4th period to an increase in M2 (Figure 21). M2 has a negative but a non-significant effect on inflation. With regards to wages, a one standard deviation increase in WG has a stably negative effect on output but a positive short-run effect on inflation. Both effects are insignificant. For Kazakhstan, domestic output and inflation both increase in the short run due to an impulse of wage growth (Figure 22). Broad money supply has no effect on either Kazakh GDP or prices.

Wages carry a positive, although insignificant, impact on Kyrgyz GDP; the response of inflation is too unstable (Figure 23). M2 has no effect whatsoever on output or inflation. In the case of Moldova, an increase in M2 has a light positive effect on domestic production and no seemingly meaningful effect on prices (Figure 24). Wages cause no response from the dynamic of Moldavian GDP, although they initiate a decline in inflation in the short run and then a slight recovery. Neither effect is statistically significant, even at the 10% level.

For Russia, broad money does a poor job of affecting either GDP or CPI (Figure 25). Wages, on the other hand, have a significant positive effect on output in the short run (peculiar form of a price effect), which is followed by a long-run decline. Inflation follows a similar path: rising in the short run due to an increase in nominal wage growth, and falling after several periods. Tajikistani WG has a negative effect on inflation and on GDP. In the case of inflation, the impact is particularly strong and statistically significant for 2 periods. Both GDP and M2 increase slightly due to an expansion in the monetary base, although in an insignificant manner (Figure 26). For the case of Ukraine, M2 has no effect at all on domestic GDP and CPI. Wages carry a positive effect on aggregate output for all periods, while for inflation the effect is negative in the short run and positive after the 5th period.

All in all, for almost every country of the CIS either broad money or nominal wage growth can explain at least one of our two macro variables. In general, output has shown more sensitivity to monetary variable innovations than inflation.

4.1.4. Bank Lending Channel

Short-run individual country results for the bank lending channel are available in the Appendix under Figures 28 through 36. For the bank lending channel, which according to many theoretical and empirical papers on monetary transmission in developing economies, should be an efficient and relevant channel, we are using the deposit interest rate and the lending interest rate as main policy variables. GDP and CPI are once again taken as indicators of the overall macroeconomic environment.

For Armenia, the lending rate has no impact on either GDP or CPI (Figure 28). However, output shows a considerably negative, and almost completely significant up to the 6th period, response to a one standard deviation increase in domestic deposit rates. Inflation initially rises but then falls following an innovation in the interest rates on deposits. For Azerbaijan, there is no visible effect of either deposit or credit interest rates on both output and prices (Figure 29). In the case of Belarus, domestic inflation increases following a hike in the deposit interest rates, and the effect is significant for 2 periods (Figure 30). Prices are not affected by the credit rates, and Belarusian output does not react to either lending or deposit rates of interest. In Kazakhstan, the bank lending channel doesn't exhibit any sign of efficiency, as neither deposit nor lending interest rates affect GDP or inflation in any way (Figure 31).

For Kyrgyzstan, the bank lending channel does not present any evidence for functionality (Figure 32). In the case of Moldova, output responds in a negative way to an increase in domestic deposit rates (Figure 33). The effect is not significant, but considerable. No impact is observed on GDP from the impulse to LR. Inflation is not affected by the lending rates, while the effect from deposit rates is dual: falling inflation in the short run, and then recovery in the medium-long run. There is no clear trend and the dynamic is very unstable and follows a cyclical/sinusoidal trajectory.

Innovations in Russian domestic deposit and lending interest rates both negatively affect the country's GDP, and in a statistically significant way up to the 4th period (Figure 34). The bank lending channel is extremely homogenous for Russia, since interest rates on credit and deposit affect the real economy in much the same way. Inflation has a positive response to an increase in either lending or deposit rates. For Tajikistan, LR has no effect whatsoever on GDP or CPI (Figure 35). Rise in DR, however, has a visible short-run impact on output and prices. The dynamic afterwards is too unstable for any reasonable conclusion to be reached on the working of the channel in Tajikistan. Finally, neither lending nor deposit interest rates have any consistent effect on GDP and CPI in the case of Ukraine (Figure 36).

All in all, according to our results, the bank lending channel seems to be operational in Armenia, Moldova, and Russia. Again we observe that output is much more flexible to policy innovations than is inflation.

4.2. Long-Run Results for Individual Countries

We are now presenting results of our ARDL regressions to shed light on the long-run behavior of the channels of monetary transmission in the case of our 9 CIS countries. Firstly, we note that all of our regressions are cointegrated according the bound testing procedure. F-test results are omitted for brevity but are available upon request. We have run all the regressions and summarized the results for each country in one single table (Table 2 in the Appendix). We have

once again investigated 4 channels of monetary transmission (interest rate channel, exchange rate channel, bank lending channel, and monetary channel) and used essentially the same variable set-ups as in the case of short-run VAR models presented in section 4.1. For example, we are still using the domestic refinancing rate as the prime policy variable in the interest rate channel, with the federal funds rate as the exogenous variable. Note that for the exchange rate channel, in addition to the exchange rate variable itself, we will also present for the first time quantitative evidence for using remittances as a channel of transmission.

For Armenia, the only channel which seems to operate in the long run is the monetary channel, through which both M2 and WG significantly affect the nation's aggregate output. No other effect is significant. Belarus demonstrates a high level of long-run workability in the bank lending channel. However, only the effect from the lending rate is negative, which is the theoretically correct response to a spike in interest rates. In addition, M2 has a positive significant effect on Belarusian GDP, and CPI is positively affected by innovations in the refinancing rate.

From Table 2 in the Appendix, we see that flow of remittance has a considerable and positive impact on both GDP and CPI of Azerbaijan in the long run. Monetary base (M2) positively and significantly affects the country's GDP, while an increase in the refinancing rate creates a significant positive response in the CPI. No other variables present statistically significant outcomes.

For Kazakhstan, the monetary channel seems to be the most important channel of transmission in the long run. CPI is affected both by wage growth and by the monetary base, and in a statistically significant way. GDP is also affected by the M2. Similarly to the case of Azerbaijan and Belarus, Kazakh inflation responds in a positive significant manner to innovations in the refinancing rate. Kyrgyzstan exhibits a strong monetary channel, since its domestic output is affected in a significant way by the broad money supply, and CPI responds in a positive and significant way to a rise in the nominal wage growth rate. Also, flow of remittance has a negative significant effect on Kyrgyz CPI.

Moldovan CPI can only be influenced in a significant way by raising the domestic exchange rate. GDP, however, is sensitive both to the bank lending and to the monetary channels. Increases in either M2 or WG carry a significant positive effect on Moldova's GDP, and so does the deposit interest rate. Lending interest rates negatively affect GDP in the long run, which unlike the sign of the deposit rate impact, is the theoretically correct outcome.

For Russia, all channels of monetary transmission show some degree of workability in the long run. First, domestic refinancing rate affects GDP and CPI in a negative and in a positive way respectively. Second, lending interest rates have a significant negative effect on GDP, and a significant positive effect on CPI. In response to an increase in domestic deposit rates, Russian CPI declines. GDP also responds in a statistically significant way to an increase in M2. Inflation is highly responsive both to variations in the exchange rate of the Ruble, and to the flow of remittance from abroad.

Tajikistan shows signs of a working exchange rate channel in the long run, as the exchange rate of Somoni affects both the Tajik GDP and CPI. Remittances and domestic interest rates on deposit both explain inflation, and cause its decline in the long run. Finally, for the case of

Ukraine, the refinancing rate has a positive significant effect on both output and inflation. So does the broad money base, as GDP and CPI increase in the long run following an impulse from M2. CPI can also be influenced by varying either interest rates on deposits or the domestic exchange rate, since both variables carry a significant positive effect on domestic price level.

By and large, long-run GDP of all CIS countries is responsive to innovations in the broad supply of money (M2). All 9 cases show that M2 positively affects GDP in the long run. For inflation the situation is different, as there is no universal conclusion. For some cases, CPI is driven by the exchange rate, for others – by the refinancing rate or the deposit interest rates. Consistent with our finding in Section 4.1, output is a lot more responsive to variations in policy variables than is inflation, suggesting that both in the short run and in the long run inflation cannot be systematically affected, or explained for that matter, in the region of CIS. Remittance, our original addition to the traditional discussion of monetary transmission channels, affects long-run inflation in a statistically significant way in 4 of 9 cases, and output only for the case of Azerbaijan.

4.3. Panel Results for CIS as a Group

We conclude our presentation of results by reporting the outcome from our panel fixed effects analysis of the CIS as a distinct group. All our variables are non-stationary of order I(1) according to our panel unit root test results, which are omitted for brevity. We have run 2 equations for our panel: one with GDP and the other with CPI as dependent variable. For the CPI regression we are adding an additional variable of CPI(-1), which is the lag of inflation, to check on inflation inertia in the CIS. Table 3 has the outcome of the GDP regression, and Table reports the numbers for the CPI model.

For CIS as a whole, output is influenced only by the fluctuations in the exchange rates and by the movements in the monetary base. None of our interest rate variables, nor the wage growth rate or flow of remittance has a significant effect on GDP. In essence, these panel results are consistent with what we achieved for the individual country long-run estimations in Section 4.2: M2 seems to have a strong impact over production and output in the CIS in the long run.

For the CPI regression, we conclude that the refinancing rate, nominal wage growth rate, and the flow of remittance carry statistically significant effects on long run regional inflation. Again, this outcome is similar to our conclusion following the analysis in Section 4.2: individual country results also confirmed that remittances and refinancing rate are good predictors of price fluctuations in the long run. Note that, although inflation does have inertia, the effect is not statistically significant. Also an interesting observation is that all interest rate variables affect the region-wise inflation in a positive way, whereas theory would predict CPI to be inversely related to interest rates.

5. Discussion

We have achieved much heterogeneity for our short-run results: some countries of the CIS show strength virtually in all channels of monetary transmission, while others are effective just in one of the channels. In the long run, we can confidently state that GDP is affected by the supply of money, in addition to some marginal influence from the exchange rate. CPI is driven mainly by the movement in the refinancing rates, flow of remittance, and to some extent by the exchange

rates and wages. Countries do differ greatly in the relative efficiency of their respective domestic monetary policies. However, there are some unifying arguments such as the monetary base being a universally strong factor of GDP, or the refinancing rate and remittances being a good predictor of inflation.

We have witnessed once again that the question of monetary transmission channels is indeed very empirical and contextual, and depends as much on the country of focus as it does on theoretical models and generalizations. We also prove that treating CIS as a region is reasonable, since our results from the CIS panel fixed effects regressions do coincide with the individual country based VAR model. Our results are, by and large, consistent with the findings of previous literature. Flow of remittance, our original introduction to the exchange rate channel of monetary transmission, proves to be an important factor for future studies.

Based on the results of this study and our survey of the practices, failures, and success stories in monetary policy-making of CIS states in the past 20 years, we wish to list once again the key directions for progress that this region needs to adopt to ensure continuous development of the region's channels of monetary transmission.

- **Use short-term policy interest rates.** Based on the success stories of CIS states with very efficient interest rate channels of monetary transmission, it is desirable that CIS countries, and indeed all developing economies, would focus on policies affecting short-term policy interest rates, e.g. overnight repo rates. The shorter the duration of those rates, the more influential the channel becomes and the easier it is for policy makers to quickly and correctly influence market interest rates.
- **Adopt inflation-targeting regimes.** Although not exactly at the hyperinflation levels of early-mid 1990s, inflation rates in some CIS states are still structurally very high, especially when comparing with the developing parts of Central and Eastern Europe. Strategic shifts towards inflation targeting policy regimes would serve a dual benevolent purpose for policy makers: it would not only drag the core inflation rate down, but also improve the overall working capacity of the channel of transmission.
- **De-dollarize the economy.** High degrees of dollarization do not allow monetary policy interventions to affect domestic market variables up to a satisfactory level. Elevation of trust into the purchasing strength of the domestic currency, credibility of the national money issuer (i.e. central bank), transparent and credible expectations on future monetary policy stances are all important factors that contribute to the rebalancing of the population's currency portfolio holdings towards the local currency and away from the foreign currency anchor.
- **Increase risk-premium for external financing.** The vice of all interest rate channels of monetary transmission is the ease of obtaining funds from the sources alternative to the formal route. Policy makers should identify the dominant types of domestic informal financing, and attempt to raise the premium that fund-seekers should pay to get access to those informal finances; either through bureaucracy, a form of taxation and a mixture of financial incentives, or through legal enforcement.

- **Minimize the informal sector and the shadow economy.** Econometric models of monetary transmission channels cannot assess (not in full, at least) the workings of the informal sectors of the economy. Coupled with the efforts to increase risk-premium for external financing, policy makers need to either eradicate the shadow economy completely or to at least make it feasible and beneficial for the informal agents to shift their interests towards the formal (legal) sector. Shadow economy minimization is an age old struggle but the benefits, which at least include an improvement of the monetary transmission channels, are worth the continuous effort.
- **Develop domestic capital markets and sources of non-bank financing.** For better or for worse, banks are still the chief allocators of resources in most emerging economies, and certainly in the CIS. Formation of an optimal market for transference of funds from those with excess to those with deficit is paramount for fluidity and mobility of the whole financial sector. Much focus must be placed on the development of pension funds, markets for short-term governmental and non-governmental corporate bonds, markets for stocks and equity. Also important is to educate economic and financial agents about the value and advantages of non-bank sources of funding.
- **Increase competitiveness in domestic banking sectors.** Precisely because the populations of transition economies do not have alternative ways of formal financing, the banking sectors typically become uncompetitive. A monopoly on resource provision leads both to sector consolidation and also to artificially high market interest rates. Although, typically by legal mandate, the national bank cannot influence market interest rates on deposit and/credit directly (it can achieve this only indirectly through policy rate innovations), the government can limit bank mergers and acquisitions to protect the idea of an “optimal bank size”. It can also place interest rates on state-driven instruments (such as mortgage credit through the public/government channel) so low, that the bank-provided alternatives would seem rational.
- **Establish a solid, transparent financial governing framework.** Much as a supporting caveat to the ongoing technical financial and monetary reform, CIS states must ensure that the region is governed by an easy-to-understand and robust legal foundation. Many countries in the CIS still do not have a modern law on mortgage lending, or are in need of an urgent and considerable pension reform. The problem is that the financial sector is developing quicker than the legal framework which supports it. Gaps and inefficiencies in the legal code create room for informal activities. It is necessary, however, to not overcomplicate legal procedures, which would have an adverse incentive effect such as the desire to circumvent complex requirements and seek an easier, once again an informal, way out.

6. Conclusion

In this paper we have attempted to gather the efforts of decades of theoretical and empirical work on the channels of monetary transmission and produce a comprehensive review for the case of CIS. We have provided an extensive introduction and literature review which identified the most common transmission channels and their applicability to the CIS. In the stage of empirical

analysis, we have studied both the short-run and the long-run performance of 4 channels of monetary transmission for 9 countries of the CIS. We have also looked at how the region performs as a distinct economic unit, having employed a panel data approach.

We conclude that broad supply of money (M2) is the only consistent channel through which policy makers can affect aggregate output. Meanwhile, flow of remittance and domestic refinancing interest rate are the main factors and indicators of inflation. The exchange rate seems to be playing a supporting role, both for output and inflation determination. While it is clear that the sphere of the channels of monetary transmission is largely an empirical and contextual issue, we have also found that CIS does behave like an integral unit from this particular angle.

Although the region has accomplished a lot in the past two decades, still many challenges remain until the local channels of transmission reach its optimal level of efficiency. Among others, development of capital markets and non-bank sources of financing, adoption of inflation targeting regimes, improvement of the legal framework, and placement of a larger emphasis on short-term interest rate management are the questions to address for CIS policy makers in the years to come.

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Appendix

Figure 1: Response of GDP and CPI to Refinancing Rate – Armenia

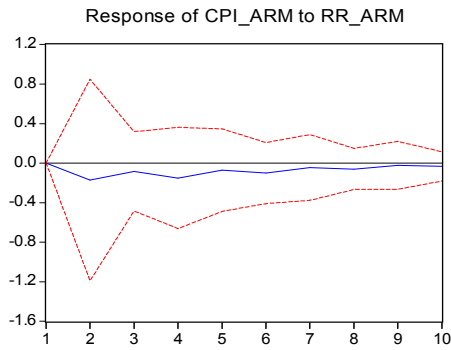
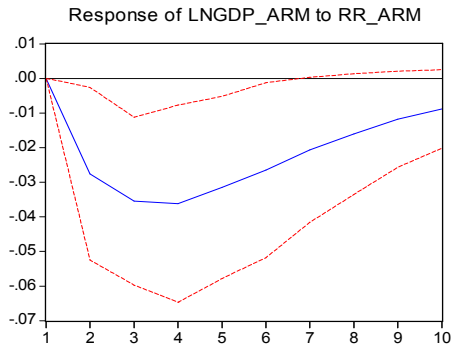


Figure 2: Response of GDP and CPI to Refinancing Rate – Azerbaijan

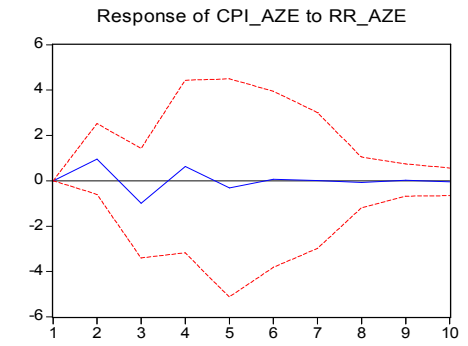
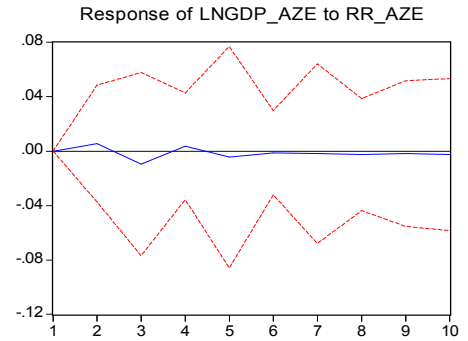


Figure 3: Response of GDP and CPI to Refinancing Rate – Belarus

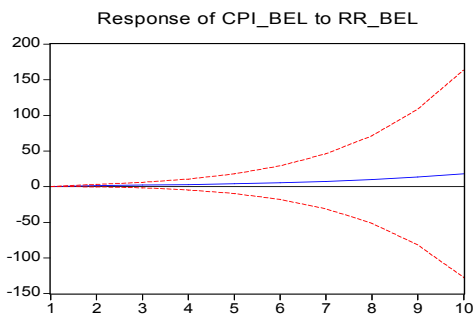
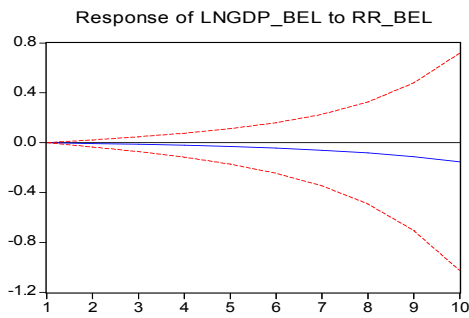


Figure 4: Response of GDP and CPI to Refinancing Rate – Kazakhstan

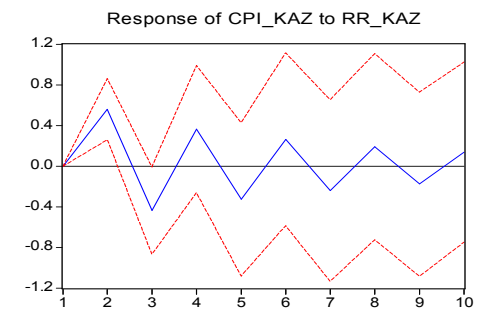
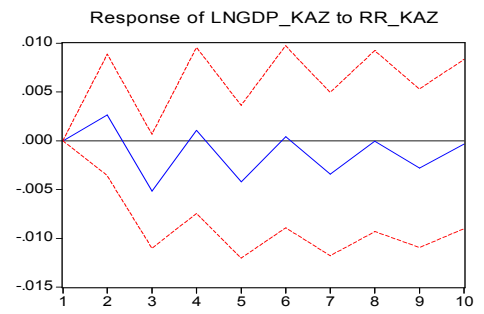


Figure 5: Response of GDP and CPI to Refinancing Rate – Kyrgyzstan

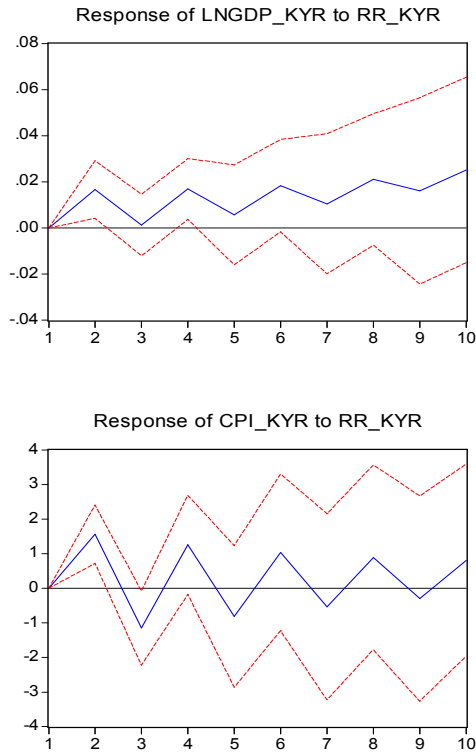


Figure 6: Response of GDP and CPI to Refinancing Rate – Moldova

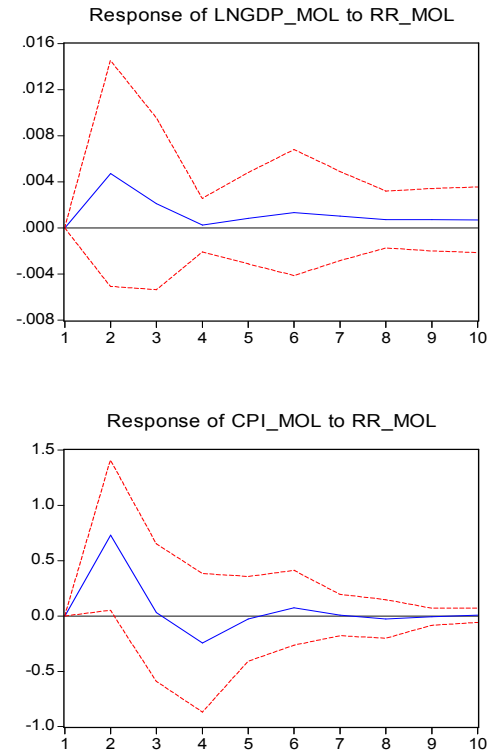


Figure 7: Response of GDP and CPI to Refinancing Rate – Russia

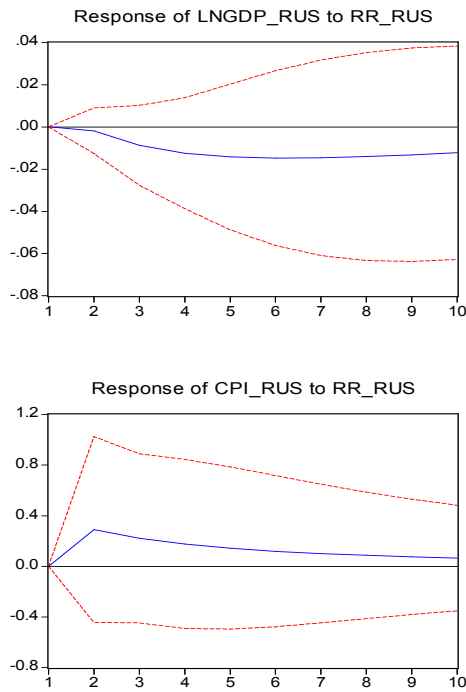


Figure 8: Response of GDP and CPI to Refinancing Rate – Tajikistan

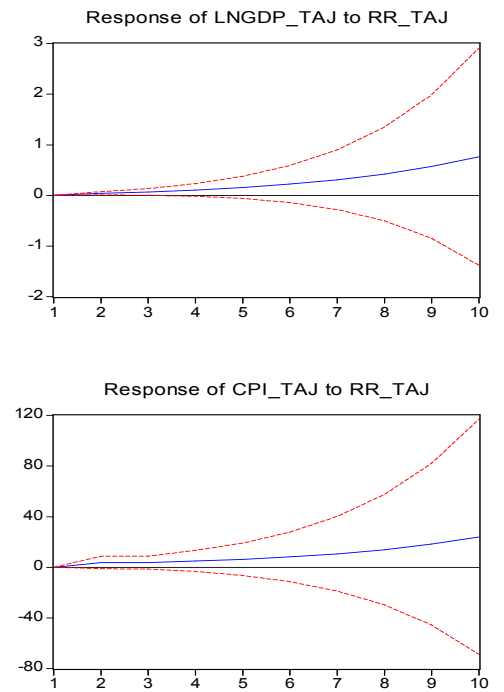


Figure 9: Response of GDP and CPI to Refinancing Rate – Ukraine

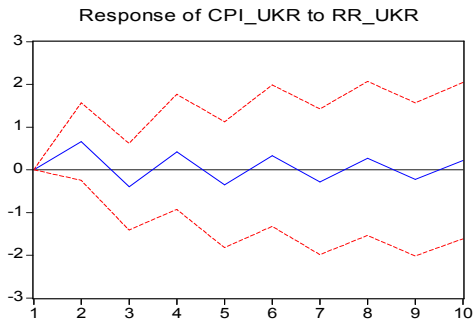
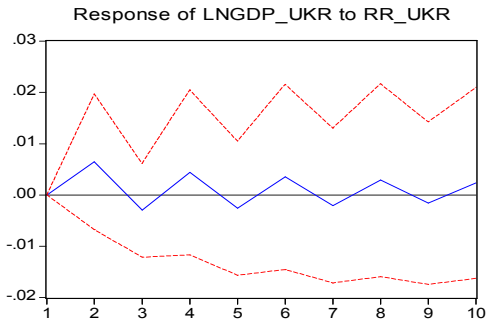


Figure 10: Response of GDP and CPI to Exchange Rate – Armenia

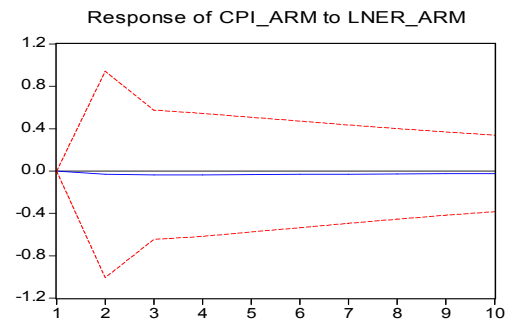
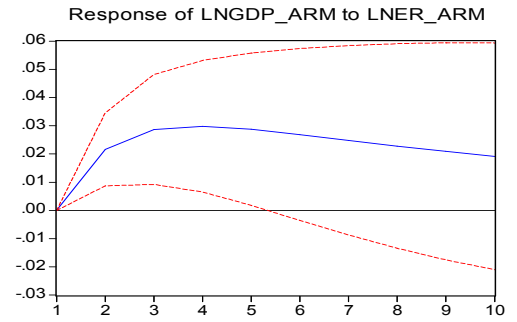


Figure 11: Response of GDP and CPI to Exchange Rate – Azerbaijan

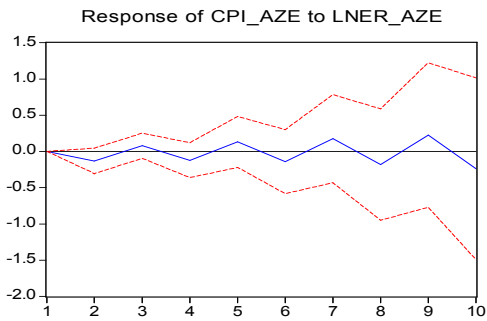
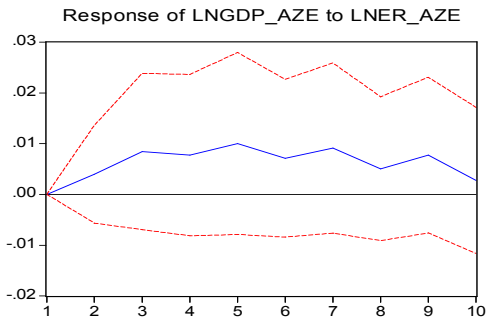


Figure 12: Response of GDP and CPI to Exchange Rate – Belarus

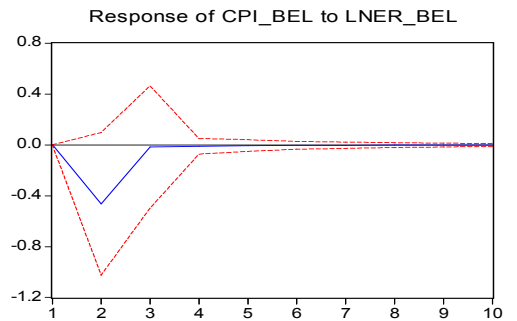
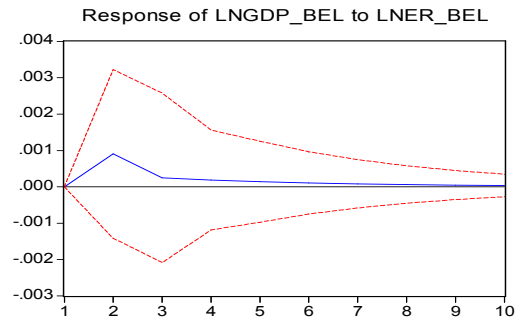


Figure 13: Response of GDP and CPI to Exchange Rate – Kazakhstan

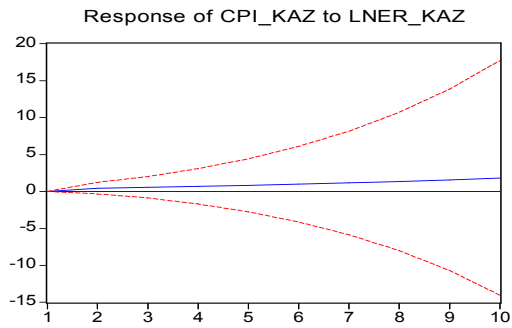
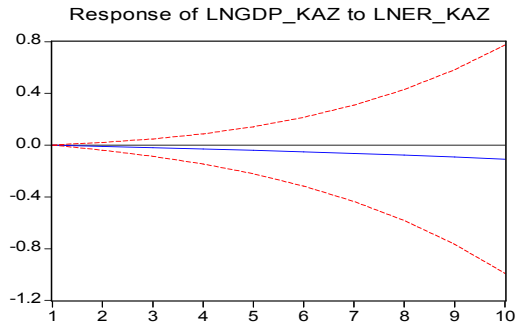


Figure 14: Response of GDP and CPI to Exchange Rate – Kyrgyzstan

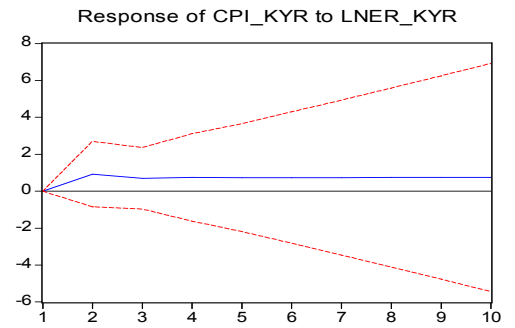
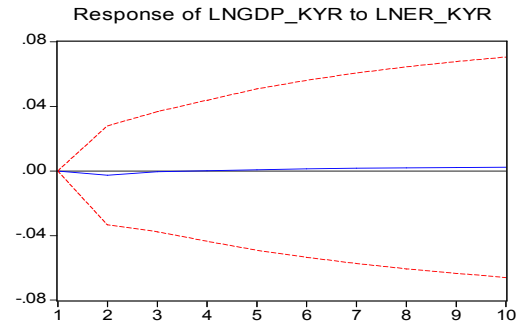


Figure 15: Response of GDP and CPI to Exchange Rate – Moldova

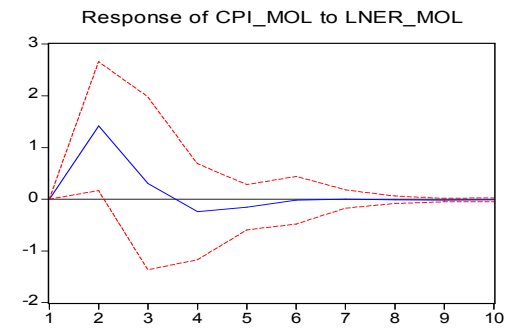
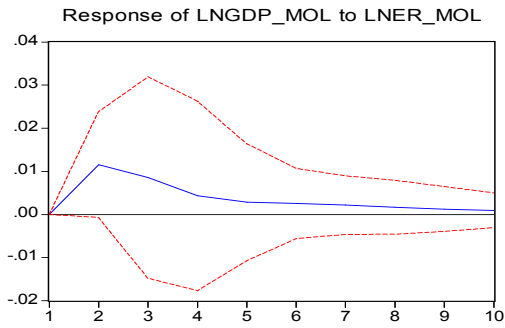


Figure 16: Response of GDP and CPI to Exchange Rate – Russia

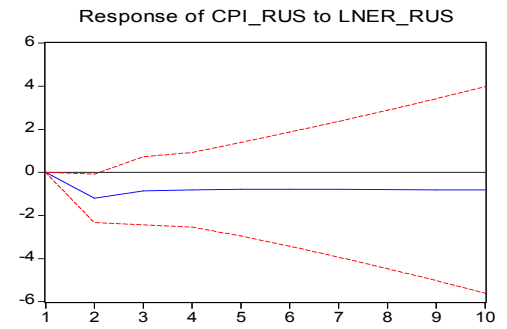
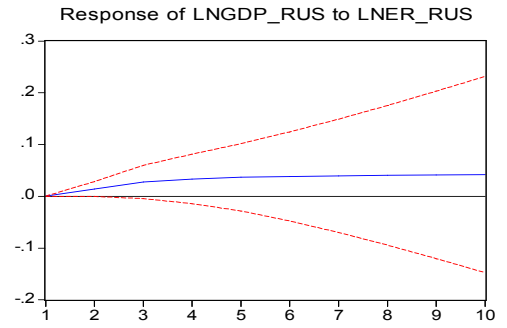


Figure 17: Response of GDP and CPI to Exchange Rate – Tajikistan

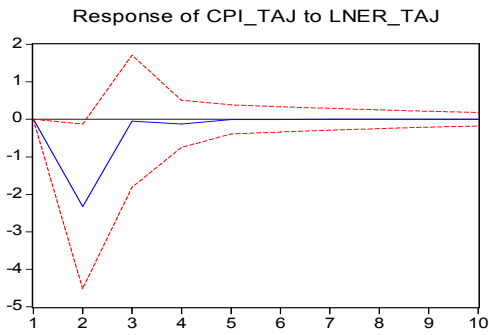
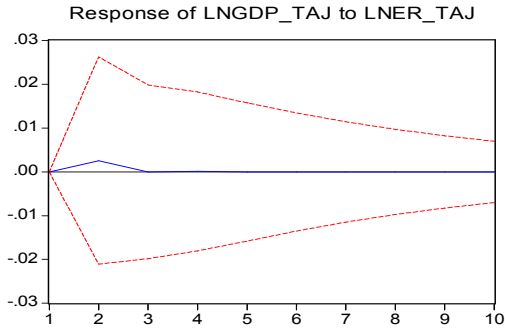


Figure 18: Response of GDP and CPI to Exchange Rate – Ukraine

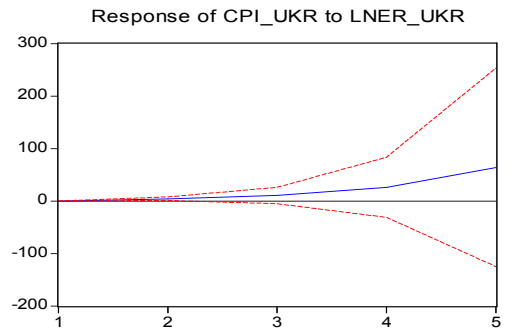
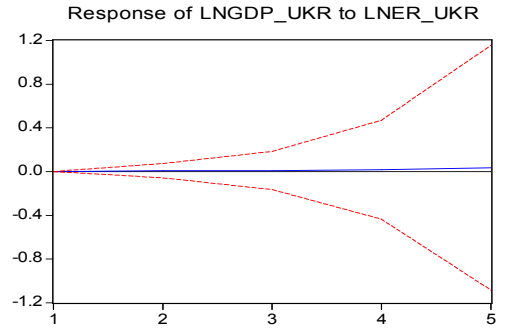


Figure 19: Response of GDP and CPI to Wages and M2 – Armenia

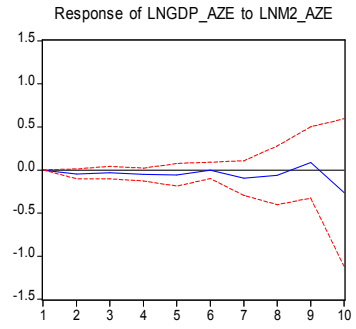
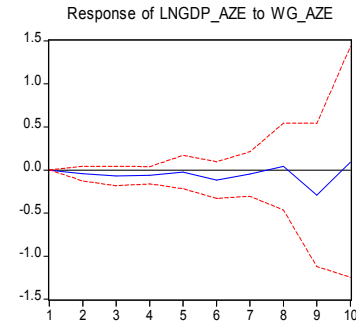
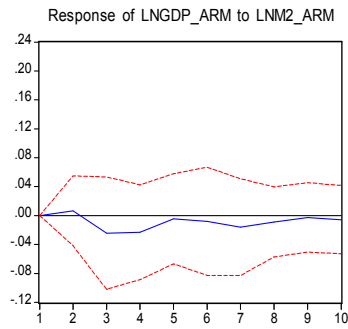
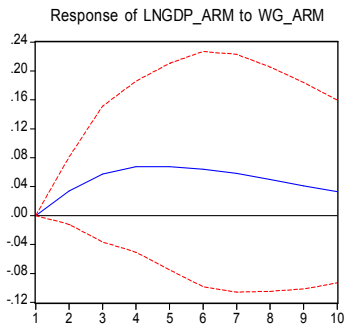


Figure 20: Response of GDP and CPI to Wages and M2 – Azerbaijan

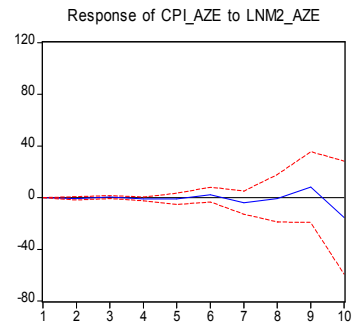
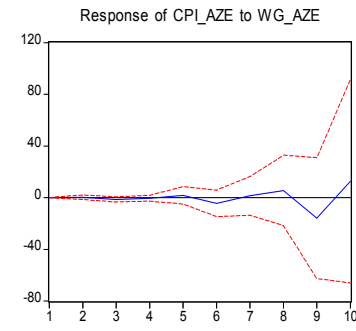
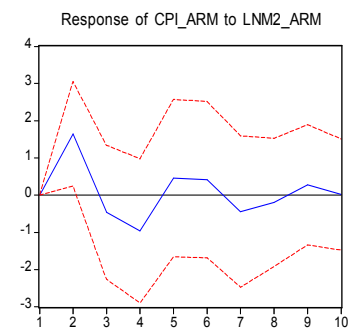
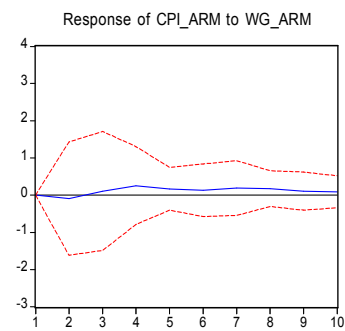


Figure 21: Response of GDP and CPI to Wages and M2 – Belarus

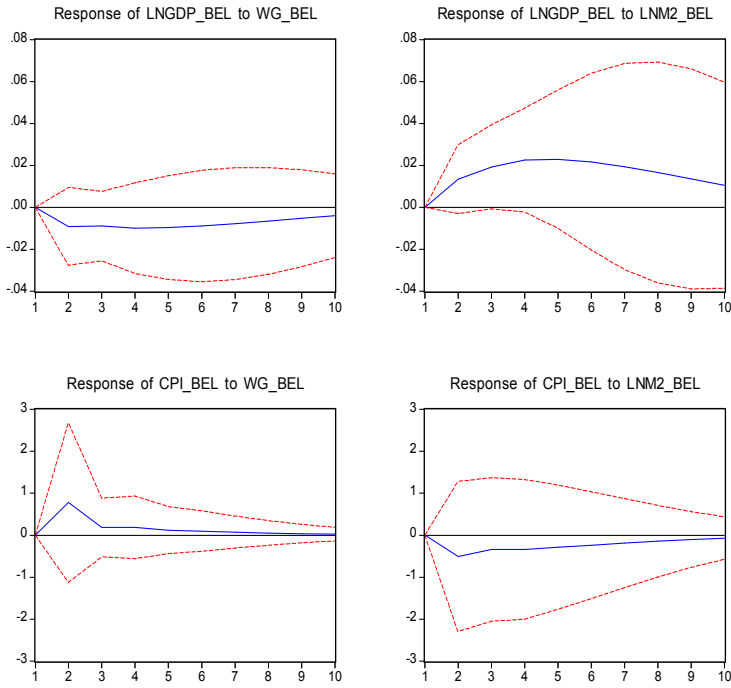


Figure 22: Response of GDP and CPI to Wages and M2 – Kazakhstan

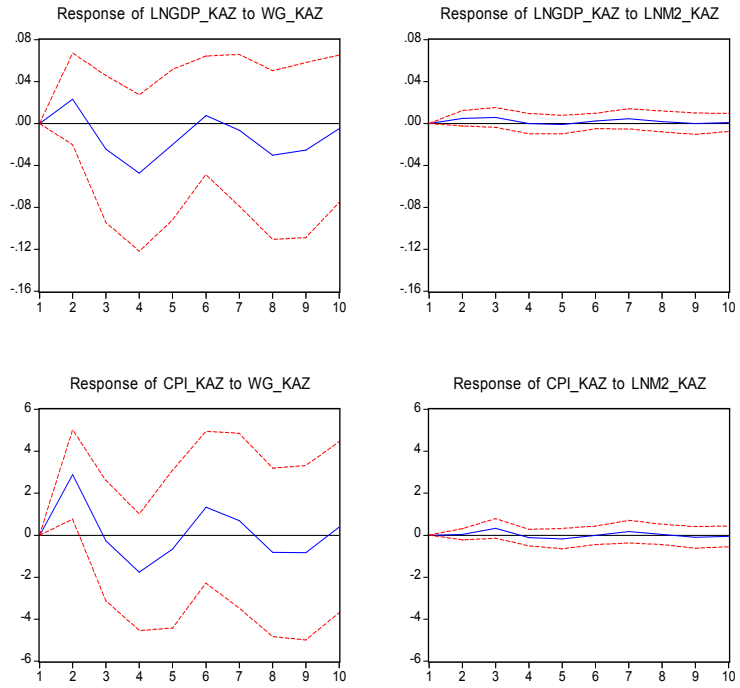


Figure 23: Response of GDP and CPI to Wages and M2 – Kyrgyzstan

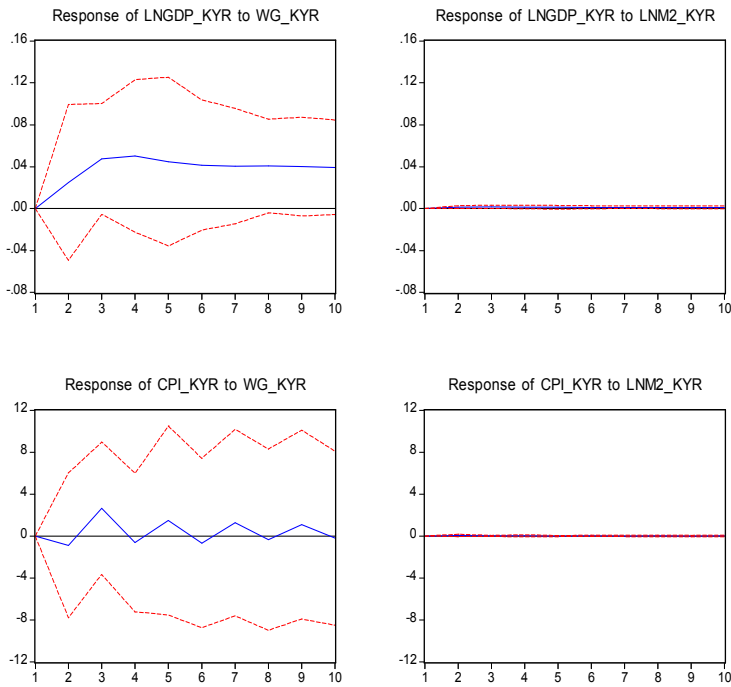


Figure 24: Response of GDP and CPI to Wages and M2 – Moldova

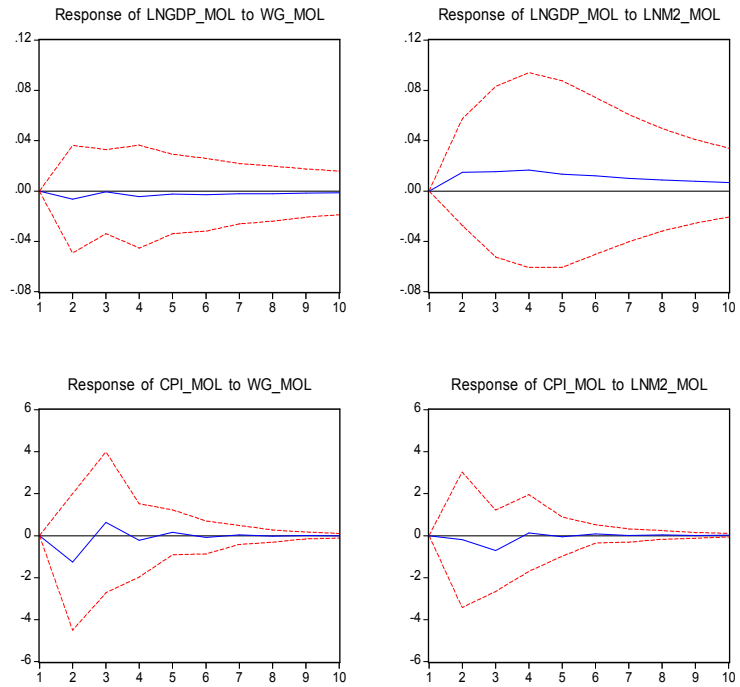


Figure 25: Response of GDP and CPI to Wages and M2 – Russia

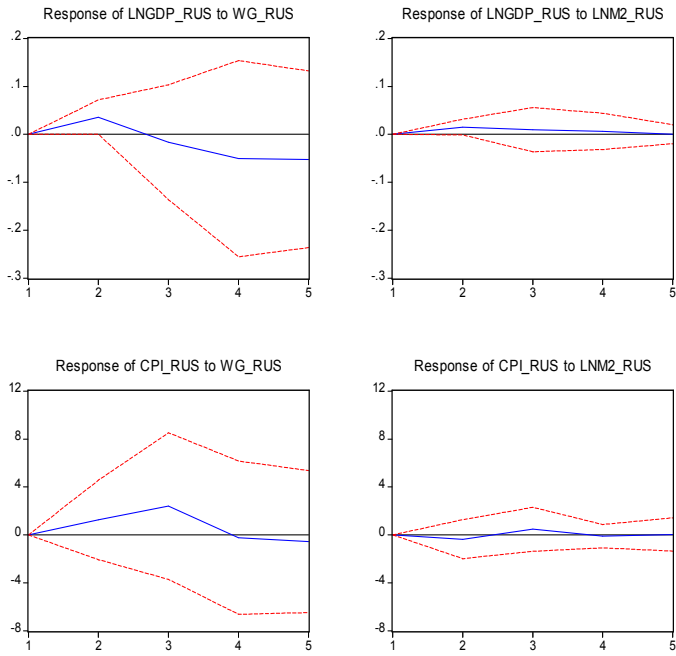


Figure 26: Response of GDP and CPI to Wages and M2 – Tajikistan

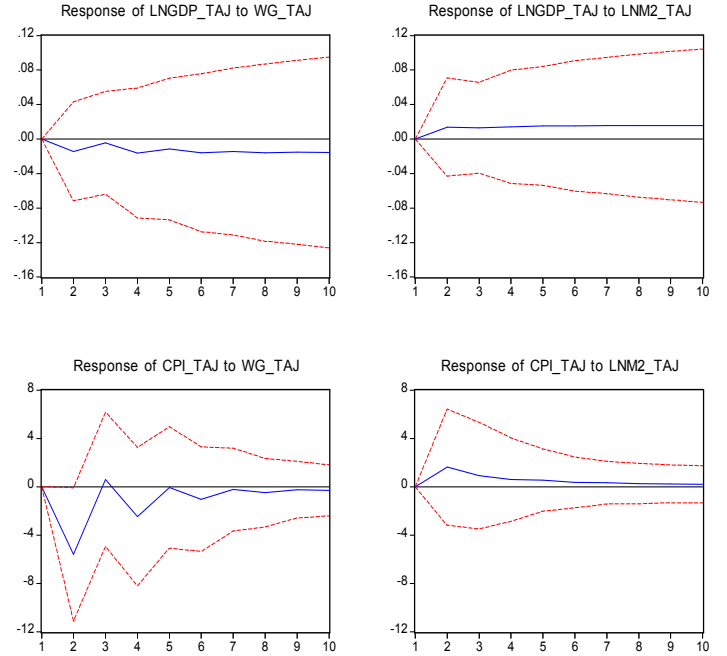


Figure 27: Response of GDP and CPI to Wages and M2 – Ukraine

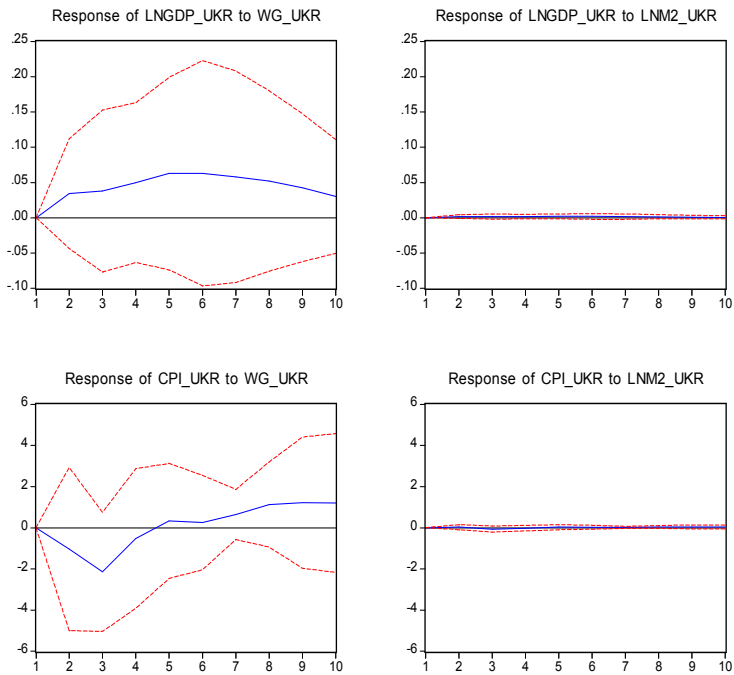


Figure 28: Response of GDP and CPI to Deposit and Lending Interest Rates – Armenia

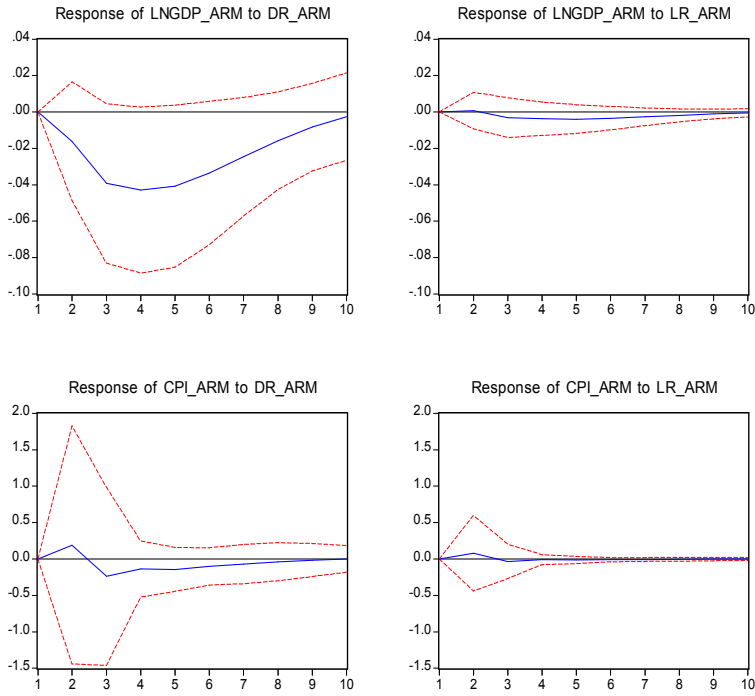


Figure 29: Response of GDP and CPI Deposit and Lending Interest Rates– Azerbaijan

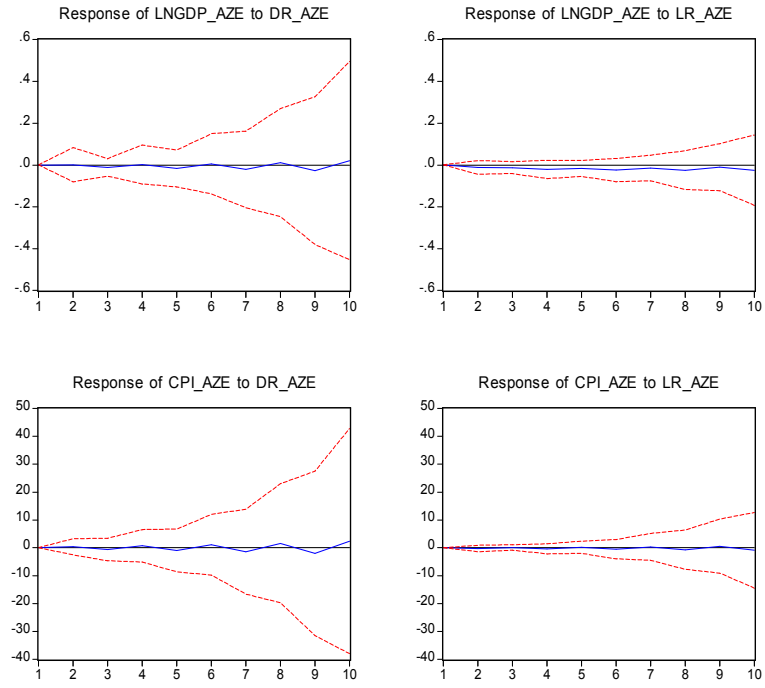


Figure 30: Response of GDP and CPI to Deposit and Lending Interest Rates – Belarus

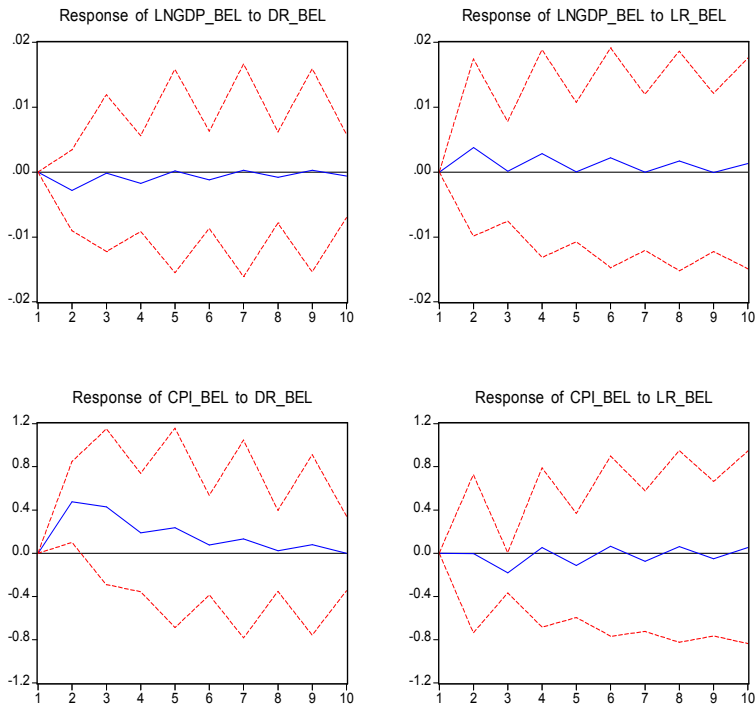


Figure 31: Response of GDP and CPI Deposit and Lending Interest Rates– Kazakhstan

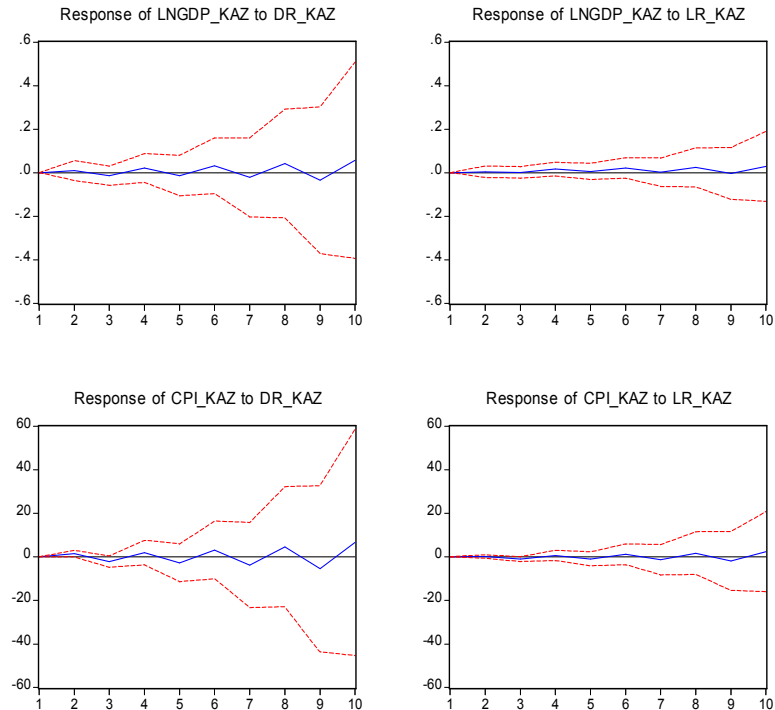


Figure 32: Response of GDP and CPI to Deposit and Lending Interest Rates – Kyrgyzstan

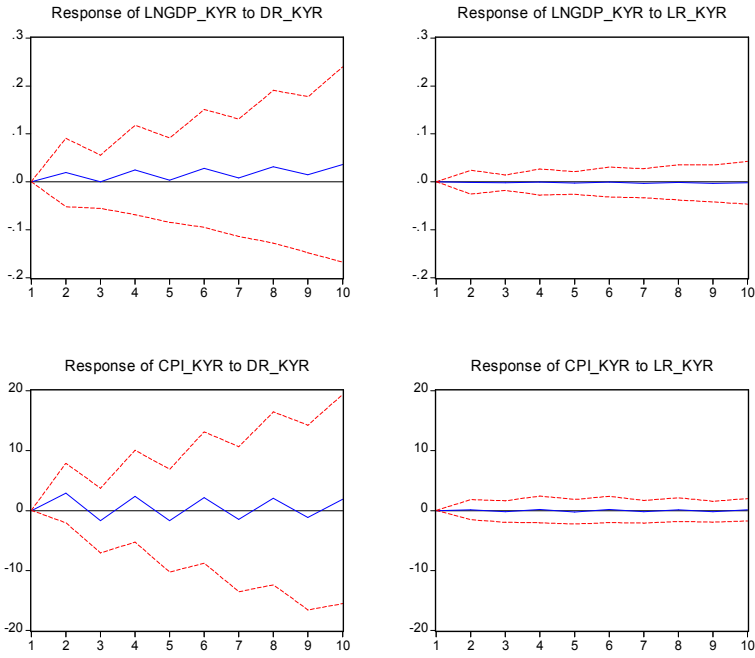


Figure 33: Response of GDP and CPI Deposit and Lending Interest Rates– Moldova

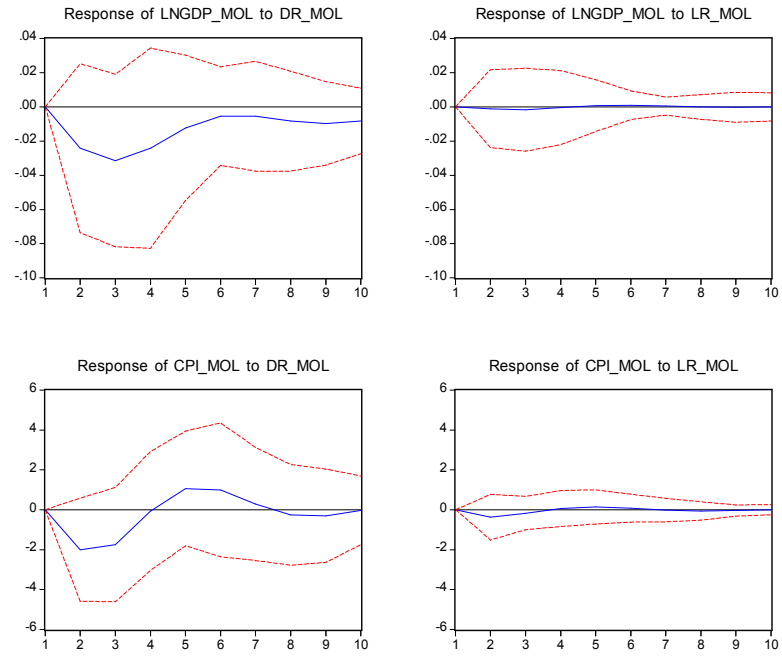


Figure 34: Response of GDP and CPI to Deposit and Lending Interest Rates – Russia

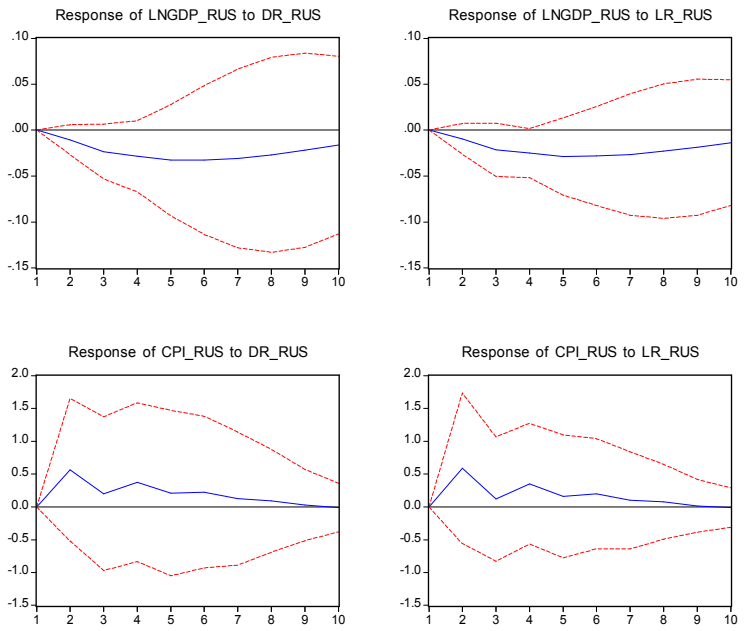


Figure 35: Response of GDP and CPI Deposit and Lending Interest Rates– Tajikistan

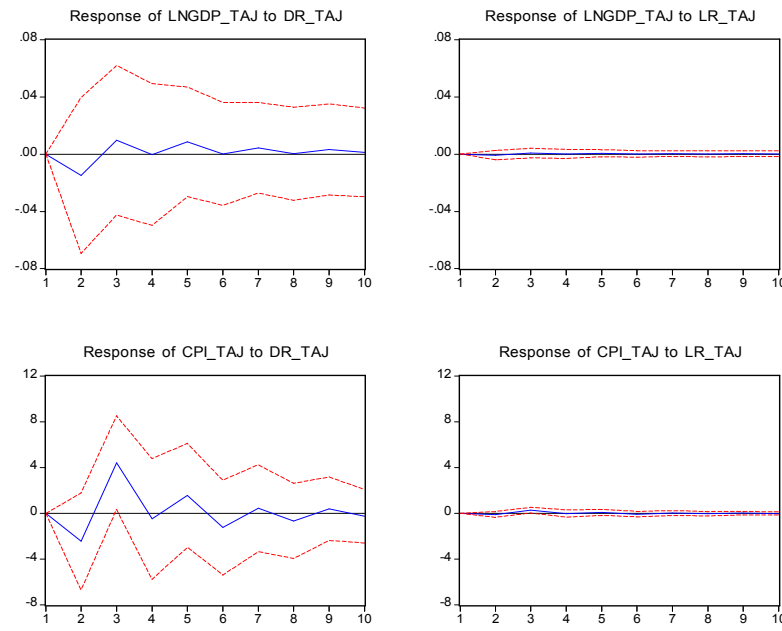


Figure 36: Response of GDP and CPI to Deposit and Lending Interest Rates – Ukraine

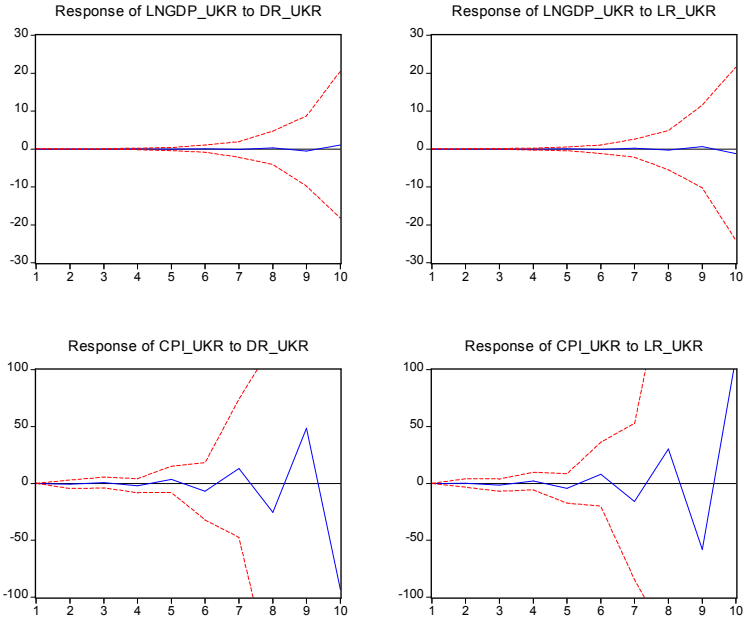


Table 1: Data Sources and Description

Indicator	Source and Description	Transmission Channel
Consumer Price Index (CPI)	Source: OECD, National Bureaus of Statistics; Format: Nominal, Annual Average; in %	Macro Variable
Gross Domestic Product (GDP)	Source: CIS Stats; Format: Nominal, Domestic Currency; LN Transformation	Macro Variable
Refinancing Rate (RR)	Source: OECD, National Central Banks; Format: 6-month Rates, End-Year; in %	Interest Rate Channel
Federal Funds Rate (FFR)	Source: St. Louis Federal Reserve Bank Online Database; Format: Effective Federal Funds Rate, nominal, End-Year; in %	Interest Rate Channel (Exogenous)
Lending Rate (LR)	Source: OECD, National Central Banks; Format: End-Year, Average Lending Rate; in %	Bank Lending Channel
Deposit Rate (DR)	Source: OECD, National Central Banks; Format: End-Year, Average Lending Rate; in %	Bank Lending Channel
Wage Growth Rate (WG)	Source: OECD, National Central Banks; Format: Gross Average Monthly Earnings, Percent Change; in %	Monetary Channel
Monetary Base (M2)	Source: CIS Stats; Format: Nominal, End-of-year, LN Transformation	Monetary Channel
Exchange Rate (ER)	Source: OECD; Format: Domestic Currency per 1 US Dollar, End-of-Year, LN Transformation	Exchange Rate Channel
Remittances (REM)	Source: World Bank Remittances Factbook 2008, 2011; Format: Total Inward Remittance Flow, in USD, Nominal, LN Transformation	Exchange Rate Channel (Exogenous)
Oil Prices (OILP)	Source: St. Louis Federal Reserve Bank Online Database; Format: Spot price per barrel, in USD, Annual-Average	Exchange Rate Channel (Exogenous)

Table 2: Long-run ARDL Estimates of the Channels of Monetary Transmission in individual CIS countries

	Dependent Variable	Interest Channel	Banking Channel		Monetary Channel		Exchange Rate Channel	
		RR	LR	DR	M2	WG	ER	REM
Armenia	GDP	-0.03241	-0.10789	0.003136	0.49321	0.012336	-6.7442	1.1154
	CPI	-0.13305	0.029878	-0.27944	1.1926	0.10831	9.2648	-0.67652
Azerbaijan	GDP	-1.0749	0.32143	-0.086	0.77205	-0.02417	-0.77127	0.42941
	CPI	4.2079	1.5718	0.091337	4.2565	-10.3781	-0.12487	1.5576
Belarus	GDP	0.027193	-0.2526	0.33208	0.61478	0.004057	0.91783	0.08743
	CPI	1.0724	-2.5356	5.1889	-10.7729	0.16538	-3.4737	-1.7363
Kazakhstan	GDP	0.12968	-0.1591	0.018284	0.60873	0.005028	-12.2264	-1.2213
	CPI	2.8766	2.135	-0.40912	1.4938	0.53666	-19.9	-27.925
Kyrgyzstan	GDP	-0.20092	0.090923	-0.23863	0.41251	0.028863	8.5998	3.5021
	CPI	1.998	-0.31599	-0.01535	2.2517	0.75434	12.5628	-4.1365
Moldova	GDP	0.12351	-0.6562	0.17436	0.68782	0.013584	5.1249	-0.16673
	CPI	1.2194	-10.9836	1.9765	1.2155	-0.31324	8.1786	0.16672
Russia	GDP	-0.08053	-0.16297	0.10564	0.66078	0.001362	2.055	0.44869
	CPI	0.64986	1.661	-1.1322	-1.7035	0.27264	-6.7306	-11.3705
Tajikistan	GDP	-0.39436	-0.37563	-0.39966	0.63523	0.030577	5.4776	-0.10471
	CPI	1.5514	-1.3845	-2.2224	4.7645	0.15076	10.9657	-15.8348
Ukraine	GDP	0.19143	0.12031	1.8635	0.70479	0.018636	-29.7124	-9.598
	CPI	3.4232	-0.60575	2.3894	14.4865	-0.70358	35.0952	4.5702

Note: RR – refinancing rate, LR – lending rate, DR – deposit rate, M2 – broad monetary base, WG – annual wage growth, ER – exchange rate, REM – remittances. Bold formatting indicates statistical significance of the coefficient at the 5% level. For example, the impact of the refinancing rate on the CPI of Azerbaijan is **4.2079**: statistically significant at the 5% level.

Table 3: Panel Fixed Effects Estimates for the GDP Determinants in the CIS

Dependent Variable: LN_GDP

Method: Panel Least Squares

Sample: 2000 2009

Cross-sections included: 7

Total panel (balanced) observations: 70

White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.473668	0.455185	5.434422	0.0000
LN_ER	0.390588	0.106693	3.660861	0.0006
LN_M2	0.659864	0.014310	46.11061	0.0000
WG	-0.000358	0.000793	-0.451608	0.6533
DR	-0.001239	0.004514	-0.274427	0.7848
LR	0.008848	0.005782	1.530349	0.1316
RR	-0.003931	0.003813	-1.030912	0.3070
LN_REM	0.013141	0.014203	0.925220	0.3588

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.998682	Mean dependent var	8.797067
Adjusted R-squared	0.998376	S.D. dependent var	2.057362
S.E. of regression	0.082903	Akaike info criterion	-1.965434
Sum squared resid	0.384883	Schwarz criterion	-1.515735
Log likelihood	82.79019	F-statistic	3264.478
Durbin-Watson stat	1.979005	Prob(F-statistic)	0.000000

Note: RR- refinancing rate; DR – deposit rate; LR – lending rate; WG – nominal wage growth rate; LN_ER – natural log of the exchange rate vis-à-vis US Dollar; LN_M2 – natural log of the broad monetary base; LN_REM – natural log of the flow of remittances in USD.

Table 4: Panel Fixed Effects Estimates for the Inflation Determinants in the CIS

Dependent Variable: CPI

Method: Panel Least Squares

Sample (adjusted): 2001 2009

Cross-sections included: 7

Total panel (balanced) observations: 63

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-41.15838	21.20753	-1.940743	0.0582
CPI1	0.036606	0.046927	0.780072	0.4392
RR	0.699298	0.127161	5.499297	0.0000
DR	0.266550	0.288744	0.923137	0.3606
LR	0.075246	0.231706	0.324748	0.7468
WG	0.202738	0.056461	3.590758	0.0008
LN_ER	3.030569	4.244551	0.713991	0.4787
LN_M2	1.287421	0.806225	1.596851	0.1169
LN_REM	2.040335	0.790227	2.581962	0.0129

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.926820	Mean dependent var	10.56206
Adjusted R-squared	0.905476	S.D. dependent var	9.687898
S.E. of regression	2.978514	Akaike info criterion	5.224983
Sum squared resid	425.8343	Schwarz criterion	5.735253
Log likelihood	-149.5870	F-statistic	43.42291
Durbin-Watson stat	2.200179	Prob(F-statistic)	0.000000

Note: CPI1 indicates inflation inertia, i.e. the lag of CPI(-1); RR- refinancing rate; DR – deposit rate; LR – lending rate; WG – nominal wage growth rate; LN_ER – natural log of the exchange rate vis-à-vis US Dollar; LN_M2 – natural log of the broad monetary base; LN_REM – natural log of the flow of remittances in USD.