VAR Analysis of the Monetary Transmission Mechanism in Kyrgyzstan

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Abstract

This article examines the effects of monetary transmission on real output and price level in Kyrgyzstan which is very important issue for central banks. We analyzed the relationships between the money supply, real output, price level, interest rate, credit and real exchange rate by using the vector autoregression approach (VAR) and monthly data for 2003-2011. As a result the interest rate channel remains weak, on the other hand it have been revealed that the credit channel has some affects to real output, the exchange rate channel affects the prices. Exchange rate channel remains still the most effective channel. Based on these results, it can be argued that government can use credit and interest rate channel in increasing real output, and the exchange rate channel in achieving price stability in Kyrgyzstan.

Keywords: Monetary policy, transmission mechanism, vector autoregression, Kyrgyzstan
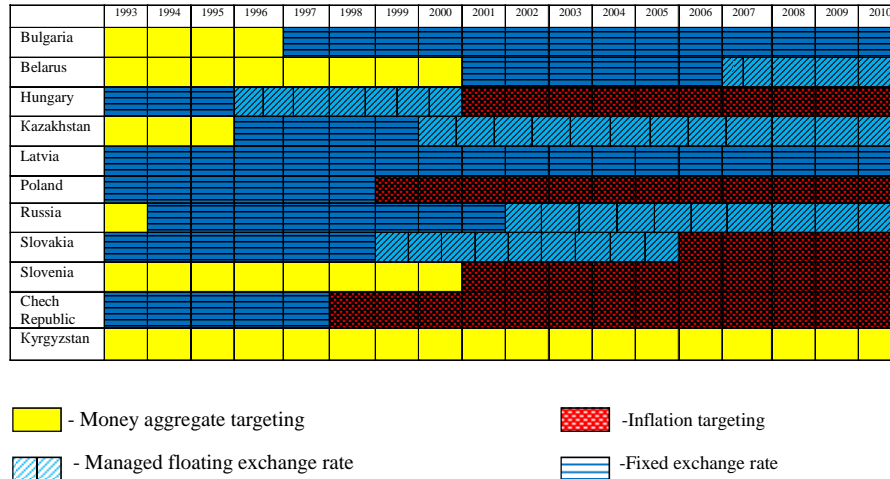
JEL Code Classification: E51, E52, E58, O40

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1. Introduction

Political and economic transition proved to be difficult and challenging process in Kyrgyzstan (Kurmanalieva, 2008:85). Kyrgyzstan was the pioneer country in Central Asia who introduced national currency and started independent monetary policy. The primary objective of the National Bank of Kyrgyz Republic (NBKR) as defined in the law of NBKR in 1992 (1997) is to maintain price stability and to assist economic growth. For 20 years NBKR has not changed the monetary policy target which is monetary aggregates as seen in Figure 1.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Bulgaria																		
Belarus																		
Hungary																		
Kazakhstan																		
Latvia																		
Poland																		
Russia																		
Slovakia																		
Slovenia																		
Chech Republic																		
Kyrgyzstan																		

- Money aggregate targeting　　　-Inflation targeting

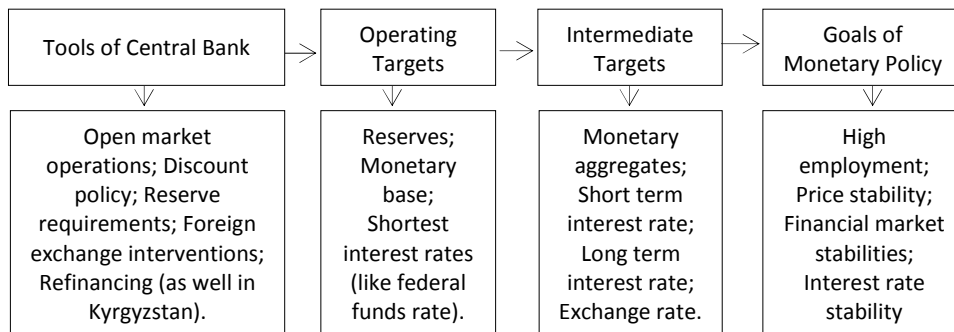- Managed floating exchange rate　　　-Fixed exchange rate

Figure 1: Evolution of regimes of monetary policy within the transition economies countries

When the neighbor and other CIS countries were adopted different targets because of change the world economy, global financial crises and financial integrations. At the beginning and mid 1990 Central Bank of Kyrgyz Republic succeeded in stabilizing prices by managing high inflation process. Since 2000 in Kyrgyz Republic globalization and high degree of dollarization changes the demand and money supply in money market which make monetary policy limited. We go on to analyze the transmission mechanisms of monetary policy and evaluate the empirical evidence on them to understand better the role of the monetary policy in the Kyrgyz Republic.

By using tools the central bank can regulate the monetary base and reserves to aim for change money supply, which have impact on macroeconomic process. The strategy in Kyrgyz Republic is written in red as seen in Figure 2. Which are as final goal of monetary policy is price stability, intermediate target is monetary aggregate, and operating target is monetary base, also NBKR has all arsenal tools of monetary policy. To find out the efficiency of monetary policy we will start from analyzing the link between monetary targets and price stability.

The advantages of monetary targets are that: first monetary targets can send almost immediate signals to both the public and markets about the stance of monetary policy to keep inflation in check. Second monetary targets promote almost immediate accountability for monetary policy to keep inflation low and so constrain the monetary policymaker from falling into the time-inconsistency trap. The advantages of monetary aggregate targeting will work if there will be a strong and reliable relationship between the goal variable (price stability) and the targeted aggregate and if targeted monetary aggregate must be well controlled by the central bank. If the relationship between the monetary aggregate and the goal variable is weak, or the weak control of money supply than monetary aggregate targeting will not work. By the VAR approach analyzes results shows on a Figure 2 that the monetary aggregate does not impact to inflation and output.

Tools of Central Bank	Operating Targets	Intermediate Targets	Goals of Monetary Policy
Open market operations; Discount policy; Reserve requirements; Foreign exchange interventions; Refinancing (as well in Kyrgyzstan).	Reserves; Monetary base; Shortest interest rates (like federal funds rate).	Monetary aggregates; Short term interest rate; Long term interest rate; Exchange rate.	High employment; Price stability; Financial market stabilities; Interest rate stability

Figure 2: Strategy of Central Bank

2. Literature

Many researches have been done on monetary transmission mechanism in developed and developing countries. Transmission mechanism studies in USA has been done by Bernanke and Blinder (1992), Bernanke and Garter (1995). Kakes (1998) in Holland; Hsing (2004) in Argentine; Morsink and Bayoumi (2001) in Japan; Chow (2004) Singapore; Drobyshewsky (2008) in Russia, in Turkey the transmission mechanism researches have been done by Cavusoglu (2002), Seyrek (2004) and Gunduz (2001) but they had different results. According to Ornek (2009) monetary transmission mechanism impact to real GDP was mainly through the interest rate channel. And the exchange rate channel was efficient as well but the asset and bank lending channels were insignificant. In Kyrgyzstan before has not been done any study on transmission mechanism on monetary policy.

3. Data and Methodology

We use seasonally adjusted data from 2003/01 to 2012/12 to study the monetary transmission mechanism empirically in Kyrgyz Republic. The dataset included the following variables:

    gdp: Real Gross Domestic (2000 base year price);
    cpi: Consumer Price Index;
    m2: Monetary Aggregate (mill. som);
    er: Nominal Exchange Rate of USA dollar;
    irate: Average Interest Rate of given credits by commercial banks;
    credit: Volume of given credits by commercial banks (mill. som).

These variables are taken from the National Bank of Kyrgyz Republic and the National Statistic Committee.

To eliminate the spurious regression problem we use Augmented Dickey Fuller test where we get all variables stationary by their logarithm and first-differences as shown in Table 1.

Table 1: ADF Unit Root Test' Results

Variable	Level			Variable	First Differences		
	Lags	t-value	p-value		Lags	t-value	p-value
lgdp_sa	0	-4,94*	0,000	-	-	-	-
lcpi	0	-6,36*	0,000	-	-	-	-
lm2	0	-0,69	0,841	dlm2	0	-10,51*	0,000
Ler	1	-1,40	0,578	dler	0	-6,39*	0,000
lirate	4	-2,24	0,193	dlirate	0	-8,59*	0,000
lcredit	0	-0,11	0,994	dlcredit	0	-7,74*	0,000

Note: All of these tests include only a constant term as an exogenous variable.
* indicates stationarity on the 1% level.

Akaike (AIC) and Schwarz (SC) information criteria suggested same optimal one lag lengths in the basic model and other transmission channels for VAR model as seen in Table 2.

In this paper first analyzed the Granger causality tests in order to estimate VAR model regarding to methodology. The order of the variables is based on the assumption that shock to the money supply would be transmitted through the transmission channels to the price level and output as shown in Figure 3 below.
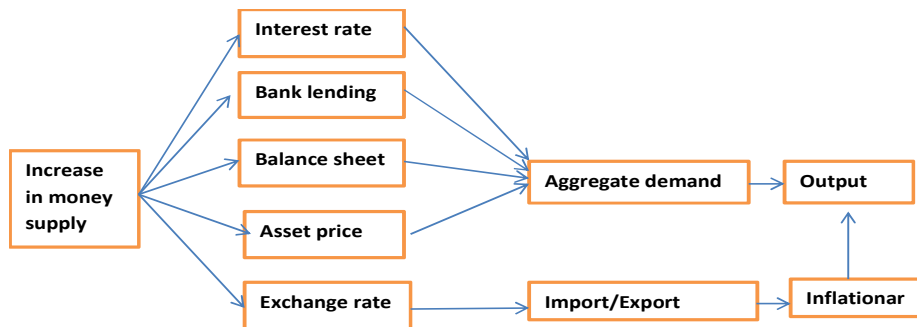
Figure 3: Transmission mechanism of monetary policy

Table 2. Lag Length Selection of the Basic and Extended Models

Lag	LogL	LR	FPE	AIC	SC	HQ
			Basic Model			
0	534.6561	NA	1.13E-09	-12.08309	-11.99864	-12.04907
1	557.0024	42.66117	8.38E-10*	-12.38642*	-12.04860*	-12.25032*
2	563.7864	12.48864	8.82E-10	-12.33605	-11.74487	-12.09788
3	568.4276	8.227602	9.76E-10	-12.23699	-11.39244	-11.89674
4	570.9536	4.305591	1.13E-09	-12.08985	-10.99194	-11.64753
5	579.0912	13.31616	1.16E-09	-12.07025	-10.71898	-11.52586
6	590.4365	17.79148*	1.11E-09	-12.12356	-10.51892	-11.47709
			Interest rate channel			
0	815.1338	NA	1.16E-13	-18.43486	-18.32225*	-18.38949
1	843.4265	53.37020*	8.77E-14	-18.71424*	-18.15121	-18.48741*
2	855.6055	21.86688	9.58E-14	-18.62740	-17.61394	-18.21910
3	867.6927	20.60326	1.05E-13	-18.53847	-17.07459	-17.94871
4	872.7713	8.194978	1.37E-13	-18.29026	-16.37595	-17.51903
5	888.3788	23.76592	1.40E-13	-18.28134	-15.91660	-17.32864
6	902.1513	19.71976	1.52E-13	-18.23071	-15.41556	-17.09656
			Bank lending channel			
0	707.0400	NA	1.35E-12	-15.97818	-15.86558*	-15.93282
1	732.8603	48.70645	1.08E-12*	-16.20137*	-15.63834	-15.97454*
2	745.2460	22.23802	1.18E-12	-16.11923	-15.10577	-15.71093
3	752.1147	11.70808	1.46E-12	-15.91170	-14.44782	-15.32194
4	758.4528	10.22726	1.84E-12	-15.69211	-13.77780	-14.92088
5	768.8381	15.81396	2.12E-12	-15.56450	-13.19977	-14.61181
6	788.0169	27.46058*	2.03E-12	-15.63675	-12.82159	-14.50259
			Exchange rate channel			
0	772.3646	NA	3.06E-13	-17.46283	-17.35023*	-17.41747
1	806.3532	64.11492	2.04E-13*	-17.87166*	-17.30863	-17.64483*
2	817.8841	20.70317	2.26E-13	-17.77009	-16.75664	-17.36180
3	827.3776	16.18210	2.63E-13	-17.62222	-16.15834	-17.03246
4	836.0876	14.05474	3.14E-13	-17.45654	-15.54223	-16.68531
5	850.5435	22.01242	3.31E-13	-17.42144	-15.05671	-16.46875
6	871.0580	29.37300*	3.07E-13	-17.52404	-14.70889	-16.38989

Note: * indicates lag order selected by the criterion; LR: sequential modified; LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

4. Basic Model

The test indicates that in a basic model monetary aggregate has an insignificant Granger effect on output and on price level. An extended model Granger causality test results are as seen in Table 3.

As monetary theory suggests that an increase in money supply leads to an increase in price level and an increase in real output. However in a basic model the Granger causality test showed above Table 3 that money doesn't statistically significant Granger cause output and price.

**Table 3: Pair wise Granger Causality Tests**

Null Hypothesis:			
DLCREDIT does not Granger Cause LGDP_SA	94	2.84597	*0.06338****
LGDP_SA does not Granger Cause DLCREDIT		0.42875	0.65266
DLIRATE does not Granger Cause LGDP_SA	94	0.85340	0.42942
LGDP_SA does not Granger Cause DLIRATE		0.51616	0.59858
DLER does not Granger Cause LGDP_SA	94	2.82669	*0.06454****
LGDP_SA does not Granger Cause DLER		2.01857	0.13888
DLM2 does not Granger Cause LGDP_SA	94	1.39606	0.25294
LGDP_SA does not Granger Cause DLM2		0.50007	0.60818
LCPI does not Granger Cause LGDP_SA	94	0.40236	0.66995
LGDP_SA does not Granger Cause LCPI		2.22512	0.11403
DLIRATE does not Granger Cause DLCREDIT	105	0.19195	0.82565
DLCREDIT does not Granger Cause DLIRATE		0.88012	0.41792
DLER does not Granger Cause DLCREDIT	105	4.46397	*0.01390***
DLCREDIT does not Granger Cause DLER		3.70892	*0.02794***
DLM2 does not Granger Cause DLCREDIT	105	0.58240	0.56044
DLCREDIT does not Granger Cause DLM2		0.83187	0.43823
LCPI does not Granger Cause DLCREDIT	105	0.47759	0.62168
DLCREDIT does not Granger Cause LCPI		0.00480	0.99521
DLER does not Granger Cause DLIRATE	105	0.27480	0.76029
DLIRATE does not Granger Cause DLER		3.14923	*0.04717***
DLM2 does not Granger Cause DLIRATE	105	3.42829	*0.03630***
DLIRATE does not Granger Cause DLM2		0.16146	0.85112
LCPI does not Granger Cause DLIRATE	105	1.63921	0.19931
DLIRATE does not Granger Cause LCPI		0.32988	0.71979
DLM2 does not Granger Cause DLER	105	0.34358	0.71006
DLER does not Granger Cause DLM2		1.69362	0.18908
LCPI does not Granger Cause DLER	105	0.43956	0.64556
DLER does not Granger Cause LCPI		2.94812	*0.05701****
LCPI does not Granger Cause DLM2	105	0.12540	0.88228
DLM2 does not Granger Cause LCPI		0.48606	0.61649

Note: *, **, and *** denote rejection of the null at the 1%, 5%, and 10% levels, respectively.

4.1. Impulse Responses

Impulse response functions indicating the impact of variables on price and output as seen in Figure 4, with the dotted lines representing ±2 standard error confidence intervals and on horizons given 15 month period. The results using impulse response functions conform to those of the Granger analysis. A one – standard deviation shock to the monetary aggregate effect on prices and real output statistical insignificant. However the reaction of price to monetary aggregate shock is negative but the reaction of real output is positive. One – standard deviation monetary shock on price as shown in Figure 4 impact last between 1 to 5 months and gradually effect disappears in 6th month. Monetarist's way at looking at increase on money supply leads to inflation has not been confirmed by our

analyses because of high level of dollarization. But the monetary view on money supply leads to increase output confirmed by the impulse response function, which as shown peaking after first month gradually declines after 6th month.

Response to Cholesky One S.D. Innovations ± 2 S.E.
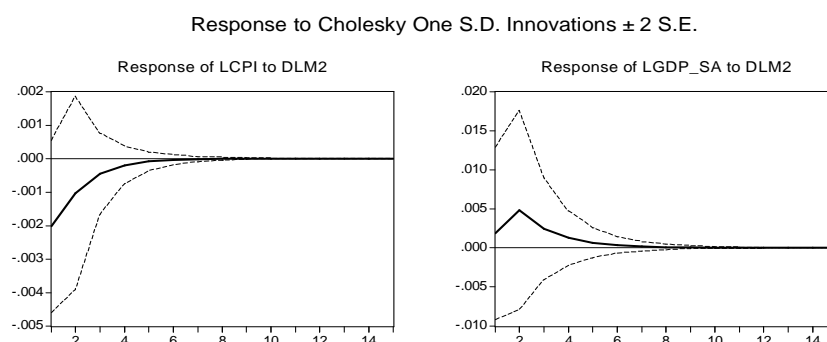
Figure 4: Impulse response function for the Basic Model

The variance decomposition demonstrates that money shock is account for 2.75% in price while own shocks account for 97% and money supply account for 0.86% in output while own shock account for 99% as seen in Table 4.

Transmission channels of monetary transmission mechanism transfers through the extended channels as: interest rate channel; bank lending channel; exchange rate channel; asset price channel and balance sheet channel. Because of undeveloped capital market and opaque corporate accounting we will not consider the last two channels which are asset price and balance sheet channels.

Table 4: Basic Model Variance Decomposition (%)

Variance Decomposition of LCPI:			
Period	S.E.	DLM2	LCPI	LGDP_SA
3	0.013990	2.749360	97.24572	0.004924
6	0.014038	2.755443	97.23821	0.006351
9	0.014038	2.755502	97.23809	0.006412
12	0.014038	2.755502	97.23808	0.006414
15	0.014038	2.755502	97.23808	0.006414
Variance Decomposition of LGDP_SA:			
Period	S.E.	DLM2	LCPI	LGDP_SA
3	0.062841	0.823204	0.005150	99.17165
6	0.063488	0.860534	0.005489	99.13398
9	0.063500	0.861273	0.005502	99.13322
12	0.063501	0.861288	0.005503	99.13321
15	0.063501	0.861288	0.005503	99.13321
Cholesky Ordering: DLM2 LCPI LGDP_SA			

4.2. Interest Rate Channel

Traditional Interest Rate channel is the key monetary transmission mechanism in the Keynesian IS-LM model. In order to analyze the effect of the interest rate channel, we add the commercial banks interest rate for credits to the basic model. This permits us to consider how money supply impacts interest rate, how interest rates affect output and inflation. As shown on Figure 5 the monetary change impact to interest rate negatively as confirmed in theory. The monetary shock effect to interest rate remains only for 3 month. Interest rate shock impact to inflation and output negatively as anticipated and effect lasted for 2 month in a both cases.

Response to Cholesky One S.D. Innovations ± 2 S.E.
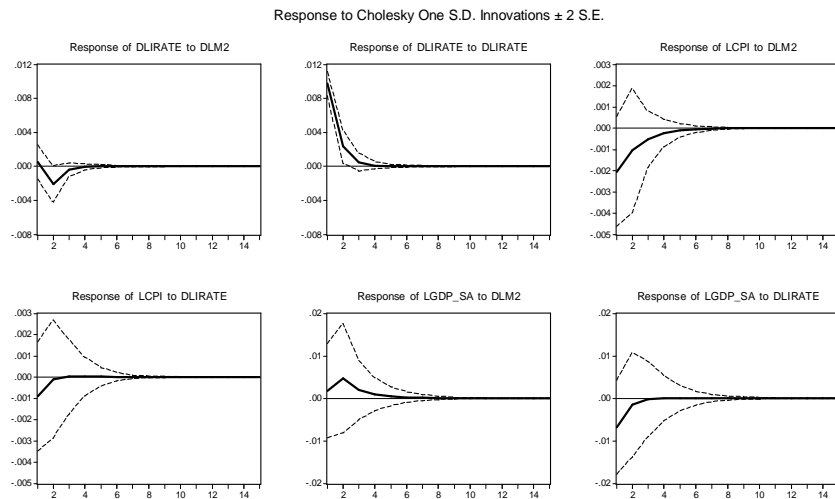
Figure 5. Impulse response functions to interest rate

The interest rate variance decomposition indicates innovations to money supply account for 4.3% of the fluctuation in interest rate as seen in Table 5. The decrease of interest rate increase output as seen in impulse response function than NBKR can increase output by increasing money supply though the interest rate channel.

In general interest rate channel in money transmission mechanism is not efficient. Due to these reasons: 1) there is no correlation between the discount rate and commercial banks interest rate; 2) because of weak competition between commercial banks interest rates are remains high and the low levels of financial intermediation and monetization (average given credit to GDP in 2003 – 2011 was 10.16%).

Table 5: Interest rate channel variance decomposition (%)

Variance Decomposition of DLIRATE:				
Period	S.E.	DLM2	DLIRATE	LCPI	LGDP_SA
3	0.037637	4.326201	93.61169	0.298499	1.763610
6	0.037644	4.308427	93.17064	0.313886	2.207052
9	0.037644	4.307919	93.15815	0.313997	2.219939
12	0.037644	4.307907	93.15782	0.313997	2.220271
15	0.037644	4.307907	93.15782	0.313997	2.220279
Variance Decomposition of LCPI:				
Period	S.E.	DLM2	DLIRATE	LCPI	LGDP_SA
3	0.010389	2.812959	0.421341	96.76428	0.001425
6	0.010414	2.828099	0.418822	96.75128	0.001804
9	0.010415	2.828196	0.418808	96.75110	0.001891
12	0.010415	2.828197	0.418807	96.75110	0.001896
15	0.010415	2.828197	0.418807	96.75110	0.001896
Variance Decomposition of LGDP_SA:				
Period	S.E.	DLM2	DLIRATE	LCPI	LGDP_SA
3	0.014065	0.747388	1.217593	0.008789	98.02623
6	0.014115	0.759533	1.190160	0.008679	98.04163
9	0.014116	0.759712	1.189495	0.008677	98.04212
12	0.014116	0.759716	1.189479	0.008677	98.04213
15	0.014116	0.759716	1.189478	0.008677	98.04213
Cholesky Ordering: DLM2 DLIRATE LCPI LGDP_SA				

Table 6: Bank Lending Variance Decomposition (%)

| Variance Decomposition of DLCREDIT:				
Period	S.E.	DLM2	DLCREDIT	LCPI	LGDP_SA
3	0.037637	2.599114	96.42528	0.932691	0.042916
6	0.037646	2.606114	96.30439	1.034956	0.054539
9	0.037646	2.606097	96.30324	1.035890	0.054769
12	0.037646	2.606096	96.30323	1.035896	0.054772
15	0.037646	2.606096	96.30323	1.035896	0.054773
Variance Decomposition of LCPI:				
Period	S.E.	DLM2	DLCREDIT	LCPI	LGDP_SA
3	0.037600	2.750957	0.369898	96.86696	0.012181
6	0.037629	2.754689	0.367589	96.86134	0.016386
9	0.037630	2.754739	0.367581	96.86110	0.016577
12	0.037630	2.754739	0.367581	96.86110	0.016582
15	0.037630	2.754739	0.367581	96.86110	0.016582
Variance Decomposition of LGDP_SA:				
Period	S.E.	DLM2	DLCREDIT	LCPI	LGDP_SA
3	0.014069	0.833562	6.375947	0.037113	92.75338
6	0.014116	0.879440	6.454955	0.036541	92.62906
9	0.014116	0.880374	6.456634	0.036573	92.62642
12	0.014116	0.880392	6.456665	0.036575	92.62637
15	0.014116	0.880393	6.456665	0.036575	92.62637
Cholesky Ordering: DLM2 DLCREDIT LCPI LGDP_SA				

4.3. Bank Lending Channel

Expansionary monetary policy increase bank reserves which increase the quantity of bank loans available. One – standard deviation bank lending shock impact on output statistically significant. The impulse response function positively effect on output as anticipated and remains for 6 month but effect on price insignificant as shown in Figure 6. Bank lending channel is more efficient than the interest rate channel.

The variance decomposition innovations to money supply account for 2.5% of the fluctuation in bank lending as seen in Table 6. Innovations to bank loan account for 6.7% of the fluctuation in output. Despite the low level of crediting economy by banks.

To increase the output in Kyrgyz Republic the NBKR can use the bank lending channel. The NBKR can improve the bank lending channel by implementing the discount loans and refinancing to increase the reserves of commercial banks. Nowadays average interest rate is 21% in Kyrgyz Republic which is very expensive. That is why loans are invests in a trade rather than in a real economy. The reasons for weak crediting the real economy are: 1) low integration of economic agents with the banking system; 2) creditworthiness of the economic agents is low due to opaque corporate accounting as they are not willing to show profitability of the company; 3) as an alternative source of financing for business serves remittances.
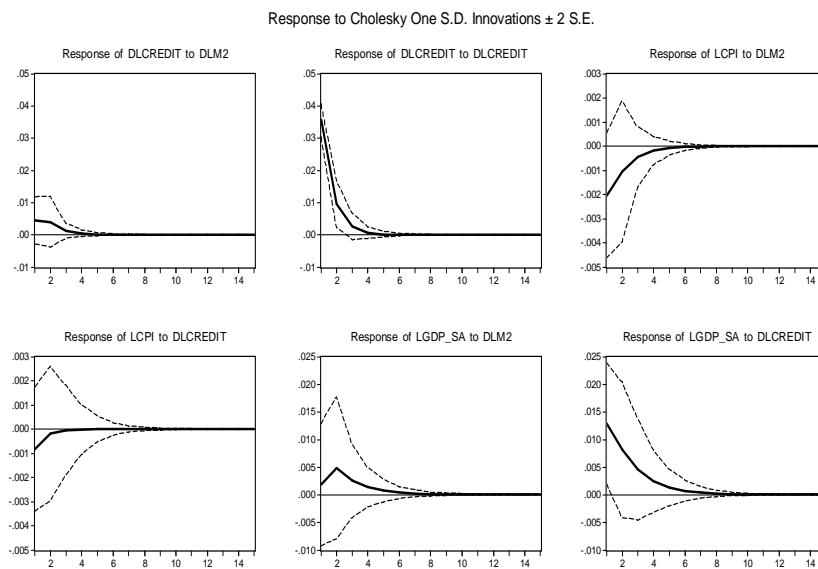
Figure 6: Impulse response functions to Bank lending channel

4.4. Exchange Rate Channel

The exchange rate channel is the most important transmission channel in small open economies with floating exchange rates. The nominal exchange rate shock impact on price significant but the impulse response function shows that the price first 2 month response negatively than between 3 to 10 months remains positively. The paradox situation can be explained by the huge exchange rate intervention by NBKR especially when the foreign currency (USA dollar) appreciates. In dollar appreciation NBKR sells the dollar for 2 months to smooth the price of dollar and that is why first two month response of price to nominal exchange rate is negative as shown in Figure 7.

Response to Cholesky One S.D. Innovations ± 2 S.E.
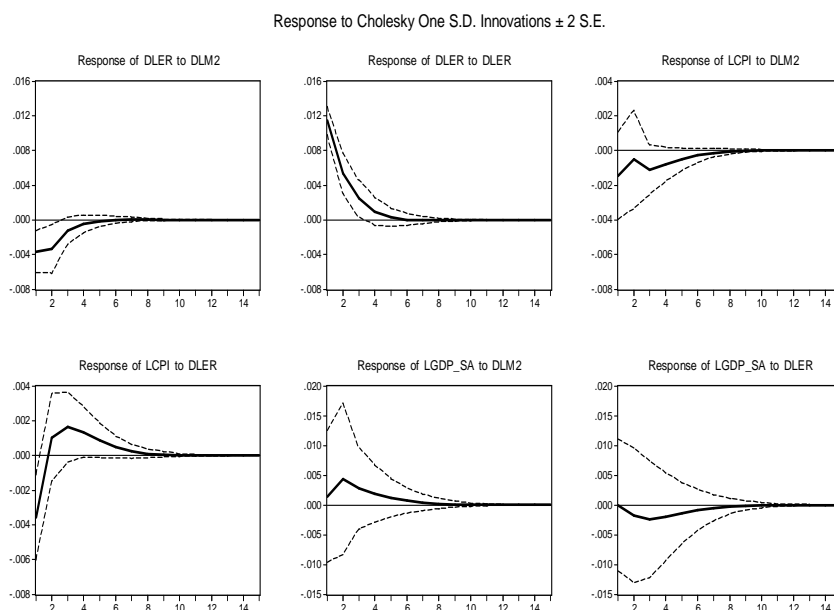
Figure 7: Impulse response functions to exchange rate channel

Variance decomposition shows that both the money supply and inflation were important sources of shocks in nominal exchange rate. Money supply accounted for 13.08% of the shocks in nominal exchange rate, where the price level accounted for 3.9% of the shock while own shock accounted for 82.26% as shown in Table 7.

The exchange rate transmission policy can be used as a price stabilization policy.

The main reason of importance exchange rate channel in Kyrgyz Republic: 1) high level of dollarization which is officially shows 23% and unofficially counted up to70% (saving account in foreign currency/ M2X). 2) Flouting exchange rate

regime. 3) Kyrgyz Republic is small open developing country which is highly dependent on imported products (more than 90% imported products to GDP).

Table 7: Exchange Rate Variance Decomposition (%)

Period	S.E.	DLM2	DLER	LCPI	LGDP_SA
Variance Decomposition of DLER:					
3	0.037602	13.15881	83.15405	3.088231	0.598904
6	0.037632	13.08316	82.28115	3.904297	0.731388
9	0.037633	13.08188	82.26951	3.915120	0.733492
12	0.037633	13.08191	82.26948	3.915114	0.733492
15	0.037633	13.08191	82.26948	3.915117	0.733492
Variance Decomposition of LCPI:					
3	0.014108	1.874016	8.482542	89.62000	0.023447
6	0.014223	2.322076	9.650395	87.93312	0.094409
9	0.014224	2.331724	9.677311	87.88691	0.104057
12	0.014224	2.331725	9.677285	87.88662	0.104368
15	0.014224	2.331726	9.677287	87.88661	0.104373
Variance Decomposition of LGDP_SA:					
3	0.013959	0.714337	0.231831	0.025884	99.02795
6	0.014118	0.832466	0.393013	0.027912	98.74661
9	0.014123	0.836902	0.401146	0.029913	98.73204
12	0.014123	0.836973	0.401271	0.030045	98.73171
15	0.014123	0.836973	0.401271	0.030048	98.73171
Cholesky Ordering: DLM2 DLER LCPI LGDP_SA					

5. Conclusion

In order to provide monetary policy in efficient way, the central bank should possess a thorough understanding of the monetary transmission mechanism. Our VAR approach analysis has found that the impact of monetary policy to inflation and economic activity is weak. Despite NBKR has come a long way in developing the whole arsenal instruments of monetary policy is still limited. Due to undeveloped capital market and opaque corporate accounting we could not include the asset price channel and balance sheet channel into our analyses. However we found the exchange rate channel statistically significant impact on inflation and bank lending channels statistically significant impact on output while the interest rate channel remains insignificant. Moreover we found in basic model analysis that inflation and output did not respond to money supply.

Interest rate channel limited due to these reasons: low level of monetization and financial intermediation; weak correlation between discount rate of NBKR and commercial bank lending rate; high level of foreign currency- denominated loans to the private sector further reduce the sensitivity of borrowers to domestic interest rate movements; low degree of competition between banks; huge amount of

capital inflow is driven by external financing and remittance money. Exchange rate channel efficient because of these reasons: high share of imports in GDP; economy of Kyrgyzstan highly dollarized and depends on remittance flows from abroad; high degree of dollarization. Bank lending channel needs to enforce and increase efficiency of impact to output by making discount loans, refinancing commercial banks and by increasing the bank reserves.

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