

Estimation of the Central Bank monetary policy effectiveness during the financial crisis

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Summary.

In this article we analyze the Bank of Russia monetary policy during the crisis using econometric modeling, estimate monetary policy instruments influence on the targets, define the nature and extent of this influence, and conclude about effect of various tools applied in the crisis and pre-crisis periods.

Key words.

Monetary policy; Bank of Russia; financial crisis; econometric modeling; ARCH model.

Economic costs of modern financial crises have increased so much that no government can ignore it any longer. Countries have to use monetary policy mechanisms more extensively to stabilize their financial systems. Therefore the Bank Of Russia immediately implemented in September – December 2008 a set of measures to smooth the adverse effect of international financial markets crises state on Russian credit institutions, and first of all on their ability to achieve the Bank of Russia liquidity.

In this regard it seems interesting to consider the efficiency of monetary instruments, aimed to achieve targets declared by the Central Bank of Russia for the crisis and pre-crisis periods.

According to principal directions of sole state monetary policy, its targets are [3]:

1. inflation ratio decline and maintaining it on the level that provide conditions for the long-term stable growth,
2. strengthening and maintaining banking system stability,
3. support of financial markets and restriction of worldwide financial and economic crisis negative influence on the economic state of Russia.

Preserving an anti-inflationary monetary and credit policy the Bank of Russia in the short-term period will act concerning monetary and credit regulation substantially to minimize the negative influence of world financial and economic crisis on the Russian economy and bank sector.

Let us examine some indexes that can be associated with the monetary policy targets. For the first two targets we may use consumer price index and effective exchange ratio of ruble as resulting factors.

As an adequate quantitative factor that estimate overall state of banking system (the third aim of MP) we may consider the index of banking system state developed by “Mobile” Agency. [4] The index of banking system state (IBSS) estimates monthly variations of Russian banking system financial stability by 12 point scale. IBSS calculation is based on range allocation of banks according to banks Dynamic Financial Stability Ratings (DFSR). The more banks belong to higher financial stability range, the higher IBSS is. IBSS shows the current state and its variations show general trend of Russian bank system development.

As a financial market indicator we take “MICEX finance” share index that reflects Russian largest banks valuation. Calculation base of this index consists of VTB-Group (31,24%), Bank of Moscow (25,68%), Sberbank (25,19%), “Vozrozhdenie” Bank (4,56%), “Rosbank” (2,01%) and others. [4]. Note that stock market mainly depends on information field consisting of different information types. First of all, this is information about introducing measures and monetary instruments being used, economy status reports including different industries,

analysis reports, predictions, statistics. Besides companies' direct disclosure influences significantly on trading and so on share indexes.

Bank of Russia like other governmental authorities guarantees implementation of Russian Federation monetary policy [2]. In this case credit system regulatory methods are: Bank of Russia operations interest rates, standards for obligate reserves deposited in the bank of Russia (legal reserve requirements), open-market operations, credit institutions refinancing, currency intervention, setting monetary expansion reference points, direct quantitative restrictions, bond emission [2].

Further we will associate monetary instruments and factors (indicators) that give them quantitative definition.

Table 1

Quantitative indicators characterizing monetary instruments

Monetary Policy Instrument	Qualitative factor	Notation
Managing Bank of Russia transaction rates	Refinance rate	REF
Refinancing credit organizations (liquidity extension)	Bank of Russia credit financing extent (consists of intraday, lombard loans and overnight loans, credits with nonmarket guarantee and unsecured credits – last ones became popular during the crisis period since the end of 2008)	CREDIT
	Direct REPO operations extent	REPO
	“Currency SWAP” operations extent	SWAP
Liquidity occlusion	Volume of credit organizations deposits in Bank of Russia	DEPOS
	Bank of Russia obligations to credit institutions according to Bank of Russia bonds	OBR
Legal reserves requirements managing	Norm of legal reserves requirements	NORM
	Extent of required reserves deposited in Bank of Russia	RESERVES
Currency interventions	Executed currency interventions extent	INTERVENTS

To check the influence of the instruments on the MP aims the regress analysis shall be used – model ARCH(1). ARCH - model combines benefits of the line regress

model and possibility to take into account the influence of the past value of the assessed variable on its current value that can be useful for the modeling of the monetary policy instruments influence. The ARCH-model shows volatility as function of the volatility lags (delay 1 or more periods behind) reflected as dispersion of the remainders. Conditional variance of financial indicators in this Model is used as a measure of price indeterminacy or risk. This factor reflects level of the system risk, measures indeterminacy related to market dynamics forecast.

The rate of ARCH-model is determined by the quantity of the lags for each particular case. In general, ARCH(q)-model can be interpreted in two equations:

$$Y_t = c + \sum_{i=1}^N \beta_i \cdot X_{it} + \varepsilon_t \quad (1)$$

$$\sigma_t^2 = \gamma_0 + \sum_{i=1}^q \gamma_i \cdot \varepsilon_{t-i}^2 \quad (2)$$

with: Y_t – dependent variable in t moment; X_t – vector, consisting of the depicting variable in t moment ; β_i – coefficient at i factor; c – constant; ε_t – value of the remainder in t moment; σ_t^2 – dependent variable of the remainders or volatility in t moment; γ_0 – constant, base volatility; q – rate of the ARCH-model; γ_i – weight coefficients, determining the scale of influence of the past values of the remainders on the current volatility value. At that, ARCH(q)-model assumes that standardized remainders are independent and subordinated to normal distribution.

The empirical and analytical base for the research was statistic materials of the State Statistics Federal Service, statistic data of Central Bank of Russia, data of the national stock exchanges. [4].

The valuation of the influence of each instrument was done separately.

Below is the currency rate management . We assume that real effective ruble rate is being influenced by Bank of Russia operational rate, level of obligatory reserves, scale of Bank of Russia operations: offering and adsorptions of liquidity and foreign currency interventions.

Here is the equation of regression in interpretation of ARCH(1)-model:

$$\begin{aligned}
RUB_t = & c + \beta_{REF} \cdot REF_t + \beta_{CREDIT} \cdot CREDIT_t + \beta_{REPO} \cdot REPO_t + \beta_{SWAP} \cdot SWAP_t + \\
& + \beta_{DEPOS} \cdot DEPOS_t + \beta_{OBR} \cdot OBR_t + \beta_{NORM} \cdot NORM_t + \beta_{RESERVES} \cdot RESERVES_t + \\
& + \beta_{INTERVENTS} \cdot INTERVENTS_t + \varepsilon_t
\end{aligned}
\tag{3}$$

The calculations shall be done for crisis period and crisis period with lag of 1 month as the data on foreign currency interventions for the pre-crisis period is not available.

Table 2

The results of calculations of influence of the factors on increase of the real effective ruble rate.

Period of time	Index	Correlation	Significance	Expectation
Crisis period (model 1)	REF	↓	Not significant	0.1578
	CREDIT	↑	Not significant	0.3558
	REPO	↓	Significant	0.0009
	SWAP	↑	Not significant	0.1884
	DEPOS	↓	Not significant	0.4854
	OBR	↑	Significant	0.0260
	NORM	↑	Not significant	0.7697
	RESERVES	↓	Not significant	0.9578
	INTERVENTS	↓	Significant	0.0040
Crisis period (model 2)	REF	↓	Significant	0.0595
	CREDIT	↑	Not significant	0.1125
	REPO	↓	Significant	0.0006
	SWAP	↑	Significant	0.0653
	DEPOS	↓	Not significant	0.3988
	OBR	↑	Significant	0.0067
	NORM	↓	Not significant	0.7578
	RESERVES	↑	Not significant	0.4401
	INTERVENTS	↓	Not significant	0.4978

Table 3

Valuation of the adequacy of the models

Model	Criteria and estimations						
	R2	Akaike criterion	Schwarz Criterion	F-statistics	ARCH test	LM-test	Jarque-Bera test
Model 1	0,820428	6,113101	6,709970	5,738098	0,8510		0,7149
Model 2	0,907867	5,301119	5,898559	7,166437	0,4940		0,351

In order to check the hypothesis regarding normal distribution of the normalized remainders statistic test Jarque-Bera shall be used. ARCH LM-test serves for determination of the autocorrelation in remainders. Herewith, taking into account relatively small data range, the results of the test are satisfactory.

Similar valuation was done for all purposes of monetary and credit policy, aggregated assessment of the influence of MP instruments on the aims of central bank elicited as a result of the econometric modeling by the authors of this research is shown in Table 4. The influence of the instruments of monetary and credit policy was assessed in two periods: pre-crisis and crisis period with lag of and without it.

Table 4
Aggregated results

MCP aims	Refin. rate	Obligatory reserves	Liquidity offering	Liquidity absorption	Foreign currency interventions
General period					
Inflation reduction	↑	↓	↓	↑	-
Ruble rate strengthening	n/d	n/d	n/d	n/d	n/d
stab. BC increase	↑	-	-	-	-
Stock market support	↓	↑	-	↑	-
General period (lag of n1 month)					
	Refin. rate	Obligatory reserves	Liquidity offering	Liquidity absorption	Foreign currency interventions
Inflation reduction	↑	↓	↓	↑	-
Ruble rate strengthening	n/d	n/d	n/d	n/d	n/d
stab. BC increase	↑	-	-	-	-
Stock market support	↓	-	-	-	-
Crisis period					
	Refin. rate	Obligatory reserves	Liquidity offering	Liquidity absorption	Foreign currency interventions
Inflation reduction	↑	↓	↑	↓	-
Ruble rate strengthening	-	-	↓	↑	↓
stab. BC increase	-	-	-	-	-
Stock market support	↓	-	-	-	-
Crisis period (lag of 1 moth)					
	Refin. rate	Obligatory reserves	Liquidity offering	Liquidity absorption	Foreign currency interventions
Inflation reduction	↑	↓	↑	↓	-
Ruble rate strengthening	↓	-	↓	↑	-
stab. BC	-	-	-	-	-

increase					
Stock market support	↓	-	-	-	-

Average value of the determination coefficient R^2 turned up to be high for all models. To check the significance of the regress model Fisher's criteria is used F. Herewith all calculated values of F-statistics are higher then its respective table values. Akaile and Shvartz information statistics are traditionally being used to choose the most exact model: the model with smallest values of these statistics is more preferable and exact. To check the hypothesis regarding normal disbursement of the normalized remainders Jarque-Bera statistic test is used and it proved normal disbursement. ARCH LM-test is done to valuate autocorrelation in the remainders. Herewith, taking into account relatively small data range, the results of the test are satisfactory.

Analyzing the above Table the following conclusions can be made:

- in general, can be seen stable connection between actions, taken in realization of MP and MP aims;
- during crisis period less MP instruments are active then in non-crisis period;
- the influence of some inflation reduction instruments of MP (offer of liquidity and absorption of liquidity) differs during the whole period and during crisis that shows some change in priorities for the Government during crisis period (it adds to the key target of inflation reduction also target of banking sector support by offering of liquidity);
- can be seen contradictory influence of the instruments on the aims of MP; for example, increase of refinancing rate reduces inflation and increases stability of banking system however it negatively influences ruble rate and support of stock exchange market. Under such conditions Government of Russia and Central Bank have to choose the priority aims of MP and use available instruments correspondingly. For example, within framework of the main directions of the state sole MP for 2010 the

main aim stated reduction of inflation down to 9-10% in 2010 and down to 5-7% in 2012. Once the inflation started to reduce slowly (middle 2009) Bank of Russia started to reduce the refinance rate in order to support the real sector and reduction of the cost of credit funds.

Therefore revealed during the research relation between MP instruments and its aims might be utilized for formation of direct effective Bank of Russia policy the results of thereof shall be clear within the current month or in a month.

As an analysis result of Table 4 can be noted that central bank monetary policy instruments practically do not influence aims related to support of necessary banking system level and support of stock exchange markets. However, quite possibly, the action of monetary policy instruments influence the above aims with some lag. Quite interesting to see the influence of monetary policy instruments within a number of lags as action of different instruments might start in different time. In order to assess it lets examine 8 lags, 1 lag is equal to 1 month.

Below is regression equation utilizing model ARCH(1) describing the influence of monetary policy instruments on banking system.

$$ISBS_t = c + \beta_{REF} \cdot REF_t + \beta_{CREDIT} \cdot CREDIT_t + \beta_{REPO} \cdot REPO_t + \beta_{SWAP} \cdot SWAP_t + \beta_{DEPOS} \cdot DEPOS_t + \beta_{OBR} \cdot OBR_t + \beta_{NORM} \cdot NORM_t + \beta_{RESERVES} \cdot RESERVES_t + \varepsilon_t \quad (4), \quad \text{где}$$

ISBS_t-index of banking system stability in t time.

The results of valuation are shown in table 5.

Table 5

Influence of monetary policy instruments on acceptable level of banking system.

Lag		Repressors							
		REF	CREDIT	REPO	SWAP	DEPOS	OBR	NORM	RESERVES
0	Dependence						↑		
	Significance	No	No	No	No	No	Yes	No	No
	Possibility	0,2383	0,6710	0,9004	0,4060	0,6729	0,0119	0,6686	0,1501
1	Dependence								
	Significance	No	No	No	No	No	No	No	No
	Possibility	0,2418	0,9492	0,2606	0,8277	0,4293	0,3575	0,9878	0,1420

2	Dependence								
	Significance	No	No	No	No	No	No	No	No
	Possibility	0,2337	0,6867	0,7122	0,8510	0,5077	0,8422	0,9431	0,1619
3	Dependence	↑							
	Significance	Yes	No	No	No	No	No	No	No
	Possibility	0,0954	0,3524	0,7118	0,8651	0,5456	0,2922	0,2973	0,7491
4	Dependence	↑							↓
	Significance	Yes	No	No	No	No	No	No	Yes
	Possibility	0,0109	0,8210	0,6439	0,6750	0,5588	0,5494	0,2527	0,0180
5	Dependence	↑					↓		
	Significance	Yes	No	No	No	No	Yes	No	No
	Possibility	0,0068	0,7281	0,6567	0,7985	0,6542	0,0859	0,3238	0,2045
6	Dependence	↑			↑		↓	↑	↓
	Significance	Yes	No	No	Yes	No	Yes	Yes	Yes
	Possibility	0,0009	0,6053	0,7341	0,0524	0,4499	0,0770	0,0162	0,0110
7	Dependence	↑					↓		
	Significance	Yes	No	No	No	No	Yes	No	No
	Possibility	0,0001	0,2336	0,9018	0,7907	0,9333	0,0154	0,3144	0,7023
8	Dependence	↑	↑	↓	↑		↓		
	Significance	Yes	Yes	Yes	Yes	No	Yes	No	No
	Possibility	0,0000	0,0272	0,0576	0,0001	0,9340	0,0099	0,5859	0,6760

The information component of the measures taken in the frame of monetary and credit policy does not start acting at once after its publication. In general, monetary policy instruments start acting from 6th lag and continue till 8th lag. For development of banking system as a whole and credit organization in particular liquidity is required. The key indicators determining the volume of the liquidity offered by Bank of Russia to credit organizations and its cost are: refinancing rate, obligatory reserves and actual volume of financing .

The most informative signals for banking system is the level of refinancing rate, acting of this instrument starts from third lag and lasts till 8th lag. Operations on investing/absorption of liquidity influence in some time, the significance of the obligations of Russian Government before credit organizations under Bank of Russia bonds starts from fifth lag and lasts till 8th lag. At that the size of deposits of credit organizations with Bank of Russia does not matter. Instruments of reserve requirements management start influence in 4-6 lags and the obligatory reserves request deposited by credit organizations with bank of Russia have the opposite influence. The refinancing of credit organizations influence in 8th lag on support of acceptable finance market level.

As it can be seen from the results received the main action of monetary policy methods starts to show on the index of banking system stability with lag of 3-6 month, in 8-th lag out of 8 instrument being analyzed – significant are only 5 instruments. Such significant lags due to actual receipt of credit funds by credit organizations, its work and receipt of certain result reflected in the balance sheets and financial reports.

Below is consideration of monetary and credit policy instruments influence on support of required level of the finance market. The valued equation is below.

$$MICEX_FIN_t = c + \beta_{REF} \cdot REF_t + \beta_{CREDIT} \cdot CREDIT_t + \beta_{REPO} \cdot REPO_t + \beta_{SWAP} \cdot SWAP_t + \beta_{DEPOS} \cdot DEPOS_t + \beta_{OBR} \cdot OBR_t + \beta_{NORM} \cdot NORM_t + \beta_{RESERVES} \cdot RESERVES_t + \varepsilon_t \quad ($$

), where MICEX_FIN_t- stock exchange index «MICEX finance». The results of the valuation are represented in Table 6.

Table 6

Influence of monetary and credit policy instruments on financial market

Lags		Repressors							
		REF	CREDIT	REPO	SWAP	DEPOS	OBR	NORM	RESERVES
0	Dependence	↓							
	Significance	Yes	No	No	No	No	No	No	No
	Possibility	0.0001	0.4218	0.8174	0.3193	0.4828	0.1545	0.4885	0.1471
1	Dependence	↓							↑
	Significance	Yes	No	No	No	No	No	No	Yes
	Possibility	0.0000	0.1917	0.6162	0.3129	0.8815	0.2471	0.1265	0.0996
2	Dependence	↓					↑	↓	
	Significance	Yes	No	No	No	No	Yes	Yes	No
	Possibility	0.0000	0.2423	0.7738	0.4547	0.7199	0.0604	0.0431	0.1856
3	Dependence	↓					↑		
	Significance	Yes	No	No	No	No	Yes	No	No
	Possibility	0.0000	0.2370	0.6547	0.2032	0.3182	0.0002	0.3645	0.8526
4	Dependence	↓	↓		↓		↑		
	Significance	Yes	Yes	No	Yes	No	Yes	No	No
	Possibility	0.0000	0.0189	0.1109	0.0941	0.3746	0.0011	0.7791	0.1644
5	Dependence	↓	↓				↑		
	Significance	Yes	Yes	No	No	No	Yes	No	No
	Possibility	0.0000	0.0044	0.3878	0.1505	0.6807	0.0065	0.4573	0.3503
6	Dependence	↓	↓				↑		
	Significance	Yes	Yes	No	No	No	Yes	No	No
	Possibility	0.0000	0.0301	0.7151	0.1628	0.9079	0.0466	0.1343	0.5646
7	Dependence	↓	↓				↑	↓	
	Significance	Yes	Yes	No	No	No	Yes	Yes	No
	Possibility	0.0031	0.0151	0.9498	0.6282	0.5415	0.0211	0.0600	0.7886

8	Dependence	↓					↑		
	Significance	Yes	No	No	No	No	Yes	No	No
	Possibility	0.0855	0.1253	0.9618	0.3591	0.2129	0.0423	0.2555	0.5565

Refinance rate starts to influence financial market from the first lag and continues for the whole research period. The lower is refinance rate the lower is MICEX index and the higher is level of financial market. However, refinance rate influence the level of banking stability in the opposite direction: the lower is refinance rate, the lower is index of banking stability. Due to the crisis Bank of Russia started to use new instrument – scale of credit organizations’ financing by Bank of Russia and it influences more financial market level then the level of banking system. It starts acting from 4th lag and continues its activity till 7th lag. The third significant instrument is the obligations of Bank of Russia before credit organizations under Bank of Russia bonds, its influence on financial market level starts in second lag continues till 8th lag.

Further to the analysis of Table 5 it can be noted that central Bank can manage banking system more effectively then financial market in long-term perspective as banking system is influenced by many instruments of monetary and credit policy. However, in short-term period financial market react faster to the actions of Bank of Russia, influence of number of monetary instruments start from the first lag and continue during all research term.

Usage of stipulated by legislature types of refinancing during crisis time turned out to be insufficient therefore on 13th October, 2008 Central Bank tried new instrument to support finance system – financing of Russian credit organizations without credit security. It became possible due to coming into force of Federal Law dated 13th October, 2008 N 171-FZ “ Regarding introductions changes into Article 46 of Federal Law “About Central Bank of Russian Federation (Bank of Russia)” [1], according to which Bank of Russia receive the right to offer financing without credit security for the period not more than six months. Stated term of 6 months did not suite the requirements of market and on 30 December, 2008 by Federal Law N 317-FZ it was permitted to Bank of Russia to offer non secured loans for the term not more than one year. Currently, access to

this facility have about 190 banks. Thus introduced during the crisis new instrument of monetary policy – scale of Bank of Russia financing is effective for the level of financial market development, its action starts in third lag and continues till the eighth.

Under conditions of withdrawal by the investors of funds from Russian assets and related increase of demand for foreign currency the actions of central Bank of Russia were directed to non-admission of over weakness of ruble and securing of bi-currency basket cost.

Therefore Bank of Russia in August, September, October, November and December carried out sale of foreign currency in national market (first time from August 2007). As a result scale of international reserves decreased drastically. Its total value (taking into account other changes and foreign currency revaluation) as on 1 January 2009 decreased down to 427,1 billion US Dollars. Many experts regarded expense of international reserves to support ruble as “inadequate policy”. However such policy lasted till January 2009 as Government of Russian Federation did all possible to rule out drastic volatility of ruble rate. Though this instrument is also very effective and influences ruble rate with lag of one month.

At the same time it should be also noted that the efficiency of the monetary and credit policy is influenced a number of negative factors.

One of the factors is that action of different instruments of monetary policy starts in different time lags, for example, scale of credit organizations financing by Bank of Russia starts influencing the level of banking system in 8th lag. Moreover, usage of interest rates as an instrument of monetary policy shows that the results of the latter are very difficult to forecast. Practically subject to all results of the models' valuation this instrument has differently directed influence on the aims of monetary and credit policy.

Taking into account that Government of Russia together with Bank of Russia as a whole managed to keep the situation with inflation, exchange rate and banking system under control and it is evidenced by presence of dependence in the models, and positive result in post-crisis period (decrease of inflation rate,

strengthening of national currency, relative stability of the banking institutions) therefore their actions shall be acknowledged as effective.

However, it shall be also taken into account that monetary and credit policy is an integral part of the economic state policy as a whole and its measures shall harmonize with flexible budget, tax and structure policies of Government of Russian Federation. The efficiency of the measures taken by Bank of Russia also depends on activity of credit organizations, their trust to financial system of Russian Federation. Therefore in 2011 one of the most important elements of the policy shall be reforms that allow to start solving key problems appeared during crisis and reforms assisting to modernization of economy.

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