Monetary Stabilisation under External Shocks: The Case of Russia

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Abstract

This paper develops and estimates reduced monetary model for the Russian economy. We consider Central Bank's international reserves volume as the key factor of monetary and exchange rate stabilization using monetary rule for the country with intermediate exchange rate regime. The model is estimated with Bayesian techniques using four key monetary variables: nominal interest rate, nominal exchange rate, real exchange rate, international reserves. Using empirical investigation of Central bank preference parameters we analyse whether the monetary stabilization during crisis of 2008-2009 was discretionary or not. The hypothesis of following the same rule in crisis and non-crisis period is not rejected by the data.

Keywords: monetary stabilization, monetary rule, Bayesian estimation.

1. Introduction

During 2008 – 2009 global financial crisis the Russian economy faced external shock of a large scale induced by sharp changes of the situation on global financial and commodities markets. Losses of Russian economy during financial crisis were one the most significant in the group of developing countries. In particular, the ruble was devalued by 30%, inflation accelerated in 2008 to 13.3% per year, there was a decline in GDP growth by 13%[1] and a drop in share prices of Russian corporations for 64%[2]. Considering this issues, it is interesting to analyse how, in the last decade, the Central Bank of Russia responded to external challenges.

Monetary policy of Russian Central Bank in 2000-th was traditionally associated with targeting nominal exchange rate. From 2001 to 2008 this meant limiting the real appreciation of the ruble; conversely, in autumn 2008, the rapid fall in oil prices and the rapid outflow of portfolio investors from developing countries caused devaluation pressure. In crisis situation Bank of Russia began to defend the ruble from devaluation, as a result, devaluation occurred, but later than fundamentals changed. The fact that devaluation lagged behind external shocks gave the opportunity for debt holders to repay in the appreciated currency but triggered massive currency speculations. So the analysis of the process of smooth devaluation raises a lot of questions. Among them whether the policy of the Bank of Russia in the conditions of crisis was discretionary or the Bank has not changed its policy priorities. This paper aims to develop a simple framework for the analysis of monetary sphere and find out does monetary policy rule for the exchange rate regime explains monetary stabilization dynamics in crisis or there were changes in preference parameters.

For the purpose of identifying changes in the policy preferences in this paper we, first, develop a reduced short run dynamic monetary model for Russian economy and ad-hoc monetary rule for the Central Bank. The model considers the main features of Russian monetary sphere: dependence on export earnings and capital movements. Monetary rule for the intermediate exchange rate regime includes nominal currency basket exchange rate and international reserves dynamics. Next, we estimate the model using four key monetary variables: nominal interest rate, nominal exchange rate, real exchange rate, international reserves. Following recent developments in Bayesian estimation techniques, we estimate the model by minimising the posterior distribution of the model parameters based on the linearised representation of the model. Finally we analyse the estimated parameters of monetary policy in crisis and in a stable macroeconomic environment to find out whether Central Bank changed its preferences of not. In other words we estimate the ability of monetary rule for the intermediate exchange rate regime to explain crisis dynamics. Recent policy changes associated with the transition to inflation targeting are not considered.

The results of the estimation show that the monetary rule in the framework of developed model fits the data. We got significant estimates of Central Bank preference parameter for both the whole sample and crisis periods. The confidence intervals for the estimates on two datasets are overlapping, so the hypothesis of following the same monetary rule is not rejected by the data.

The paper includes introduction, two parts and conclusion. The first part involves the description and analysis of the monetary sphere model and the analysis of monetary policy rule. The second part presents the results of calibration and estimation of the model using the data of the Russian economy from 2004 to 2012. Discussion of the results is in conclusion.

2. Theoretical analysis of monetary sphere of Russian economy

In this section we derive and present the reduced monetary model that we estimate in Section 3.

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[1] http://www.gks.ru

[2] http://moex.com/

Among the external factors that determine the macroeconomic cycle, experts usually emphasize oil prices [9] and the outflow of capital from the country [7]. Admittedly Russian economy depends a lot on export earnings. Not surprisingly, the dynamics of export follows the dynamics of oil price. Monetary policy aims to avoid high volatility of earnings thus Central bank takes under control exchange rate which determines competitiveness of export goods. Russia as a country with an intermediate exchange rate regime traditionally had difficulties during the sharp fluctuations of the current and capital accounts of the balance of payments. That is why for the analysis of monetary policy, it is important to consider balance of payments dynamics in a single system. And the exchange rate can be used as a benchmark for the Central Bank, and as a tool of policy, along with the interest rate and the stock of international reserves.

As the basis for the modeling we use the paper of Granville, Mallik [3], there the authors analyze the optimal policy of the Bank of Russia. The authors model the process of stabilization of inflation and output in terms for Russian dependence on oil prices and intermediate exchange rate regime. However, the model does not completely suit for our purposes - we want to emphasize that the dynamics of international reserves begin to create additional incentives to stabilize the monetary sphere. These new mechanisms of interaction could not be observed in the pre-crisis period, we use qualitative analysis of former crisis to introduce the new form of monetary rule. We also use the model of optimal devaluation in the condition of twin crisis for Russian economy [7] as the basis for balance of payment equation. The dynamics in the model comes from two sources: oil price dynamics and shock in capital account, for this paper we modify balance of payment equation by including real sector variable (real exchange rate) instead of nominal.

2.1 The Model

We assume a simple dynamic model of monetary and financial sector which is subject to external shocks.

$$\overline{W}_t = NPFA_t + H_t \tag{1}$$

$$NPFA_t = -k \cdot \mathrm{E}_t \cdot id_{t+1} \tag{2}$$

$$id_t = i_{t-1} - i^*_{t-1} - \frac{\Delta S_t}{S_{t-1}} \cdot (1 + i_{t-1}) \tag{3}$$

$$i_t^* - \bar{i}^* = \rho_i \cdot (i^*_{t-1} - \bar{i}^*) \tag{4}$$

$$H_t = IC_t + IR_t \tag{5}$$

$$\Delta IC_t = -\theta \cdot \Delta IR_t + U_t^{IC} \tag{6}$$

$$U_t^{IC} = \rho_{IC} \cdot U_{t-1}^{IC} + \varepsilon_t^{IC} \tag{7}$$

$$-\Delta NPFA_t + a \cdot \ln Q_t + U_{BP} - \Delta IR_t = 0 \tag{8}$$

$$\ln Q_t = \ln S_t + \ln RP_t \tag{9}$$

$$\ln RP_t = \rho_p \cdot \ln RP_{t-1} + (1-\rho_p) \cdot \ln \overline{RP} + \varepsilon_t^p \tag{10}$$

$$U_t^{BP} = \rho_{BP} \cdot U_{t-1}^{BP} + \varepsilon_t^{BP} \tag{11}$$

Equation (1) defines the structure of the wealth of society ($\overline{W}_t$), which is distributed on the ruble-denominated assets (H_t - monetary base) and foreign assets ($NPFA_t$ - net foreign assets of the private domestic agents). Net private foreign assets depend on the expectations of the interest rate differential (id_{t+1}) with a coefficient k, here E_t is the expectation operator. Equation (3) describes the premium of domestic investors, arising due to the failure of uncovered interest parity, here S_t - the nominal exchange rate of foreign currency, i_t, i_t^* - the nominal interest rates in the country and abroad (respectively). Equation (4) specifies an adjustment rule for foreign nominal interest rates with a coefficient of adjustment $\rho_i > 0$, here $\bar{i}^*$ is a steady state level

Equation (5) determines the money supply. The monetary base H_t^s is under the control of the Central Bank and is created by the operations with international reserves IR_t and in the process of refinancing of commercial banks in the domestic currency IC_t. Equation (6) defines sterilization rule for currency operations with the parameter of sterilization $\theta < 1$. The exogenous function U_t^{IC} represents the autoregressive process with coefficient $\rho_{IC} \in (0,1)$ and shock ε_t^{IC}.

Equation (8) defines in a simplified manner the dynamics of the balance of payment. Capital account KA_t is represented by the net foreign private assets. $NPFA_t > 0$ means the purchase of foreign assets by household. The current account CA_t is represented by the logarithm of the real exchange rate (Q_t) with a coefficient a. The real exchange rate is related to the nominal exchange rate by the relative price level (RP_t). The dynamics of the relative price level is determined by the steady state level of the variable $\overline{RP_t}$ adjusted by the ratio $\rho_p \in (0,1)$ and shock ε_t^p.

Balance of payment have an exogenous component U_{BP}. The dynamics of capital account implies inflow or outflow of capital, the dynamics of the current account means export earnings fluctuations. Function follows AR(1) – process with an autoregression factor $\rho_{BP} \in (0,1)$ and shock ε_t^{BP}. Equation (9) determines the equilibrium in the foreign exchange market: balance of payments in case of intermediate exchange rate regime is balanced by the operations with international reserves ΔIR_t.

The system of equations describes the interaction of tools and operational goals of monetary policy, this framework allows to analyze the process of monetary stabilization. The model is based on monetary and financial sectors, the connection with the real sector is provided by real exchange rate variable and relative price level which reflects the dynamics of inflation in the country. We assume that other indicators of economic activity do not affect the process of monetary stabilization substantially. This simplification limits the usage of the model and don't allow to assess the optimal monetary policy with respect to the welfare of society.

2.2 The Monetary Rule

According to the reports on monetary policy in 2005, the Bank of Russia introduced a dual-currency basket (that consisted of the US dollar and the euro) as the operational indicator of its exchange rate policy. The Bank of Russia set the corridor for this operational indicator (the operational band) and implemented foreign exchange (FX) interventions on its boundaries to limit excessive dual-currency basket value fluctuations. When shifting the operational band's boundaries the Bank of Russia took into account the balance of payment dynamics and domestic FX market developments. Using the operational band the Bank of Russia smoothed rouble exchange rate volatility to other major currencies

In the end of 2008 – beginning of 2009, the Russian economy faced external shock of a large scale induced by sharp changes of the situation on global financial and commodities markets. In this situation the Bank of Russia modified its exchange rate policy framework. The Bank of Russia set the rule for automatic shift of the operational band related to the amount of currency interventions. Since then the width of the floating operational band was gradually increased to ensure shift to a more flexible exchange rate. The latest tendency of operating under managed floating regime is not considered in the paper.

Strong dependence of exchange rate dynamics and FX operations characterizes not only crisis periods, but stable ones too. We assume that the mechanism of automatic exchange rate corrections based on the volume of foreign exchange intervention, may be included in a simple monetary rule for the intermediate regime, so that in times of instability the effect would be substantial, in other periods its role would be minimal.

It is obvious that the intense of FX operation during the crisis changed, but we believe that it does not indicate a change in a control model, the degree of rigidity can be automatically determined by the dynamics of international reserves that regulator uses.

So, in this paper to analyze changes in monetary policy we use a monetary rule that reflect the stabilization of the exchange rate in the intermediate regime.

As a basis we use the rule for adjusting the exchange rate band, depending on the amount of currency intervention:

$$\Delta S_t = -\mu \cdot \Delta IR_t \quad ,$$

In terms of deviations from the steady state, we obtain:

$$\frac{S_t - \overline{S}}{\overline{S}} = -\mu \cdot \frac{(IR_t - \overline{IR})}{\overline{IR}} + U^S \qquad (12),$$

where $\overline{S}$ - the steady state value of the nominal exchange rate and $\overline{IR}$ - steady state value of international reserves.

$$U_t^S = \rho_s \cdot U_{t-1}^S + \varepsilon_t^S \qquad (13)$$

The rule means that monetary authorities target both: the nominal exchange rate and the value of international reserves. If the value of exchange rate is close to the long-term equilibrium level, the intervention in the monetary sphere is minimal. If speculative fluctuations in foreign financial markets or changes in the terms of trade caused the demand for ruble (or reduced), Central Bank will use reserves to smooth out fluctuations. Adjustments are complete, if the value of the policy coefficient (μ) is close to one, it corresponds to more strict regime. In more floating regimes, the policy coefficient will have a value close to zero. The coefficient should decrease with an increase in exchange rate flexibility and increases for policy tightening.

For the purpose of identifying changes in the policy preferences we test the null hypothesis of following the same monetary rule in non-crisis period and the full sample ($\mu_{full} = \mu_{cris}$) against the alternative hypothesis: using the different policy coefficient in crisis period.

3. Empirical analysis of monetary stabilization in Russia

Empirical part of the paper presents the results of calibration of the model and estimation for crisis and non-crisis periods.

3.1 Data

The research is based on the statistical data for Russian economy for the period from January 2004 to September 2012. The number of observations is large, it is important to improve the quality of empirical estimations. The period under consideration includes the crisis stage from August 15, 2008 to March 6, 2009. We chose the beginning of the crisis period by date of oil prices lowering, the end of the crisis period corresponds to the period of stabilization of the ruble around the level of 41 rubles for currency basket.

The analysis uses weekly data for Russia. We use four observable variables to make Bayesian estimation of the model.

The dynamics of international reserves is published by the Bank of Russia in a weekly format. As interest rate we used the actual rate on ruble loans 1 day-MIACR[3]. We used the nominal exchange rate of the currency basket of the Central Bank, which at the time of writing this paper is 0,45 EUR and 0,55 USD. The calculation of the real exchange rate is made using data on the nominal exchange rate of the currency basket of the Central Bank and the CPI for the Euro area countries, the USA and Russia.

Trends in time series data are removed using the Hodrick-Prescott filter. We used deviations from the steady-state level variables in estimation (see Table 2).

In the steady state model takes the following values:

Table 2: Steady state values of endogenous variables

Variables	Values	Variables	Values
$\overline{H}$	1.000	$\overline{NPFA}$	0.000
$\bar{i}$	0.003	$\overline{i^*}$	0.003
$\overline{IR}$	0.850	$\overline{id}$	0.000
$\overline{IC}$	0.150	$\overline{U^{BP}}$	0.000
$\overline{S}$	1.000	$\overline{U^{IC}}$	0.000
$\overline{Q}$	1.000	$\overline{U^{S}}$	0.000
$\overline{RP}$	1.000		

We assume that in the steady state all the wealth of domestic agents (W) amounts one and is represented by the domestic currency, which means agents do not have foreign assets. The supply of money is under the control of the Central Bank, the distribution between international reserves and internal credit is based on the average ratio of international reserves to the monetary base in the Bank of Russia balance sheet from 2004 to 2012 (0.85:1)[4]. The value of the real exchange rate is derived from the balance of payments equation in the steady state with a constant value of international reserves and foreign assets. The relative price level equals one, the nominal exchange rate equals real exchange rate. We use LIBOR[5] rate for the foreign weekly interest rate.

2.2 Econometric estimation of the model

In our tests we used a Bayesian approach that allows to estimate the distribution of the estimated parameters. We apply Bayesian techniques because this approach allows to formalise the use of prior information coming from macroeconomic statistics and thereby makes an explicit link with the macroeconomic environment. Besides, this technique became popular in estimation of general equilibrium models and shows better performance that standard VARs (see for example, Smets, Wouters, 2002). We built posterior distribution for the parameters and shocks acting in the model. The system was linearized around the steady state. For the four shocks - the balance of payments shock, sterilization shock, monetary rules shock and relative price level shock - we use four observable variables. Prior distributions are specified using a standard gamma distribution. The coefficient of the exchange rate from the equation of balance of payments and the policy AR-coefficient have an average value of 1. Autoregression coefficients in the equations for other shocks have an average at 0.2. Shocks in the model have a mean equal to one. Maximizing the likelihood function yields the following results (Table 3).

We got a significant parameter estimates. The preference parameter of the Central Bank (μ) is positive. It does not contradict to the idea that the rule implies depreciation of the exchange rate in replay to negative deviations of international reserves. Thus, the estimation results confirm the role of this factor in the dynamics of monetary variables. Estimates for the crisis and non-crisis periods suggest that there is some deviation in the preference parameter - a tightening of monetary policy is observed. But considering the 95% asymptotic confidence interval the difference is not significant: (0.44;0.59) for the full sample and (0.57;0.65) for the crisis period. The hypothesis about following the same rule in crisis and non-crisis period is not rejected by the data. So, we can not state that the policy of the Central Bank during the crisis was discretionary.

Table 3. Estimation results

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[3] Moscow InterBank Actual Credit Rate

[4] http://www.cbr.ru/statistics/

[5] 12-Month London Interbank Offered Rate

Parameter	Estimates with full sample		Estimates with crisis sample	
	Mode	St. Errors	Mode	St. Errors
a	8.8848	(1.6250)	7.0858	(1.2870)
μ	0.5138	(0.0729)	0.6109	(0.0355)
ρ_{BP}	0.7214	(0.0647)	0.7516	(0.0618)
ρ_{IC}	0.1166	(0.0548)	0.0990	(0.0487)
ρ_{S}	0.1500	(0.0866)	0.1500	(0.0866)
ρ_{P}	0.9454	(0.0256)	0.9195	(0.0232)
ε_{BP}	0.1873	(0.0309)	0.1092	(0.0180)
ε_{IC}	0.0645	(0.0045)	0.0394	(0.0028)
ε_{S}	0.0695	(0.0102)	0.0250	(0.0022)
ε_{P}	0.0079	(0.0006)	0.0068	(0.0005)

Thus, the exchange rate adjustment can be explained by the same rule that works in non-crisis periods, but the speed of adjustment varies due to internal constraints of the Central Bank, the exchange rate response to deviations of international reserves in crisis is higher on its average than non-crisis response.

Autoregression coefficient values for the balance of payments shocks and the real exchange rate are close to one. One can interpret these estimates as an indicator of long-term impact of these shocks on the monetary sphere of the country. Autoregression coefficient for sterilization mechanism and monetary policy assessment is low enough, which means quick resection on shocks, but their impact in the long run is minimal.

4. Conclusion

In this paper we constructed, solved and estimated the model which allows to analyse the peculiarities of monetary policy of the Central Bank. The model takes into account the main features of the Russian economy, such as high dependence on export earnings and capital markets. The model involves the monetary rule of exchange rate adjustment, which describes the relationship of the nominal exchange rate and the dynamics of international reserves. The dynamics of international reserves provides an additional source of exchange rate dynamics in the model. The reduced model developed in the paper can be used as a simple framework for the analysis of monetary sphere of the countries with an intermediate exchange rate regime and strong dependence on balance of payment shocks.

The econometric part of the paper focuses on the calibration and estimation of the model for the Russian economy using data from 2004 - 2012 years. Estimation is carried out with the Bayesian technique. The estimated coefficient that shows the relation between nominal exchange rate and international reserves in the Central Bank rule is significant and positive (as theoretically predicted) for the entire period and for the crisis period. Thus the monetary policy rule of the Central Bank in the form proposed in the paper allows to describe the current and stabilization policy of the regulator. The estimated policy parameters for crisis and non-crisis period have comparable values, so the hypothesis of following the same monetary rule is not rejected by the data. The alternative hypothesis that anti-crisis policy was discretionary is not supported. We do not discuss the question of the optimality of this policy in this paper, it requires using the methodology of dynamic stochastic general equilibrium model which we assume as the most promising framework for further developments.

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