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INTEREST RATE RULE FOR THE RUSSIAN MONETARY POLICY: NONLINEARITY AND ASYMMETRICITY*

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Abstract

This study reconsiders the interest rate rule for the Russian monetary policy, of which no evidence was found in earlier studies. This study successfully estimates an interest rate rule. In order to obtain this result, we follow Surico (2007)'s nonlinear approach.

The main contributions of this study are as follows. Our empirical results indicate that the Russian monetary policy follows a nonlinear interest rate rule. Further, we clarify the preference of the monetary policy in subsample estimation. When the 1998 financial crisis is considered, Russia's preference for output expansion is evident. According to Surico, this increases inflation in Russia.

Key Words: nonlinear rule; asymmetric objective; Bank of Russia

JEL Classification: E52, E58, P51

I. *Introduction*

Price and output stability are the main goals of central banks all over the world. On the basis of this fact, the traditional social loss function has been expressed as a quadratic equation of inflation deviation and output gap as follows:

$$L = E_{t-1}\frac{1}{2}\sum_{t=0}^{\infty}\delta^{i}[(\pi_{t+i} - \bar{\pi})^2 + \lambda y_{t+i}^2] \quad (1)$$

where $\pi_t - \bar{\pi}$ is the inflation deviation and y_t is the output gap.

Woodford (2003) provided a micro-foundation for this loss function; loss function (1) can be generated as a second-order approximation of the agent's utility function. Furthermore, this assumption yields the Taylor rule—the most famous interest rate rule (see Taylor (1993) and Svensson (1997)).

Although the quadratic loss function (and the Taylor rule) has a rigid theoretical

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background, this assumption does not seem to apt for Russia since earlier studies have rejected the notion that the Russian monetary policy follows the Taylor rule; Esanov et al. (2005) estimated the Taylor-type rules and concluded that these did not apply in Russia.[1] Vdovichenko (2006) used the generalized method of moments (GMM) estimation and concluded that the Taylor rule does not apply to Russia. These rejections raise the questions regarding the validity of assumption (1) in Russia.

In order to address this question and estimate an alternative interest rate rule, this paper follows Surico (2007)'s approach: Surico (2007) employed the linex loss function instead of (1) and estimated the nonlinear interest rate rules in the United States. The linex loss function is not quadratic but origin asymmetric with regard to output and/or inflation, which depend on the monetary policy preference. We examine the nonlinear interest rate rule as a candidate for the Russian monetary policy rule.

This paper proceeds as follows. The nonlinear rule is introduced and estimated in section II, where we find that the nonlinear rule describes the Russian monetary policy very well. In section III, a more detailed analysis of the Russian monetary policy is implemented using the subsample estimation through which, we obtain a robust preference of the Russian monetary policy. Section IV offers the concluding remarks.

II. *Nonlinearity in the Russian Monetary Policy*

1. Nonlinear Rule

In this section, we briefly introduce the nonlinear rule provided by Surico (2007). For details of the nonlinear interest rate rules, see Surico (2003, 2007) and Ruge-Murcia (2003).

We assume that the central banker has an asymmetric loss function, i.e., the linex loss function expressed below:

$$L_t=\frac{e^{\alpha(\pi_t-\bar{\pi})}-\alpha(\pi_t-\bar{\pi})-1}{\alpha^2}+\lambda\left[\frac{e^{\gamma y_t}-\gamma y_t-1}{\gamma^2}\right]+\frac{1}{2}(i_t-i^*)^2. \tag{2}$$

In this case, the parameters, α and γ represent the preference with regard to inflation and output gap, respectively. The asymmetric parameters determine the shape of the loss function (so-called asymmetric parameters), for example, see Figure 1. The central banker with a loss function as in Figure 1 dislikes output expansion more than the one with a quadratic loss function.

In addition, assume the dynamic systems are as follows:

$$y_t=\beta y_{t+1}-\phi(i_t-\pi_t)+\varepsilon_{t+1}, \tag{3}$$

$$\pi_t=\theta\pi_{t+1}+\varsigma y_t+\eta_{t+1}. \tag{4}$$

These systems are based on the optimization of the representative agent. Equation (4) is called the New Keynesian Phillips Curve (NKPC) and (3) is called the Dynamic IS curve (DIS).[2]

[1] Esanov et al. (2005) reported that the MacCallum rule was the best description of the Russian monetary policy (see McCallum (1988)).

On minimizing (2) and taking these systems and expectations of agents as given, we get the following nonlinear interest rate rule:

$$i_t = c_1 + c_2(\pi_t - \overline{\pi}) + c_3 y_t + c_4(\pi_t - \overline{\pi})^2 + c_5 y_t^2 + \nu_t, \tag{5}$$

where

$$c_1 = i^*,\ c_2 = \frac{\varsigma\phi}{\mu},\ c_3 = \frac{\lambda\phi}{\mu},\ c_4 = \frac{\alpha\phi\varsigma}{2\mu},\ c_5 = \frac{\lambda\phi\gamma}{2\mu}.$$

The asymmetric parameters α and γ are reconstructed as $2c_4/c_2$ and $2c_5/c_3$, respectively.

2. Evidence of the Nonlinear Rule

The nonlinear interest rate rule has not been previously estimated for Russia. In addition, No report shows that the interest rate rule can serve as the Central Bank of Russia (CBR)'s monetary policy rule. This section provides the evidence for the nonlinear interest rate rule in Russia.

The samples are as follows:

- Refinancing rate: CBR
- Consumer price index (CPI): Vienna Institute for International Economic Studies (WIIW)
- Production index (PI): WIIW
- Real exchange rate: CBR

We use monthly data covering the period from 1997:1 to 2007:7 due to data availability. The CPI and PI are seasonally adjusted using the Census X12 program. The inflation rate is the annual percentage change in the monthly CPI. The output gap is defined as the deviation of (log) production from its natural rate. We use the linear trend estimated by the Hodrick-Prescott filter as the natural rate of production.

We estimate the nonlinear rule using GMM because there seems to be a correlation between the error term and the regressors.[3] Instrument variables for GMM are selected from the observable information sets for the central bank. The instruments are as follows: three lags of unemployment, three lags of construction production, three lags of imports to the Commonwealth of Independent States (CIS), three lags of government deposit, two lags of M2, one-lag of loan rate, one-lag of real exchange rate, and lags of regressors. The Newey-West heteroskedasticity and autocorrelation consistent (HAC) covariance matrix is used to eliminate the serial correlation in the error term.

Table 1 reports the GMM estimates of the interest rate rule (5) and asymmetric parameters α and γ. All coefficients are strongly significant. Simultaneously, we also explore the robustness of our baseline model. All the output gaps are exchanged with the unemployment rate, keeping instruments unchanged.[4] Even after real variables are changed, the nonlinear

[2] *The NKPC determines inflation given a path for the output gap, whereas the DIS equation determines the output gap given a path for the (exogenous) natural rate and the actual real rate* (Gali, 2008, pp.49).

[3] In this case, the error term is defined as the prediction error of the central banker (see Surico (2007) and Clarida, Gali and Gertler (2000)).

TABLE 1. ESTIMATION FOR THE NONLINEAR RULE (BASELINE)

Regressors / The nonlinear rule	Baseline	Robustness
Intercept	-4.520^{***}	55.372^{***}
	(1.663)	(14.159)
Inflation	1.802^{***}	1.747^{***}
	(0.190)	(0.134)
Output gap / Unemp	0.810^{***}	-15.373^{***}
	(0.165)	(3.391)
Squared inflation	-0.013^{***}	-0.016^{***}
	(0.003)	(0.003)
Sq. output gap / Sq. Unemp	0.095^{***}	0.999^{***}
	(0.017)	(0.197)
α	-0.014^{***}	-0.018^{***}
	(0.001)	(0.001)
γ	0.234^{***}	-0.130^{***}
	(0.036)	(0.007)
p	0.131	0.391
No. of observations	124	122

Notes: (i) The figures in parentheses denote standard errors. *** denotes the significance at the 1% level. (ii) Parameters α and γ are estimated by the delta method (see Greene (2007)). (iii) p represents the critical value of Hansen's J test.

relationship is replicated. On the basis of these results, the nonlinear rule seems to explain the Russian monetary policy behavior. However, there exists one problem. Note that the baseline γ has a positive value, i.e., our estimation result suggests an unrealistic loss function. Estimated losses can be confirmed in Figure 1.

Figure 1 is the replication of the estimated loss function whose shape depends on α and γ. The deduced shape suggests that the losses held by the CBR are greater when the output gap is a positive. On the other hand, the losses from inflation seems to be almost symmetric since the asymmetric parameter of inflation, α, approaches zero ($\alpha=-0.014$).

The above suggests that the CBR is too conservative. Since the CBR resists the output expansion excessively, it would like to tighten the monetary policy by increase the nominal interest rate.[5] On the other hand, the CBR responds almost symmetrically toward inflation deviation, as is the case under the Taylor rule.

However, the CBR has *not* adopted such a tight monetary policy. In almost all samples, the instrument interest rate continues to decline in spite of the Russian economic expansion. This contradicts our estimation result where γ became positive.

What, then, is wrong in our estimation? Does there exist a more intuitive specification for the Russian monetary policy? We address these questions in the next section. The point to be noted in the next section is whether or not the CBR's asymmetric preference, particularly for output gap, γ, is positive even when we consider the various economic conditions in Russia.

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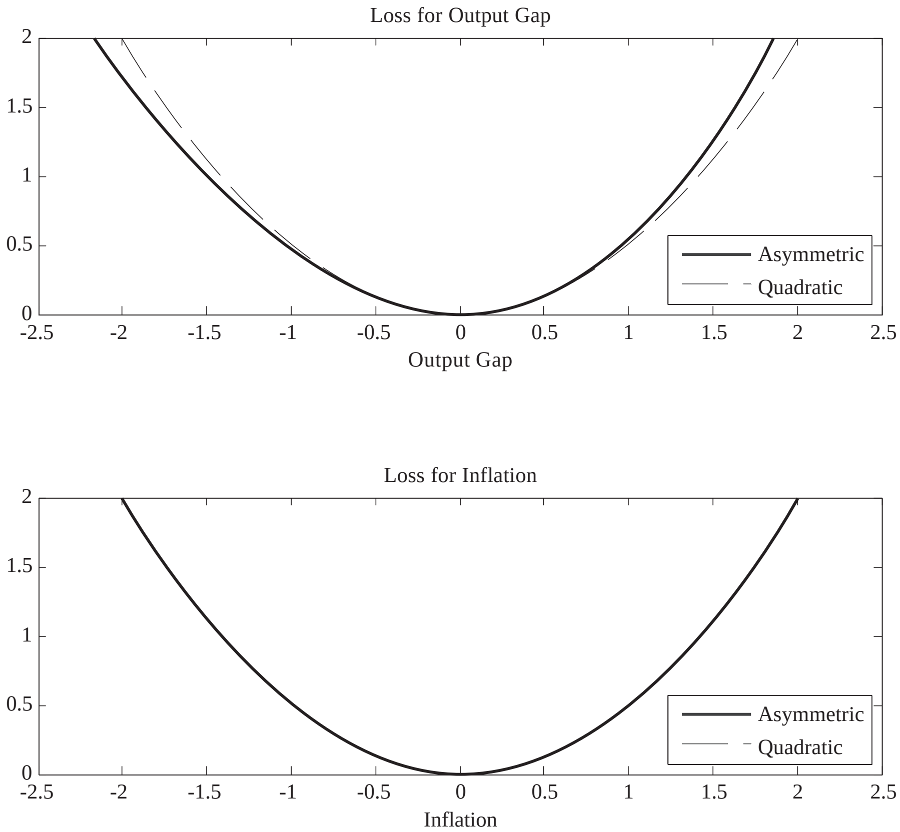
[4] Intuitively, the coefficient of the unemployment rate seems to be negative; further, γ has an opposite sign.

[5] If γ is positive, then the interest rate response is convex with regard to output gap.

FIG. 1. ASYMMETRIC LOSS (BASELINE ESTIMATION)



III. *Subsample Estimation*

We estimate two subsamples using two different methods in order to obtain the robust preference of the Russian monetary policy. First, we divide the sample data into two parts on the basis of the policy characteristics of the CBR's chairmen. Second, we eliminate from the entire sample the interval that is influenced by the 1998 crisis and then separately estimate the first and second parts. We demonstrate the robust preference of the CBR through subsample estimation.

1. Successive Chairmen of the CBR and the Corresponding Economic Situations

Our sample includes the previous three (as of February 2009) chairmen of the CBR:

・Dubinin S.K.: from November 22, 1995, to September 11, 1998;

TABLE 2. ESTIMATION BY CHAIRMEN AND ECONOMIC SITUATIONS

Regressors / Subsample	Era 1	Era 2
Intercept	−6.921	31.253***
	(5.253)	(7.038)
Inflation	1.130***	−4.981***
	(0.378)	(1.400)
Output gap	0.801***	0.288**
	(0.115)	(0.129)
Squared inflation	−0.005	0.307***
	(0.004)	(0.067)
Sq. output gap	0.108***	−0.059
	(0.017)	(0.067)
α	−0.009**	−0.123***
	(0.005)	(0.008)
γ	0.270***	−0.412
	(0.028)	(0.460)
p	0.376	0.749
No. of observations	60	64

Notes: (i) The figures in parentheses denote standard errors. *** denotes the significance at the 1% level; ** Idem., 5%. (ii) Parameters α and γ are estimated by employing the delta method. (iii) p represents the critical value of Hansen's J test.

・Gerashchenko V.V.: from September 11, 1998, to March 22, 2002; and
・Ignatiev S.M.: from March 22, 2002, to the present.

In order to investigate the Russian monetary policy stance vis-a-vis the CBR chairmanship and the economic situation, we divide the entire sample into two parts. The first part, which is termed Era 1, includes data from the Dubinin and Gerashchenko era. This part corresponds to sample data from April 1997 to March 2002. The second part, which we term "Era 2," corresponds to sample data from April 2002 to July 2007.

Dubinin preferred economic growth over inflation stabilization, and therefore, did not tighten the monetary policy until the beginning of the ruble depreciation in late 1997. Gerashchenko was appointed as the chairman after the 1998 ruble collapse. In general, he contributed to the economic recovery after the crisis, but he approved of the double-digit inflation in order to stabilize the exchange rate after the crisis. Both these chairmen adopted adverse monetary policies with regard to the price stability. On the other hand, Ignatiev earned the trust of the government and the markets as a result of his financial market reforms and currency liberalization. His monetary policy has been sustained by a very stable economic situation, as represented by high oil prices and the gentle dynamics of the exchange rate (the political situation has also been stable). For these reasons, we differentiate the Ignatiev era from those of the other two chairmen.

The estimated results are reported in Table 2. Not surprisingly, the result for Era 1 is identical to that of the baseline sample. Therefore, in our estimation for Era 1, much like in our estimation for the baseline sample, the problematic parameter γ remains positive and α approaches zero. On the other hand, the results for Era 2 are considerably different from those for Era 1 (as well for the entire sample), especially with regard to the sign of γ. A negative γ indicates that the nonlinear rule can describe the Russian monetary policy in Era 2. It is noteworthy that the result of Era 2 is supported by the favorable economic situation. Therefore, the negative (expansionary) preference in Era 2 seems to imply the ordinary monetary policy stance in Russia.

We summarize these results as follows:

1. The estimation results for Era 1 are identical to those for the entire sample: γ is positive, and α approaches zero.
2. The estimation results for Era 2 are able to describe the Russian monetary policy: γ is negative.

These results confirm that the baseline model captures the real monetary policy behavior of the CBR under Ignatiev. However, one issue still remains. Why did our baseline model fail to capture the CBR's monetary policy in Era 1?

In fact, both the baseline and Era 1 include the effect of the 1998 crisis. The 1998 crisis destroyed the Russian economy and made the economic variables extremely volatile. It is probable that the estimation result in Era 1 is distorted by the financial crisis because, in reality, Dubinin and Gerashchenko seemed to favor financial expansion more than Ignatiev did. The interest rate response in the crisis may affect the former subsample estimation and therefore, the preferences of the former chairmen exhibit a positive sign.

Moreover, almost all the results indicate that the asymmetric parameter of inflation α approaches zero. We consider this and specify our baseline model as the real Russian monetary policy rule.

2. Financial Crisis in 1998 and Its Effects

(1) Brief Background

The Russian financial crisis occurred in 1998 and was a product of the low oil prices in the world market and the fallout of the Asian crisis. Lack of confidence in the emerging markets spilled over from Thailand into Russia, and the ruble depreciated drastically.

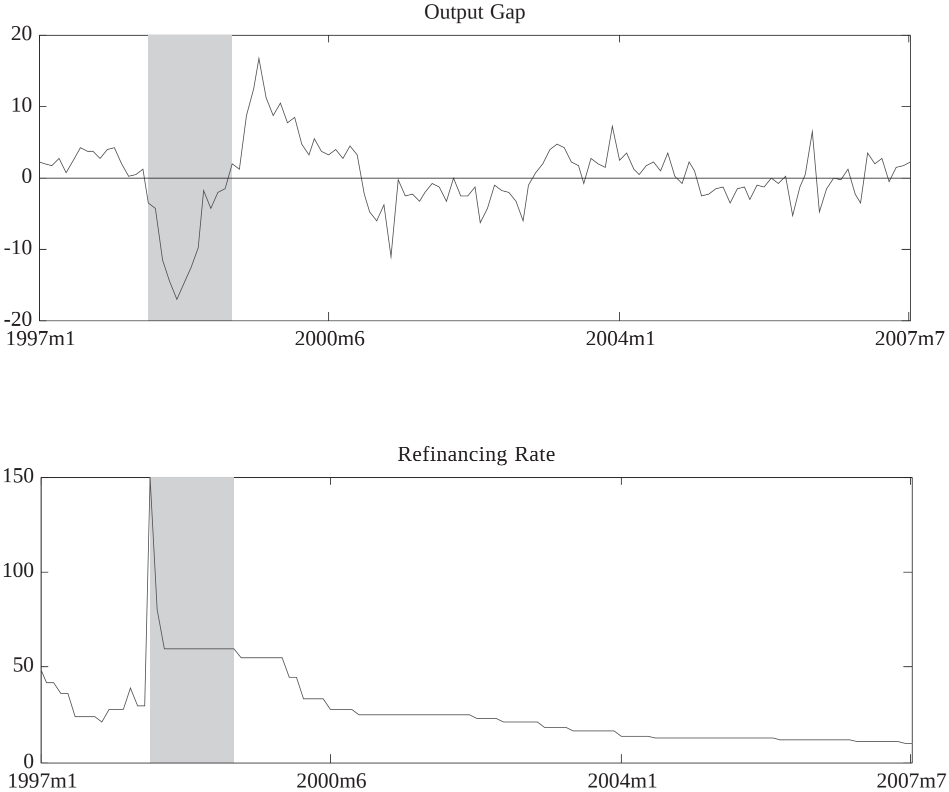
The CBR hiked the interest rate to prevent currency devaluation: however, the CBR was unable to continue this policy since the Gosudarstvennoye Kratkosrochnoye Obyazatyelstvo (Russian for "Government Short-Term Commitments;" henceforth, GKO) - Obligatsyi Federal'novo Zaima (Russian for "Federal Loan Obligations;" henceforth, OFZ) (Treasury-Bill) market was frozen. Fierce depreciation led to the collapse of the fixed exchange rate and the government decided to devalue the ruble. At the same time, the Russian government declared a temporal moratorium on treasury bills and defaulted on its obligations to enterprises by 90 days.

This crisis destroyed the domestic T-Bill market and hence, the Russian monetary policy became impotent for a certain period of time. Therefore, in sum, it can be said that the 1998 financial crisis temporally confused the Russian financial market and the monetary policy, though this effect was not long-lasting. Further, nobody expected the Russian economy to recover shortly after the crisis.

(2) Specification and Estimation

For almost all estimations, α approaches zero. Therefore, it seems that the CBR has no

FIG. 2. EFFECT OF THE 1998 FINANCIAL CRISIS



Notes: The shaded box denotes the effects of the 1998 crisis.

bias with regard to inflation (refer to Figure 1). Hence, we can set $\alpha=0$. If $\alpha\rightarrow 0$, the Linex loss function (2) is as follows:

$$L_t=\frac{1}{2}(\pi_t-\bar{\pi})^2+\lambda\left[\frac{e^{\gamma y_t}-\gamma y_t-1}{\gamma^2}\right]+\frac{\mu}{2}(i_t-i^*)^2. \tag{6}$$

This loss function is biased only with regard to the output gap. Computing the above in the same manner as in section 2, we obtain the following:

$$i_t=c_1+c_2(\pi_t-\bar{\pi})+c_3 y_t+c_5 y_t^2+\nu_t, \tag{7}$$

where

$$c_1=i^*,\ c_2=\frac{\varsigma\phi}{\mu},\ c_3=\frac{\lambda\phi}{\mu},\ c_5=\frac{\lambda\phi\gamma}{2\mu}.$$

This specification implies that the CBR reacts linearly (i.e., symmetrically) with regard to

TABLE 3. ESTIMATION CONSIDERING THE 1998 CRISIS

Regressors / Subsample	All	Before crisis	After crisis
Intercept	3.271***	17.165***	− 7.194***
	(0.638)	(2.200)	(1.852)
Inflation	0.803***	1.355***	2.098***
	(0.042)	(0.236)	(0.210)
Output gap	0.881***	4.100***	1.321**
	(0.293)	(0.682)	(0.322)
Sq. output gap	0.187***	− 2.082***	− 0.245***
	(0.031)	(0.252)	(0.088)
α	0	0	0
	–	–	–
γ	0.424***	− 0.903***	− 0.371***
	(0.132)	(0.033)	(0.103)
p	0.120	0.923	0.390
No. of observations	124	13	98

Notes: (i) The figures in parentheses are standard errors. *** denotes the significance at the 1% level; ** Idem., 5%. (ii) Parameters α and γ are estimated by the delta method. (iii) p represents the critical value of Hansen's J test. (iv) "Before crisis" corresponds to the period from April 1997 to April 1998 and "After crisis," that from Jun 1998 to July 2007.

inflation, but asymmetrically with reagrd to the output gap.

In this specification, we can identify the *average inflation bias* that arose from the asymmetric preference with regard to the output gap. The difference in the traditional inflation bias represented in Kydland and Prescott (1977) or Barro and Gordon (1983) is that the average inflation bias does not arise due to the central banker's incentive to expand the potential output but arises because of his asymmetric preference with regard to the output gap.[6] Additionally, we exclude the data belonging to the period from May 1998 to May 1999 in order to consider the effects of the 1998 crisis.

The rationale for this separation is that the CBR reduced the refinancing rate from 150% in May 1998 to 60% in the following month; the rate stayed at the same level until May 1999. On the other hand, the Russian output gap continued to exhibit a negative value during this interval (see Figure 2). In the context of asymmetric preference, the following hypothesis arises:

> *Was positive γ an outcome of the CBR's acceptance of a negative output gap during the 1998 crisis*?

The CBR's acceptance of a negative output gap during the 1998 crisis resulted in a positive γ. However, some changes do occur in the estimation after the volatile samples are eliminated.

In order to examine this hypothesis, we first estimate the specific model (7) for the full samples and then, for the two subsamples. We add the following instruments to the lags of regressors in the estimation: three lags of government claim, three lags of interbank rate, two lags of M1, two lags of domestic claim, two lags of export to the CIS countries, two lags of real exchange rate, and two lags of real trade.

The estimation results are reported in Table 3. The results of the full sample are identical to that of the baseline estimation. All coefficients are the same as in the baseline model. Note

[6] For more details, see Surico (2007) and Ruge-Murcia (2003).

that even in this specification, γ is positive for the full sample that includes the 1998 crisis. On the other hand, note that γ is negative for both subsamples. These results suggest that the crisis affected the non-intuitive results in the previous estimations. The CBR accepted the negative output gap during the 1998 crisis: this extremely tolerant behavior led to a positive γ.

It is true that the GMM estimator has a large bias when it comes to a small sample estimation: however, the results in section 2 support these results. Whereas in Era 1, γ is positive, in Era 2, it is a negative. Era 1 includes the effects of the crisis and Era 2 does *not*. On the basis of all the above estimations, we are able to demonstrate that the nonlinear interest rule can describe Russian monetary policy behavior.

We summarize the results as follows:

1. In the Russian monetary policy, the interest rate rule is characterized by nonlinearity.
2. When the 1998 crisis is taken into account, we find that the CBR usually prefers output expansion since the asymmetric parameter of output gap γ is negative.

The above results suggest that the nonlinear interest rate rule is able to explain the Russian monetary policy, which leads to relatively higher inflation.

IV. *Concluding Remarks*

This paper aimed to estimate the interest rate rule for the Russian monetary policy as there has been no successful report with regard to the estimation of an interest rate rule for Russia.

Instead of a quadratic loss function, we adopted the linex loss function, which is able to express the central banker's preference with regard to inflation and output gap. Considering the low independence of the CBR and the volatility in Russia's inflation and output, it seems that the CBR's preferences with regard to inflation and/or output gap are asymmetric.

Although the nonlinear rule is strongly supported for both the inflation and output gap in the full sample estimation, the asymmetric parameter of the output gap γ is unreal. If CBR had such a preference, it would react strongly to Russian economic expansion. However, such behavior has not been observed in our samples except for during the 1998 financial crisis.

Therefore, the subsamples were estimated in two different ways: One subsample was estimated on the basis of the characteristics of the CBR chairmen, while the other was estimated excluding the effects of the 1998 crisis. On the basis of these estimations, the robust preference of the Russian monetary policy with regard to output were obtained—the CBR prefers output expansion. According to Surico (2007), this leads to a rise in inflation. This conclusion coincides with the observations made with regard to the Russian monetary policy.

This paper provided a new possibility for the Russian monetary policy rule. However, some issues still remain: the true economic structure of Russia and the reason why the CBR has an asymmetric loss function are yet to be ascertained. In order to solve these questions, further theoretical and empirical studies are needed.

References

Barro, R. J. and D. B. Gordon (1983), "Rules, Discretion and Reputation in a Model of

Monetary Policy," *Journal of Monetary Economics* 12, pp.101-121.

Clarida, R., J. Gali, and M. Gertler (2000), "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory," *The Quarterly Journal of Economics* 115, pp.147-180.

Esanov, A., C. Merkl, and L. Vinhas de Souza (2005), "Monetary Policy Rules for Russia," *Journal of Comparative Economics* 33, pp.484-499.

Gali, J. (2008), *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework*, New Jersey, Princeton University Press.

Greene, W. H. (2007), *Econometric Analysis*, New Jersey, Prentice-Hall, 6th ed.

Kydland, F. E. and E. C. Prescott (1977), "Rules rather than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy* 85, pp.473-491.

McCallum, B. T. (1988), "Robustness Properties of a Rule for Monetary Policy," *Carnegie-Rochester Conference Series on Public Policy* 29, pp.173-203.

Ruge-Murcia, F. J. (2003), "Inflation Targeting under Asymmetric Preferences," *Journal of Money, Credit and Banking* 35, pp.763-785.

Surico, P. (2003), "Asymmetric Reaction Functions for the Euro Area," *Oxford Review of Economic Policy* 19, pp.44-57.

Surico, P. (2007), "The Fed's Monetary Policy Rule and U.S. Inflation: The Case of Asymmetric Preferences," *Journal of Economic Dynamics and Control* 31, pp.305-324.

Svensson, L. E. O. (1997), "Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets," *European Economic Review* 41, pp.1111-1146.

Taylor, J. B. (1993), "Discretion versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy* 39, pp.195-214.

Vdovichenko, A. G. and V. G. Voronina (2006), "Monetary Policy Rules and Their Application in Russia," *Research in International Business and Finance* 20, pp.145-162.

Woodford, M. (2003), *Interest and Prices : Foundations of a Theory of Monetary Policy*, New Jersey, Princeton University Press.