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THE RUSSIAN CENTRAL BANK AS A MONETARY TARGETER? AN EMPIRICAL ANALYSIS***

Abstract. The paper reviews the recent conduct of monetary policy and the central bank's rule-based behavior in Russia. Using different policy rules, we test whether the central bank in Russia reacts to changes in inflation, output gap and the exchange rate in a consistent and predictable manner. Our results indicate that during the period of 1993–2002 the Bank of Russia has used *monetary aggregates* as a main policy instrument in conducting monetary policy.

Keywords: monetary policy rules, exchange rate, central bank, Russia.
JEL Classification: E52, E61, F33, F41.

1. INTRODUCTION

The last 10 years have witnessed an upsurge in research on monetary policy rule evaluation, motivated by the seminal paper of Taylor (1993). Following this study, a great number of researchers have investigated the Federal Reserve's behavior using either a simple Taylor rule or some simple variations thereof. Overall, for the US or other developed countries, the Taylor rule explains rather well the behavior of central banks. Most of the

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time they stabilize deviations either from a target level inflation or output gap, using an interest rate instrument.

However, in the case of developing countries and emerging markets, the findings of monetary policy rule evaluations are somewhat inconsistent, with results changing, depending upon time span and model specification (Mohanty and Klau 2003). This can be explained by several facts: given the specific nature of markets in emerging economies, the adequate policy instrument could not only be the short-term interest rate, but also the monetary base (a McCallum rule).

Over the past few years a number of studies have investigated monetary policy rules in emerging markets, finding that even with some shortcomings, central banks in emerging markets follow also some rule-based monetary policy, and that an open-economy version of the Taylor rule can describe much of the variation in short-term interest rates (Calderon and Schmidt-Hebbel 2003, Minella et al. 2003, Mohanty and Klau 2003, Taylor 2001, Torres Garcia 2003).

It is, however, not clear whether this applies to transition economies, where financial markets are even less developed and where the implementation of a money-based monetary policy may face institutional problems. Because of even greater model specification difficulties and problems associated with collecting reliable data, very little research has been done on monetary policy rules in transition economies. This study is one of the first attempts to fill this gap, as it examines the conduct of monetary policy in Russia during the period of 1993–2002. The empirical estimation of alternative rules for monetary policy allows a test of the statement that in financially less developed economies, monetary targeting rules can provide an effective description of the behavior of the monetary authorities – and, in the case of Russia, of its stated objectives (cf. Taylor 2000).

The rest of the paper is organized as follows. Section 2 specifies different empirical models to be used in evaluating monetary policy rules, while Section 3 presents the results of our empirical estimations. Finally, Section 4 draws some conclusions.

2. SPECIFICATION OF THE EMPIRICAL MODEL

Since 1991 the Russian economy has experienced both sharp fluctuations in main macroeconomic variables and deep structural changes. Given this unstable nature of the economic environment in Russia, the task of estimating a monetary policy rule is complicated and no single policy rule equation

might fully capture all aspects of the central bank behavior during this period. Therefore, we will estimate different types of rules, described below.

The recent literature on monetary policy rules primarily distinguishes two types of instrument rules: interest rate based instrument rules and monetary based instrument rules, referred to as the Taylor rule and the McCallum (1988) rule, respectively. The key difference in these rules involves the choice of the instrument in central bank's reaction function in response to changes in macroeconomic conditions. While the Taylor rule, which uses a short-term nominal interest rate as an instrument, is widely used in monetary policy estimations because of its simplicity, the McCallum rule uses the growth rate of monetary base as an instrument, which figured prominently in monetary policy formulation before the 1990s.

Originally, both rules were designed to be used in the evaluation of the monetary policy in large industrial countries, and many observers expressed concerns regarding the effectiveness of this basic policy rules in evaluating the conduct of monetary policy in emerging economies. This concern raises the question as to what kind of modifications are needed to fit better the realities of emerging economies, with underdeveloped financial markets, dependence on primary commodity exports, sharp swings in productivity and relative prices, and high exposure to volatile capital flows.

To address adequately this question, researchers use modified versions of these instrument rules. One general consensus in this regard is that monetary policy makers in emerging economies are more concerned about exchange rate movements than those in mature economies, among other reasons due to the degree of exchange rate pass-through to prices. Hence, the exchange rate has been incorporated, resulting in the open economy version of the central bank's reaction function.

In his seminal work, Taylor (1993) proposed the following, now well-known, policy rule to describe the Fed's behavior in setting the short term interest rates:

(1) $$i = \pi + 0.5y + 0.5(\pi - 2.0) + 2.0,$$

where i is the short term interest rate, π is the inflation over the four previous quarters, y is the percent deviation of real GDP from a target (or "output gap"). The inflation target and the equilibrium real interest rate are set at 2.0 and assumed as constant over time. The "policy maker" is here assumed to care, with equal weights, about deviation of inflation and output from target.

This simple equation cannot be estimated in the original form in the case of Russia, since a relatively stable long-run average inflation does not

exist. The only way to estimate equation (1) is to assume that there is a constant intercept and estimate the coefficients by running a simple regression without specifying the parameters of the model (apart from inflation and output gap). We calculated the output gap by the traditional Hodrick-Prescott (HP) filter.

Following Taylor (2001), we estimate the modified open economy Taylor rule below where the lagged interest rate and the exchange rate are included to control for autocorrelation problems and the reaction of the central bank with regard to the exchange rate.

$$(2) \qquad i_t = \beta_0 + \beta_1 \pi + \beta_2 y_t + \beta_3 xr_t + \beta_4 xr_{t-1} + \beta_5 i_{t-1} + u_t,$$

where xt_t is the growth of the real effective exchange rate, u_t is a white noise error term and $t-1$ indicates the past values of the variables. The remaining variables are the same as in the equation (1). The expected signs of the parameters are as follows: β_0, β_2, $\beta_5 > 0, \beta_1(1 - \beta_5) > 1$, $\beta_3 < 0$, and $\beta_4 < 0$.

The McCallum rule can be expressed as follows:

$$(3) \qquad \Delta b_t = \Delta x^* - \Delta v_t + 0.5(\Delta x^* - \Delta x_{t-1}) + \mu_t,$$

where Δb_t is the rate of growth of the monetary base in percent per year, Δx^* is the target rate of growth of nominal GDP, in percent per year, Δv_t the rate of growth of base velocity, in percent per year, and averaged over the previous 4 years in the original McCallum estimation, and Δx is rate of growth of nominal GDP in percent per year. In this rule the target value of nominal GDP growth is calculated as the sum of the target inflation rate and the long-run average rate of growth of real GDP.

Instead of the monetary base as proposed by McCallum, we will use the monetary aggregate M1 as a policy instrument for monetary policy in Russia (cf. Section 3 for further explanations), although there may be problems associated with the direct control of this aggregate and with significant fluctuations in money velocity. We are also aware of the fact that some existing studies attempt to explain inflation dynamics by the growth of monetary aggregates (e.g. Pesonen and Korhonen 1998, Dabrowski et al. 2003) using those as an explanatory variable. However, our Granger causality tests indicate that at least in the short-run – up to seven months – there is only a Granger causality from prices to monetary aggregates, and not the other way around.

It is widely accepted that the time series data usually suffer some level of autocorrelation, and if it is not corrected the estimation results cannot

be treated as reliable. To correct for the autocorrelation problems, we will use differences rather than levels and add several lags, according to information criteria and statistical significances of the coefficients. Finally, to address the econometric problem caused by several possible structural breaks in the Russian economy during the period 1993–2002, we use dummy variables.

3. EMPIRICAL RESULTS

3.1. Data and Methodology

The availability of Russian data is limited and phenomena such as dollarization and the barter economy may lead to a somewhat biased picture. Some authors (e.g. Falcetti et al. 2000) also believe that the decline in output was overestimated during the first years of the transition period. In our empirical estimations we use monthly data covering the time span 1993–2002. This period has been chosen for data availability reasons. The sources of the data are the International Monetary Fund's International Financial Statistics database, the website of the Bank of Russia, the monthly database of the Vienna Institute for International Economic Studies (WIIW), and the Russian European Centre for Economic Policy (RECEP). For our purposes, we need data on short-term interest rates (refinancing rates), consumer price inflation, monetary aggregates, the output gap, different exchange rate measures (dollar exchange rate, nominal effective exchange rate, and real effective exchange rate). We use output numbers from RECEP and WIIW (industrial production numbers) and deflate them by the monthly consumer price inflation, due to the lack of a monthly GDP deflator.

3.2. Results for the Taylor Rule

When we estimate an open economy version of the Taylor rule – in levels and in differences, the estimated coefficient of inflation is only significant in one specification. The estimated coefficient of the output gap does not show the expected sign or is insignificant for the estimations in levels (other proxies of the output gap show also unsatisfactory results). The estimated coefficients of the exchange rate variables are insignificant. The estimated coefficient of the lagged interest rate is equal to 0.9 and remains relatively stable over the different model specifications, indicating

that the interest rate in a new period is about 90% of the old interest rate plus the effect of the other independent variables (in the level estimations). The long-run response of the central bank can be calculated as follows:

$$\text{(4)} \qquad \beta^{LR} = \frac{\beta_1}{1 - \beta_5},$$

where β^{LR} is the long-run response on inflation, β_1 is the estimated coefficient for year-to-year inflation and β_5 is the estimated coefficient of the interest rate one year before, as defined in equation (2). We get a long-run response of about 0.3 and thus the Taylor principle ($\beta^{LR} > 1$) does not hold. This means that according to our estimations the central bank reacts to a one percent increase of inflation with less than a one percent increase in the short-term nominal interest rate (decrease in real interest rate).

The unsatisfactory result of the output gap might be caused by the facts that the objective of the Bank of Russia was limited to inflation and exchange rate stabilization or that the real time data significantly differed from the *ex-post* data so that we get a biased picture in our estimations (e.g. Orphanides 2001). Overall, the estimation results suggest that a simple Taylor rule and its modifications do not describe well interest rate setting behaviour of the Bank of Russia.[1]

3.3. Results for the McCallum Rule

Because of data availability problems for the M1 series, some missing points have been recovered by using the M2 series, since these two series are highly correlated (over 95%).[2] We deflated the approximated monetary aggregates series with the monthly consumer price index. We expect that the signs of the estimated coefficients will be reversed, as a decrease in M1 means a monetary contraction and a decrease in the interest rate a monetary expansion.

The estimated coefficients are statistically insignificant, indicating a poor performance of the original McCallum rule as specified in equation (3). Moreover, this regression specification has another statistical disadvantage; as it requires discarding a large number of observations in order to average the velocity of money over the four-year period. Because of this drawback,

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[1] We do not show here these results, but they are available from the authors on request.

[2] The monetary base has is also highly correlated with M1 (89%) and its use does not change the results.

we decided to estimate a modified McCallum rule, where the interest rate instrument (of a Taylor type rule) is substituted by a deflated monetary aggregate. Assuming that the Bank of Russia was indeed concerned with the output stabilization during this period, we constructed a real-time series to correct the bias in data. As the regression results indicate, in general a modified McCallum rule performs much better in explaining the behaviour of the Bank of Russia than simple interest rate based rules or the original Taylor rule. The estimated coefficients show the expected signs, but the measure of the output gap is statistically insignificant.

However, the monetary aggregates series is non-stationary and this casts some doubt to the validity of the results. When we correct this statistical problem by differencing (cf. Table A1, first column), the regression results mostly remain unchanged, even though the magnitude of the point estimates was somewhat different. In addition, we include seasonal dummies for December and January (which are highly significant, but not shown in the Table A1), as the Russian money supply shows seasonal spikes during these months. According to Dabrowski et al. (2002) this effect is probably attributable to technical and accounting measures.

The estimated coefficient of the output gap[3] is insignificant, contradicting predictions from theory. We used the yearly output data published in the annual reports of the Bank of Russia, and on the basis of them constructed a monthly series, interpolating and re-basing the available industrial production monthly series from the WIIW. When we run regressions using the forward interpolated "real-time" output gap, the estimated coefficients show always the expected signs and are statistically significant for the period from 1994–2002.[4]

Overall, the estimation results allow us to conclude that the Bank of Russia has been targeting monetary aggregates in its policy decisions. At times of high inflation pressure, or a positive output gap calculated on the basis of the constructed real-time data, the Bank of Russia responded by reducing monetary aggregates in real terms, while at times of exchange rate appreciation the policy response was an expansionary monetary policy. Moreover, these results are not sensitive to the model specification and there are no major statistical problems.

Given the absence of *explicit* inflation targeting in Russia we estimate a "gap model" as defined in Mohanty and Klau (2003). The advantage of

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[3] When we use nominal and real GDP as an alternative to the output gap, the estimated coefficients show no sign of improvement.

[4] Because of the used approximation to real-time data, the results do not necessarily mean that the CBR was concerned with output stabilization, but they indicate that this may have been the case. Further evidence can only be obtained with actual real-time data, which was not available to us.

this model is that it allows us to use an HP measure of trend inflation instead of a targeted level.

(5) $\Delta\log(M1) = \beta_0 + \beta_1(CPI - CPItrend) + \beta_2 y_t + \beta_3(xr_t - xrtrend) +$

$$+ \beta_4(xr_{t-1} - xrtrend_{t-1}) + \beta_5\Delta\log(M1_{t-1}) + u_t,$$

where $M1$ is the deflated monetary aggregate $M1$, $CPItrend$ is the HP filter of the inflation rate and $xrtrend$ is a log of the HP filter of the exchange rate change. We add another lag to inflation to control for the autocorrelation problems. We again include seasonal dummies for December and January, and another dummy for the period before May 1998 is added since the Chow test indicates a structural break at this point. The results are on Table A1 (second column). The regression results are similar to the specification before.

3.4. Testing Responses During Different Time Periods

The Russian economy has experienced different shocks during different time periods, and it would be insightful to see whether the Bank of Russia has responded differently in different periods. First of all, we separate the period before and after 1995, as Chow breakpoint tests indicate a structural break at this time (but, peculiarly, not in August 1998). We use for this purpose the equation ("full model", cf. Table A1) of the following type:

(6) $\Delta\log(M1) = \beta_0 + \beta_1 inf_t - \beta_2 d \, inf_t + \beta_3 inf_{t-1} + \beta_4 y_t - \beta_5 dollorxr_t +$

$$+ \beta_6 ddollarxr_t - \beta_7 dollarxr_{t-1} + \beta_8\Delta\log(M1_{t-1}) +$$

$$+ \beta_9 d_1 + \beta_{10} d_2 + \beta_{11} d + u_t,$$

where d is a dummy variable that is one for the period before 1995 and zero otherwise, and d_1 and d_2 are seasonal dummies for December and January over the sample period, respectively.

The estimation results clearly suggest that the Bank of Russia conducted different monetary policies before and after 1995. The estimated coefficients indicate that before 1995 the Bank of Russia was more concerned with reducing inflation,[5] while after 1995 priorities have shifted towards exchange rate stabilization. These findings are consistent with the official announcements of the Bank of Russia.

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[5] Of course, average inflation before 1995 was also substantially greater than after 1995.

We obtain a similar result when we use a dummy variable for the crawling peg period, from July 1995 through August 1998. As one would expect, the commitment to react to changes in the exchange rate was greater during that period. During the high inflation period, the Bank of Russia attached a greater priority to inflation, while at times of relatively low inflation the main concern was exchange rate stabilization.

4. CONCLUDING REMARKS

This paper examined the conduct of monetary policy in Russia during the period of 1993–2002. We estimated two sets of monetary policy rules, the Taylor rule, and the McCallum rule, using both monthly and quarterly data. The regression results indicate that a simple Taylor rule and its different variations describe poorly the interest rate setting behavior of the Bank of Russia.

The McCallum rule, where the policy instrument is a monetary aggregate, fits best the data. Again, given that the bank of Russia officially adopts the money supply as an intermediate anchor to policy and that, even today, its main *actual* instrument of monetary policy are deposit auctions, this is a consistent result.

Nevertheless, this is in sharp contrast with the recent experience of other advanced emerging markets, were interest rate rules produce a good description of the policy setting behaviour of the monetary authority. The estimated coefficients are significant and remain unchanged across different equation specifications. The results indicate that during the period of 1993–2002 the Bank of Russia has used monetary aggregates as a main policy instrument in conducting monetary policy. Furthermore, the presented results also suggest that before 1995 the Bank of Russia was more concerned with inflation reduction, while after 1995 the primary objective was exchange rate stabilization.

The results on our estimations are backward looking, in the sense that they represent the relationships that existed so far in the data. As the experience of other advanced emerging markets show, the promotion of forward looking behavior among Russian economic agents, aided by the development of stronger institutions – especially by the strengthening of the credibility of the Bank of Russia and the development of its policy instruments, as indicated by the late 2002 reforms, plus the deepening of Russia's financial markets, shall, in time, enable the implementation of a successful interest rate policy rule, coupled with inflation targeting and

a floating exchange rate regime, which shall also reduce the GDP costs of disinflation (as Minella et al. 2003, show for the Federal Republic of Brazil).[6]

APPENDIX

Table A1. Testing a McCallum rule for Russia, 1993–2002

Independent variable	Difference model	Gap model	Full Model
Intercept	0.02	0.01	0.01
	(0.00)***	(0.00)**	(0.00)***
Quarter-to-quarter-inflation	–0.28	–0.26	
	(0.06)***	(0.07)***	
Quarter-to-quarter-inflation (–1)	0.22	0.12	
	(0.05)***	(0.08)*	
Monthly inflation			–0.17
			(0.15)
Dummy (for period before 1995)* monthly inflation			–0.50
			(0.20)**
Monthly inflation (–1)			–0.13
			(0.07)*
Output gap (ex post data)	–0.01	–0.13	0.10
	(0.08)	(0.08)	(0.09)
Growth in bilateral dollar exchange rate	–0.23	–0.26	–0.29
	(0.05)***	(0.05)***	(0.08)***
Dummy for period before 1995 growth in bilateral dollar exchange rate			0.27
			(0.13)**
Growth in bilateral dollar exchange rate (–1)	0.13	0.30	0.11
	(0.05)***	(0.05)***	(0.05) **
Growth rate of M1(–1)	0.29	0.18	0.28
	(0.07)***	(0.07)***	(0.07)***
R square (adjusted)	0.74 (0.72)	0.74 (0.72)	0.76 (0.74)
Durbin Watson statistics	2.02	1.70	1.97
Breusch–Godfrey test	No rejection	No rejection	No rejection

Note: 1% and 1% change of the variables used for the estimations are scaled to 0.01; the Breusch–Godfrey serial correlation LM-test (with no autocorrelation as a null hypothesis) was conducted for twelve lags; (–1) indicates a first lag; the effective sample period is 1993:3 – 2002:12 since we lose two months because of lags and differences; in the case of gap model (third column) we deduct the HP-trend from quarter-to-quarter inflation and the growth in the dollar exchange rate; standard errors are in parentheses, the asterisks indicate levels of significance at the 10 (*), 5(**) or 1 (***) percent level.

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[6] As a sign of this, Taylor rule regressions run only for the period after 2000, do show the expected signs for the variables, but most of them are non-significant.

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CZY BANK CENTRALNY ROSJI STOSUJE KRYTERIUM MONETARNE? ANALIZA EMPIRYCZNA

(Streszczenie)

W artykule dokonaliśmy przeglądu zasad polityki monetarnej prowadzonej przez bank centralny Rosji. Stosując różne podejścia do tych zasad, testujemy czy bank centralny Rosji reaguje na zmiany inflacji, luki produkcyjnej oraz kursu walutowego w przewidywalny sposób. Nasze badania prowadzą do wniosku, że w latach 1993–2002 bank centralny Rosji przyjmował za kryterium agregat pieniężny jako główny instrument prowadzonej polityki monetarnej.