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Monetary Policy Rules for Russia

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Contents

Akram Esanov, Christian Merkl, Lúcio Vinhas de Souza

Monetary Policy Rules for Russia

Tiivistelmä

Tässä tutkimuksessa luodaan katsaus Venäjän keskuspankin viimeaikaiseen rahapolitiikkaan ja sääntöihin, jotka siihen vaikuttavat. Tutkimuksessa testataan erilaisia politiikkasääntöjä tarkastelemalla, onko keskuspankki reagoinut inflaation, tuotantovajeen ja valuuttakurssin muutoksiin johdonmukaisella ja ennustettavalla tavalla. Tulosten mukaan vuosina 1993–2000 Venäjän keskuspankki käytti raha-aggregaatteja päärahapolitiikkakeinonaan.

Asiasanat: rahapolitiikkasäännöt, valuuttakurssi, keskuspankki, Venäjä

Monetary Policy Rules for Russia

Akram Esanov
Christian Merkl
Lúcio Vinhas de Souza[1]

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.

Key words: Monetary policy rules; exchange rate; central bank; Russia.

JEL classification: E52, E61, F33, F41.

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1. Introduction

The last ten years have witnessed an upsurge in research on monetary policy rule evaluation motivated by the seminal paper of Taylor (Taylor, 1993). Following this study, a great number of researchers have investigated the Federal Reserve's (the US Central Bank) behavior using either a simple Taylor rule or some simple variations thereof, like including lags of short-term interest rate or output deviations. Overall, for the US or other developed countries, the Taylor rule explains rather well the behavior of central banks. Most of the 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, such an outcome is not straightforward, as, 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 or the exchange rate. One must note that the inclusion of the exchange rate in the central bank's reaction function does not contradict the objectives of central banks, if exchange rate stabilization is a precondition for both output stabilization and bringing down inflation to a targeted level (Taylor, 2000).

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 also follow 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 and 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 transitional 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.

The rest of the paper is organized as follows. Section 2 describes the evolution of the monetary policy instruments and the monetary regime followed by the Russian central bank in a chronological order. Section 3 specifies different empirical models to be used in evaluating monetary policy rules, while Section 4 presents the results of our empirical estimations. Finally, Section 5 draws some conclusions.

2. Development of Monetary Policy in Russia

The dissolution of the Soviet Union at the end of 1991 did not immediately lead to the establishment of a truly *Russian* monetary authority (the Bank of Russia, or CBR), capable of conducting an independent and effective monetary policy,[2] as, until mid 1993, some of the former republics of the Soviet Union still used the ruble, the Russian national currency, and central banks of those republics conducted their own credit policy simultaneously with the Bank of Russia. Only after 1993 the Bank of Russia started to conduct its own independent monetary policy, although the scope of the policy was limited by the need to finance a huge budget deficit, mainly caused by a dramatic decline in output (see Figure 1). This loose monetary stance continued until the mid of 1995, when the Russian economy started showing signs of stabilization and a new law on the Bank of Russia was passed, providing some degree of legal independence to the Bank of Russia in conducting monetary policy.[3]

These positive developments allowed the Bank of Russia to adopt a tighter monetary policy and to introduce a pegged exchange rate regime with a

[2] The Central Bank of the Russian Federation (Bank of Russia) was founded on 13 July 1990, based on the Russian Republic Bank of the State Bank of the Soviet Union. On 2 December 1990, the Supreme Soviet of the RSFSR passed the Law "On the Central Bank of the RSFSR (Bank of Russia)", which declared the Bank of Russia a legal entity and the main bank of the Russian Federation.

[3] Nevertheless, still today the Bank of Russia maintains some functions not traditionally seen as belonging to a central bank: for instance, in spite of being a banking supervisor and regulator, the CBR has a majority stake in the largest Russian bank (and state owned bank), Sberbank Rossii, which has 23 percent of all banking assets, 70 percent of household deposits, 20 percent of corporate deposits and 21,000 branches across Russia, and, until late 2002, also had participation in the second largest state owned bank, the VTB. Further, acting as an agent for the Ministry of Finance, it set up and manages the government securities market, known as the GKO market.

crawling band against the US dollar, from July 1995 onwards. As a result of these measures inflation slowed down (see Figure 2). Furthermore, because of favorable developments in the local securities market, direct credit to the government significantly decreased and the Bank of Russia started to conduct monetary policy through indirect instruments, such as interest rates and reserve requirements. However, the start of the Asian crisis of 1997 spread a negative shock throughout emerging markets. This external shock decreased investment confidence in Russia and caused capital outflows, forcing the Bank of Russia to defend the band. Although during the exchange market interventions in November 1997 the Bank of Russia lost over $6 billion of its liquid reserves, which was equal to two thirds of total reserves at that time, the exchange band was successfully defended for a while.

Despite these efforts of the Bank of Russia, due to the severe financial crisis of August 1998, the government was forced to default its domestic debt obligations. The ruble was devalued and the exchange rate band was abandoned, leading to the adoption of a "dirty" floating regime (see Figure 3, where a *de facto* targeting of the nominal exchange rate also after 1998 seems apparent).[4] One consequence of the sharp depreciation was a rapid acceleration in inflation.

[4] This may indicate that the choice of a more flexible exchange rate regime, contrary to earlier studies (see Dabrowski et al., 2002), could have been welfare improving for Russia, due to the shock-absorbing properties of such regimes –conditional on the quality of institutions and on the consistency of the policy mix (see Vinhas de Souza and Ledrut, 2003)– and given the higher propensity of commodity-based economies to be buffeted by external shocks, which are increased by having harder exchange rate regimes (see Babula and Otker-Robe, 2003).

Although ruble-denominated debt was restructured, investor confidence kept declining because of an increase in political uncertainty and private capital outflows. In such a situation, the Bank of Russia, fulfilling its role as a lender of last resort, attempted to preserve the financial system, by injecting liquidity into banking system through a reduction of reserve requirements and extending large amounts of new credits. However, base money declined significantly in real terms, reflecting the sharp decline in output and increased use of non-monetary forms of payment.

Figure 1. GDP Index and M1 (Index1993=100)

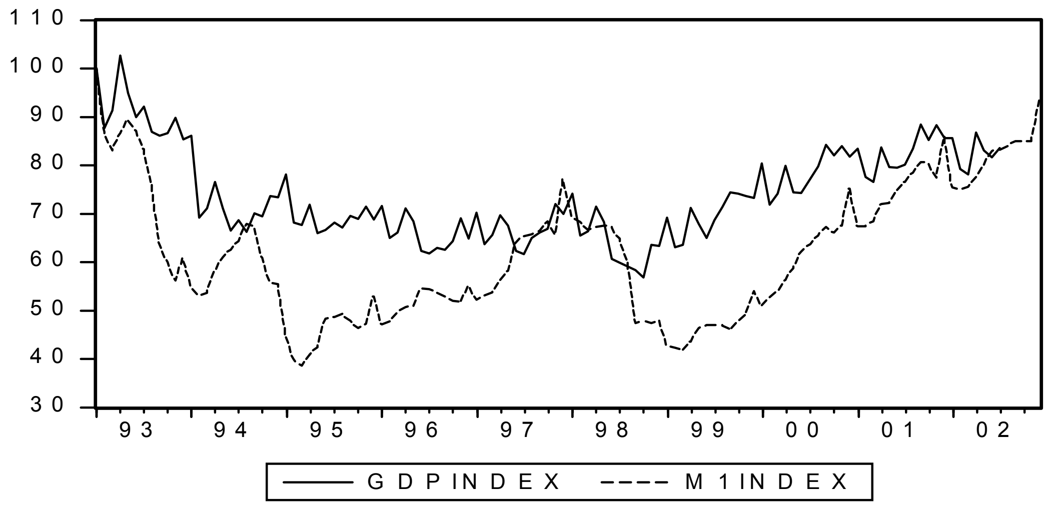


Figure 2. Refinancing Rate and Inflation (Quarterly Based, in percent)

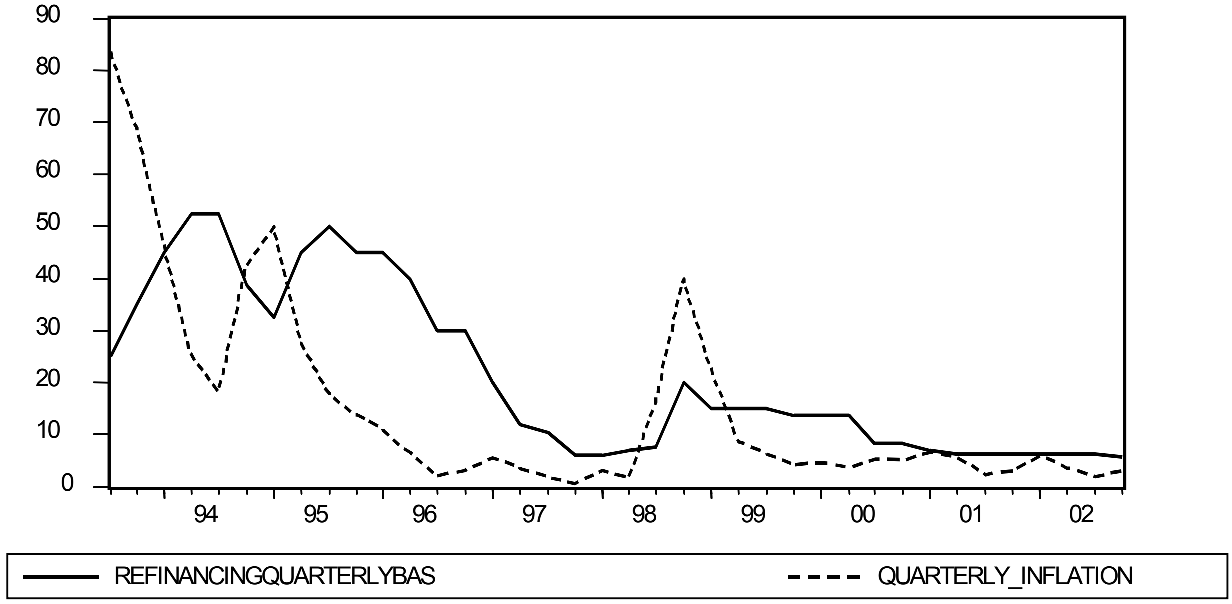
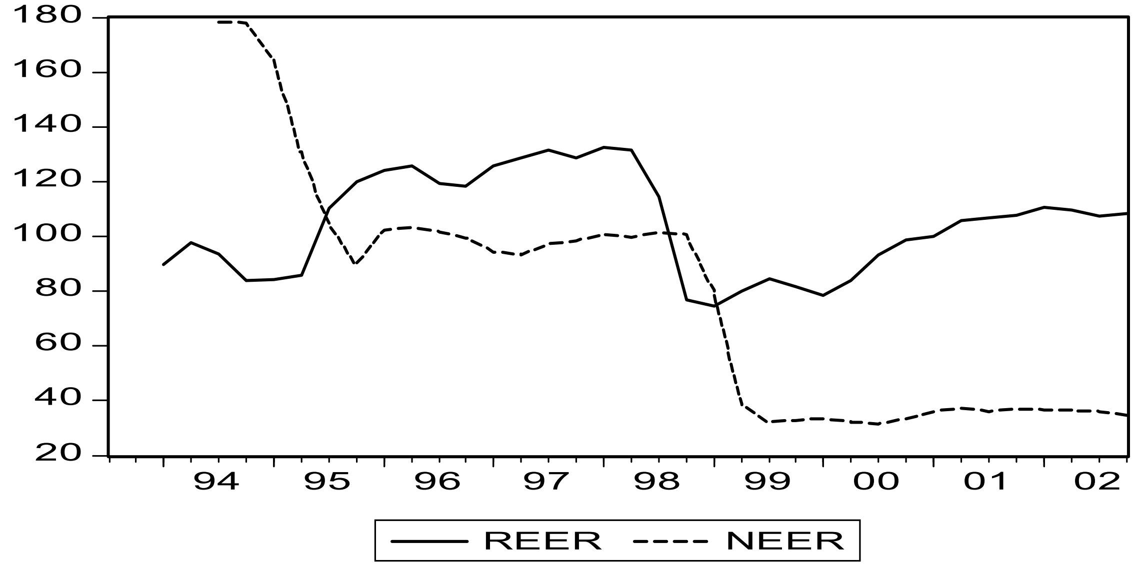


Figure 3. Real and Nominal Effective Exchange Rates (1995=100)



As a consequence of the renewed inflationary pressures in 1999, one of the main objectives of the Bank of Russia was to bring inflation down, initially to 30 percent and later to a 12–14 percent range, while keeping output decline in the range of 1–3 percent, within the framework of a "dirty float"[5] of the ruble. To achieve this objective, monetary policy was tightened by reducing net credit to banking system. Because of this measure, inflation fell sharply and the exchange rate depreciation stopped. Furthermore, fiscal performance significantly improved, due to the approval of a new package of fiscal measures and improvements in revenue collection. As world energy prices increased (over 50% of Russia's exports are of energy-related products –oil and gas), resulting in trade surpluses, renewed capital inflows and a resumption of growth in Russia. The effects of these developments on the (real) exchange rate caused it to become one of the main targets of monetary policy (see Figure 3).

According to the Bank of Russia, the main objective of its monetary policy in 2000 was to reduce inflation to 18 percent and to achieve an annual growth rate of GDP of 1.5 percent. However, the continuing strength of the balance of payments and the Bank of Russia's reluctance to permit a real appreciation of the ruble has placed increasing pressure on monetary policy. Given this continued favorable economic situation in recent years, the Bank of Russia has placed more weight on the exchange rate stability, while accepting the inflationary consequences of such a decision. This policy of the Bank of

[5] See the classification of Edwards and Savastano (1999).

Russia has slowed the *real* appreciation of the ruble and reduced inflation, even though the pace of disinflation has been slower than the one formally targeted by the authorities.[6]

3. Specification of the Empirical Model

As described above, 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 rule (McCallum, 1988), respectively.[7] 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

[6] The policy relevance of such concerns with real appreciation are somewhat doubtful, as is unclear if the real exchange rate of the Russian ruble is above its long run equilibrium value, or merely recovering from an undershooting (see IMF, 2003).

[7] Razzak (2001) shows that the McCallum and Taylor rules are, as one should expect, co-integrated.

rate of monetary base as an instrument, which figured prominently in monetary policy formulation before the nineties.[8]

To address adequately the question of the adequacy of those rules for emerging markets, researchers use modified versions of them. One general consensus in this regard is that monetary policymakers in emerging economies are more concerned about exchange rate movements than those in mature economies (for instance, see Williamson, 2000), 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. Moreover, some researchers, such as Ball (1998), even suggest that in a small open economy the central bank could use a weighted average of the nominal interest rate and the exchange rate as an instrument. However, this type of "hybrid rule" has not been popular among empirical researchers because of uncertainties involved in determining weights.[9]

Taylor rule

Following Taylor (2001), we estimate the modified open economy Taylor rule below:

[8] Perhaps the most traditional of those *quasi* "monetary targeters" was the German central bank, the Deutsche Bundesbank (more precisely, the Bundesbank announced M3 as an intermediate target –"Zwischenziel", it did not use it as an instrument or operational target). Several works (see, for instance, Clarida and Gertler, 1996) put into question the reliance of the Bundesbank on monetary aggregates even during its "golden age".

[9] Ball-type rules are hybrid rules, related to the Monetary Conditions Index (MCI) literature (see Freedman, 1996). An MCI is an indicator of the stance of monetary policy, which does not only consider an output target but also the influence of the exchange rate on inflation.

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

where xr_t is the growth of the real effective exchange rate, u_t is a white noise error term and *t-1* indicates lagged values of the variables. 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 $\beta_4 < 0$.

Money based rules

As discussed in Section 2, the short-term interest rate has not been the most important instrument in conducting monetary policy in Russia.[10] Uncertainty in measuring real interest rates, shallow financial markets and big shocks to investment or net exports may make monetary aggregates a preferred instrument. This may be the case in Russia, especially during the nineties.

The original McCallum rule can be expressed as follows:

$$\Delta b_t = \Delta x^* - \Delta v_t + 0.5(\Delta x^* - \Delta x_{t-1}) + \mu_t \qquad (2)$$

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 four 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.

10 Currently the Bank of Russia officially adopts a money supply –aggregate M2– as an intermediate anchor to policy.

We will initially use the M1 monetary aggregate as the policy instrument for monetary policy in Russia. We are aware that some studies attempt to explain inflation in Russia using monetary aggregates (see e.g. Pesonen and Korhonen, 1998, Dabrowski et al., 2003). However, our Granger causality tests indicate that at least in the short-run –up to seven months– there is only Granger causality from prices to monetary aggregates, and not the other way around.

It is widely accepted that this type of 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 lags, according to information criteria and the statistical significances of the coefficients.

A Hybrid Rule

Ball (1998) argues that interest rate based Taylor rules are inefficient. He stresses that monetary policy affects the economy through exchange rate as well as interest rate channels. Ball sets up a simple model with an open economy IS curve, Phillips curve and a link between interest and exchange rate. Rearranging terms yields the following optimal policy rule:

$$wi_t + (1-w)xr_t = \alpha y_t + \beta(\pi_t + \delta xr_{t-1}) + u_t \qquad (3)$$

where w is a weight that depends on the calibration of the model and δ is the effect of a one percent exchange rate appreciation on inflation, α and β also depend on calibrations of the model. The calibration parameters we use will be based on the work of Ball (1998). For a robustness test, we use different weights and check their effect on the estimated 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.

4. Empirical results

Data and Methodology

Data for Russia have to be treated cautiously. The availability is limited and phenomena such as dollarization and the barter economy may lead to a somewhat biased picture. Some authors (see e.g. Falcetti et al., 2000) also believe that the "transitional recession" decline in output was overestimated during the first years of the transformation period.[11] In our empirical estimations we use monthly data covering the time span 1993-2002. This period has been chosen for data availability reasons. Alternatively, in several occasions we use quarterly data to check the robustness of our results. 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

[11] For instance, Åslund (2001) estimates that, for an official figure of just 60.2 percent of the Russian 1989 GDP in 1995, the actual figure, after taking into account, among other things, illegal and under-reported activities, was an amazing 94 percent, showing, in other terms, a mere marginal GDP fall.

Centre for Economic Policy (RECEP). We use 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), the labor share as a proxy for the output gap, and the budget deficit. Our output numbers are from RECEP and WIIW (industrial production, as a proxy for GDP), deflated by the monthly consumer price inflation, due to the lack of a monthly GDP deflator.

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 (see Table 1). The estimated coefficient of the output gap does not show the expected sign and is insignificant for the estimations in levels (other proxies of the output gap, such as the real unit labor cost suggested by Gali and Gertler (1999), also shows 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 percent of the old interest rate plus the effect of the other independent variables (in the levels estimations). The long-run response of the central bank can be calculated as follows:

$$\beta^{LR} = \frac{\beta_{\inf}}{1 - i_{t-1}} \qquad (4)$$

where β^{LR} is the long-run response on inflation and $\beta_{\inf}$ is the estimated coefficient for year-to-year inflation. We get a long-run response of about 0.3 and thus the Taylor principle (β^{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 (leading, therefore, to a decrease in the *real* interest rate).

This unsatisfactory result of the output gap might be explained either if the objective of the Bank of Russia was limited to inflation and exchange rate stabilization or if the "real time" output data significantly differed from the ex-post-data, so that we get a biased picture in our estimations (see e.g. Orphanides, 2001). Assuming that the Bank of Russia was indeed concerned with output stabilization during this period, we constructed a real-time series to correct the bias in data. We used the yearly output data published in the annual reports of the Bank of Russia,[12] 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 this "real-time" output gap, its' estimated coefficients are always non-significant and no substantial changes are observed in the regressions. Overall, the estimation results suggest that a simple

[12] For differences between the original WIIW series and the "real-time" series, see Graph 1 in the Appendix.

Taylor rule and its modifications do not describe well interest rate setting behavior of the Bank of Russia. [13]

Results for the McCallum Rule

Here, the expected signs of the estimated coefficients should be reversed, as a decrease in the monetary aggregate 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 (2). 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, we decided to estimate a modified McCallum rule, where the interest rate instrument (of a Taylor type rule) is substituted by a real monetary aggregate. As the monetary aggregates series is non-stationary, we correct this statistical problem by differencing. In addition, we include seasonal dummies for December and January, 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. As the regression results indicate (see Table 2, second column), in general a modified McCallum rule performs much better in explaining the behavior of the Bank of Russia than simple interest rate based rules. The estimated coefficients show the expected

[13] We do not present those results, but they are available from the authors upon request.

signs, but the measure of the output gap is still statistically insignificant [14] and/or show the wrong signs.[15] 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 (see Table 3). The same results are obtained when we use a monetary base aggregate that is actually directly controlled by the monetary authority, namely M0, and M0 plus households holding (data kindly supplied by the IMF), to account for the degree of dollarization in the Russian economy (see Table 4). [16]

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 also

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

[15] As standard literature uses the gap as a measure of "excess output" around a long run trend – a feature of a mature economy, and in which this excess output causes concerns about future inflation. The CBR may respond significantly positively to output growth, i.e., increasing money after an output increase, if it *assumes it as the result of technological improvements*. That is, interest rate should not change after a *permanent* output increase, but the money supply should increase to accommodate the shock.

[16] 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.

estimate a "gap model" as defined in Mohanty and Klau (2003), using a GMM estimator[17]. The advantage of this model, beyond correcting for endogeneity, is that it allows us to use an HP measure of trend inflation instead of a targeted level, as given by (5) below

$$\Delta(\log(M1)) = \beta_0 + \beta_1(CPI - CPItrend) + \beta_2 y_t + \beta_3(xr_t - xrtrend) + \\ + \beta_4(xr_{t-1} - xrtrend_{t-1}) + \beta_5 \Delta(\log(M1_{t-1}) + u_t \qquad (5)$$

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 autocorrelation. We again include seasonal dummies for December and January. Another dummy for he period before May 1998 is added, since the Chow test indicates a structural break at this point. The results are on Table 2 (third column).

The regression results indicate again that the Bank of Russia reacted to above trend inflation with a contraction in real monetary aggregates. If the dollar exchange rate in the current period was higher than the HP-trend, the Bank of Russia also responded with a reduction in monetary aggregates. All estimated coefficients are significant and exhibit the expected signs. Those results remain when using M0 and M0 plus dollar holdings instead of M1.

Results for the Ball rule

The estimation results for the open economy Ball model are mixed and unstable (see Table 5). It appears that the results suffer from a severe and persistent

[17] The instruments list used included lagged values of the CPI, output gap and exchange rate.

autocorrelation problem, unless we attach a 100 percent weight to the real effective exchange rate and limit the sample period to 1996–2002. However, this last specification seems unrealistic, among other reasons, given central banks' limited foreign reserves (and the given that then equation (3) actually becomes an identity). Nevertheless, this outcome may be a reflection of an actual targeting of the exchange rate by the Bank of Russia from 1995 onwards.

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. Since the "money based" model performs best in the previous estimations, we will test it for different time periods.[18] First of all, we separate the period before and after 1995 (the time of the introduction of the exchange rate targeting regime), as Chow breakpoint tests indicate a structural break at this point in time (and *not* in August 1998) [19]. We use for this purpose the equation (6) below:

$$\begin{aligned}\Delta(\log(M1)) &= \beta_0 + \beta_1 \inf_t + \beta_2 d \inf_t + \beta_3 \inf_{t-1} + \beta_4 y_t + \beta_5 dollarxr_t + \\ &+ \beta_6 ddollarxr_t + \beta_7 dollarxr_{t-1} + \beta_8 \Delta(\log(M1_{t-1})) + \beta_9 d_1 + \beta_{10} d_2 + \beta_{11} d + u_t\end{aligned} \quad (6)$$

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

18 Briefly, the results of estimating the interest rate rule varying the timeframe are similar to the ones obtained before: they suffer, again, from insignificance problems.

19 Detken and Gaspar (2003) show that a monetary authority that cares about price deviations will also care about exchange rate developments, even without formally targeting those. Therefore, exchange rate targeting may be *observationally equivalent* to inflation targeting.

the sample period, respectively. The estimation results clearly suggest (see Table 2, column 4) 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,[20] while after 1995 priorities have shifted towards exchange rate stabilization. These findings are consistent with the official announcements of the Bank of Russia, and are robust to the use of different monetary aggregates.

We obtain similar results when using a dummy variable for the crawling peg period, from October 1994 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.

5. Concluding Remarks

This paper examined the conduct of monetary policy in Russia during the period of 1993–2002. We estimated three sets of monetary policy rules, the Taylor rule, the McCallum rule and the hybrid Ball rule, using both monthly and quarterly data. The regression results indicate that a simple Taylor rule and its different variations, where the short-term interest rate was used as a policy instrument, describes poorly the interest rate setting behavior of the Bank of Russia.

[20] Of course, average inflation before 1995 was also substantially greater than afterwards.

The McCallum rule, where the policy instrument is a monetary aggregate, fits best the data. Again, given that the bank of Russia officially adopts a 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 behavior of the monetary authority (see, for instance, Mohanty and Klau, 2003, Minella et al., 2003, Torres Garcia, 2003). 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 results also suggest that *the* structural break in series happened in 1995 (with the introduction of a exchange rate pegging regime) and not in 1998: before 1995 the Bank of Russia was more concerned with inflation reduction, and afterwards the primary objective was exchange rate stabilization. The estimation results of the hybrid, or Ball rule, where a weighted average of the interest rate and the exchange rate is used as a policy instrument, draw a mixed picture. Depending on the choice of the weights, results change and most of the time the estimated coefficients are insignificant.

The results on our estimations, of course, 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, shows for a similarly advanced emerging market, Brazil, which is a also a large economy, with an important primary sector and a history of macro instability)[21].

[21] 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 (also, given the very short time period, the number of observations is very limited).

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Appendix

Table 1: Testing a Taylor rule for Russia, 1993-2002.

Independent variable	**Open economy rule – in levels (with yearly inflation)**	**Open economy rule – in levels (with quarterly inflation)**	**Open economy rule – in differences (with yearly inflation)** [1]	**Open economy rule – in differences (with quarterly inflation)** [1]
Intercept	3.674 (2.626)	2.5922 (2.5667)	-2.3490 (1.7837)	-2.4329 (1.8413)
Year-to-year consumer price inflation[1]	0.0341 (0.0095) ***		0.0556 (0.0585)	
Quarter-to-quarter inflation[1]		0.3931 (0.3143)		0.0657 (0.2990)
Quarter-to-quarter inflation (-1) [1]		-0.0214 (0.2859)		-0.0345 (0.3193)
Output gap (ex post data)	-0.1732 (0.5103)	0.0206 (0.4917)	1.011 (0.443) **	1.0133 (0.4611) **
Growth USD exchange rate	-10.9646 (21.2278)	-23.0876 (24.4396)	10.2635 (21.1343)	11.3104 (23.6234)
Growth in USD exchange rate (-1)	12.3213 (20.1511)	-6.3265 (22.4015)	32.4323 (20.2822)	33.3887 (22.6969)
Interest rate (-1) [1]	0.8823 (0.0342) ***	0.8902 (0.0341) ***	-0.2393 (0.0967) **	-0.2276 (0.0969) **
R square	0.94	0.94	0.10	0.10
Adjusted R square	0.94	0.94	0.06	0.04
Durbin Watson statistics	2.54	2.56	2.19	2.16
Breusch-Godfrey test	No rejection	No rejection	No rejection	No rejection

Notes:
-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.
-[1] In this model the refinancing rate in differences is the dependent variable. Inflation rates and the lagged interest rate are used in differences too.
-Standard errors are in parentheses. The asterisks indicate levels of significance a 10 (*), 5(**) or 1 (***) percent level.

Table 2: Testing a McCallum rule for Russia, 1993-2002, using M1.

Independent variable	**Difference model**	**Gap model**[1)]	**Full Model**
Intercept	0.0150 (0.0042) ***	0.0108 (0.0047) **	0.0123 (0.0045) ***
Quarter-to-quarter-inflation	-0.0028 (0.0006) ***	-0.0026 (0.0007) ***	
Quarter-to-quarter-inflation (-1)	0.0022 (0.0005) ***	0.0012 (0.0008) *	
Monthly inflation			-0.0017 (0.0015)
Dummy for period before 1995 * monthly inflation			-0.0050 (0.0020) **
Monthly inflation (-1)			-0.0013 (0.0007) *
Output gap (ex post data)	-0.0001 (0.0497)	-0.0013 (0.0008)	0.0010 (0.0009)
Growth in bilateral dollar exchange rate	-0.2319 (0.0497) ***	-0.2566 (0.0529) ***	-0.2920 (0.0846) ***
Dummy for period before 1995* growth in USD exchange rate			0.2701 (0.1262) **
Growth in USD exchange rate (-1)	0.1330 (0.0483) ***	0.2955 (0.0533) ***	0.1107 (0.0480) **
Growth rate of M1(-1)	0.2938 (0.0663) ***	0.1814 (0.0675) ***	0.2821 (0.0666) ***
Seasonal dummy for January	-0.1271 (0.0131) ***	-0.1123 (0.0137) ***	-0.1294 (0.0130) ***
Seasonal dummy for December	0.0807 (0.0111) ***	0.0845 (0.0112) ***	0.0885 (0.0107) ***
Dummy for before May 1998		-0.0159 (0.0065) **	
Dummy for the period before 1995			0.0431 (0.0231) *
R square	0.74	0.74	0.76
Adjusted R square	0.72	0.72	0.74
Durbin Watson statistics	2.02	1.70	1.97
Breusch-Godfrey test	No rejection	No rejection	No rejection

Notes:
-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.
-[1)] In this case we deduct the HP-trend from quarterly inflation and the growth in the dollar exchange rate.
-Standard errors are in parentheses. The asterisks indicate levels of significance at 10 (*), 5(**) or 1 (***) percent level.

Table 3: Testing a McCallum rule for Russia, 1994-2002, using M1.

Independent variable	**Difference model with "real time" output gap**	**Difference model with ex-post output gap**
Intercept	0.0164 (0.0040) ***	0.0157 (0.0043) ***
Quarter-to-quarter-inflation	-0.0025 (0.0006) ***	-0.0026 (0.0006) ***
Quarter-to-quarter-inflation (-1)	0.0016 (0.0006) ***	0.0018 (0.0006) ***
Output gap (real time data – forward interpolation)	-0.0022 (0.0009) **	
Output gap (ex post data)		-0.0006 (0.0010)
Growth in real effective exchange rate	0.4311 (0.0671) ***	0.4020 (0.0727) ***
Growth in real effective exchange rate (-1)	-0.2738 (0.0642) ***	-0.2544 (0.0671) ***
Growth rate of M1(-1)	0.2700 (0.0659) ***	0.2494 (0.0688) ***
Seasonal dummy for January	-0.1313 (0.0125) ***	-0.1275 (0.0131) ***
Seasonal dummy for December	0.0861 (0.0107) ***	0.0825 (0.0108) ***
R square	0.78	0.77
Adjusted R square	0.76	0.75
Durbin Watson statistics	2.03	1.98
Breusch-Godfrey test	No rejection	No rejection

Notes:
-The Breusch-Godfrey serial correlation LM-test (with no autocorrelation as a null hypothesis) was conducted for twelve lags.
-(-1) indicates a first lag
-Standard errors are in parentheses. The asterisks indicate levels of significance at 10 (*), 5(**) or 1 (***) percent level.

Table 4: Testing a McCallum rule for Russia, 1994-2002, using M0 and M0 plus USD holdings.

Independent variable	**Difference model with “real time” output gap (M0)**	**Difference model with ex-post output gap (M0)**	**Difference model with “real time” output gap (M0 plus USD)**	**Difference model with ex-post output gap (M0 plus USD)**
Intercept	0.0176 (0.0049) ***	0.0182 (0.0050) ***	0.0088 (0.0043) **	0.0088 (0.0043) **
Quarter-to-quarter-inflation	-0.0026 (0.0007) ***	-0.0029 (0.0007) ***	-0.0016 (0.0006) **	-0.0015 (0.0006) **
Quarter-to-quarter-inflation (-1)	0.0022 (0.0006) ***	0.0024 (0.0006) ***	0.0014 (0.0006) **	0.0013 (0.0006) **
Output gap (real time data – forward interpolation)	-0.0015 (0.0009) *		0.0007 (0.0008)	
Output gap (ex post data)		-0.0005 (0.0009)		-0.0007 (0.0008)
Growth in real effective exchange rate	-0.2545 (0.0532) ***	-0.2385 (0.0538) ***	0.0770 (0.0507)	0.0600 (0.0505)
Growth in real effective exchange rate (-1)	0.0917 (0.0537) *	0,0922 (0.0547) *	-0.1133 (0.0459) **	-0.1177 (0.0460) **
Growth rate of M0(-1)	0.1856 (0.0711) *	0.1799 (0.0719) **	0.5177 (0.1046) ***	0.4929 (0.1049) ***
Seasonal dummy for January	-0.1167 (0.0135) ***	-0.1201 (0.0137) ***	-0.0357 (0.0127) ***	-0.0371 (0.0129) ***
Seasonal dummy for December	0.0424 (0.0133) ***	0.0399 (0.0135) ***	0.0203 (0.0121) *	0.0232 (0.0120) *
R square	0.66	0.65	0.48	0.48
Adjusted R square	0.63	0.62	0.43	0.44
Durbin Watson statistics	2.10	2.10	2.38	2.39
Breusch-Godfrey test	No rejection	No rejection	No rejection	No rejection

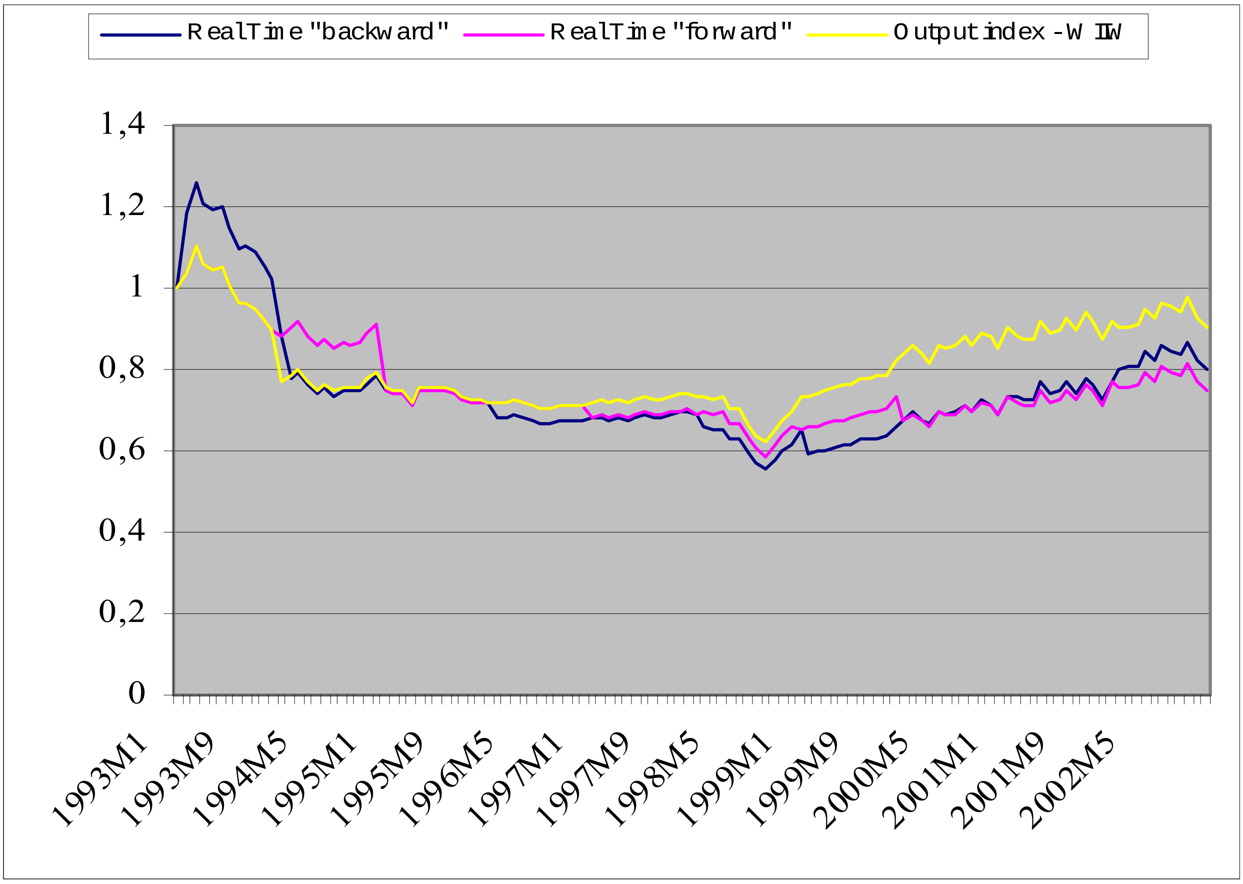
Notes:
-The Breusch-Godfrey serial correlation LM-test (with no autocorrelation as a null hypothesis) was conducted for twelve lags.
-(-1) indicates a first lag
-Standard errors are in parentheses. The asterisks indicate levels of significance at 10 (*), 5(**) or 1 (***) percent level.

Table 5: Testing a Ball rule for Russia, 1994-2002.

Independent variable	**Exchange rate weight=1**	**Exchange rate weight=0.5**
Intercept	15,4424 (6.1673) **	29.5188 (18.7053)
Output gap	0.8673 (0.3644) **	-1.2445 (1.1052)
Output gap (-1)	0.9202 (0.4386) **	-0.2921 (1.3301)
Output gap (-2)	0.5224 (0.3628)	-1.0559 (1.1005)
Month-to-month inflation + 0.5 * (real effective exchange rate (-1))	0.9126 (0.1538) ***	0.8054 (0.4665) *
Month-to-month inflation (-1) + 0.5 * (real effective exchange rate (-2))	-0.7067 (0.1518) ***	0.2628 (0.4603)
R square	0.75	0.20
Adjusted R square	0.73	0.16
Durbin Watson test statistics	0.97	0.16
Breusch-Godfrey test	Rejection	Rejection

Notes:
-The Breusch-Godfrey serial correlation LM-test (with no autocorrelation as a null hypothesis) was conducted for twelve lags.
-(-1) indicates a first lag.
-Standard errors are in parentheses. The asterisks indicate levels of significance at 10 (*), 5(**) or 1 (***) percent level.

Graph 1: Differences between Ex-Post and “Real Time” Data



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