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Breaking monetary policy rules in Russia



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Abstract

In this paper we estimate whether monetary policy rules of Bank of Russia have changed during the recent past. Russia has moved towards inflation targeting throughout past years, and this is reflected in our empirical estimations. We start by estimating various monetary policy rules for Russia, concluding that a variant of Taylor rule depicts Bank of Russia's monetary policy quite well during the past decade or so. Moreover, there clearly have been two breaks in the coefficients of the estimated monetary policy rule, possibly signifying shift towards traditional inflation targeting, but also the current recent economic turbulence.

Keywords: Russia, monetary policy, monetary policy rules

1. Introduction and motivation

In this paper we want to discover whether monetary policy rules of the Bank of Russia have changed over the past years. This paper follows a previous study by Korhonen and Nuutilainen (2016), where we estimated policy rules for Russia in a rolling window, and found that the estimated policy rule parameters do change over time. Here, the main focus is on the breaks of the estimated rules. A priori, breaks in the rules are expected, given changes in the explicit monetary policy framework as well as further development of Russia's financial system.

Previous studies (see section Korhonen and Nuutilainen (2016) and a short literature survey therein) have broadly speaking determined that in recent years Russia's monetary policy can be described in terms of Taylor rule, where central bank's steering interest rate responds to deviations from central bank's inflation target as well as to output gap. Central bank's aim is to stabilize inflation around its target and output around the level of potential output. In Russia, as well as many other open economies, exchange rate is often included in estimations as well.

In this paper we find that estimated monetary policy rules do indeed contain breaks. We observe a break in the estimated Taylor rule in February 2015, broadly coinciding with formal start of inflation targeting. It is also interesting that before summer of 2006 Taylor rule does not appear to explain the Bank of Russia's interest rate policy. This would hint that changes in Russia's monetary policy have been gradual, and the central bank perhaps behaved differently.

This paper is structured as follows. Next section offers short introduction to Russia's monetary policy. Section three introduces the data as well as the estimated monetary policy rules. In the fourth and fifth sections we estimate different versions of monetary policy rules, with and without breaks. Sixth section concludes.

2. Evolution of monetary policy in Russia

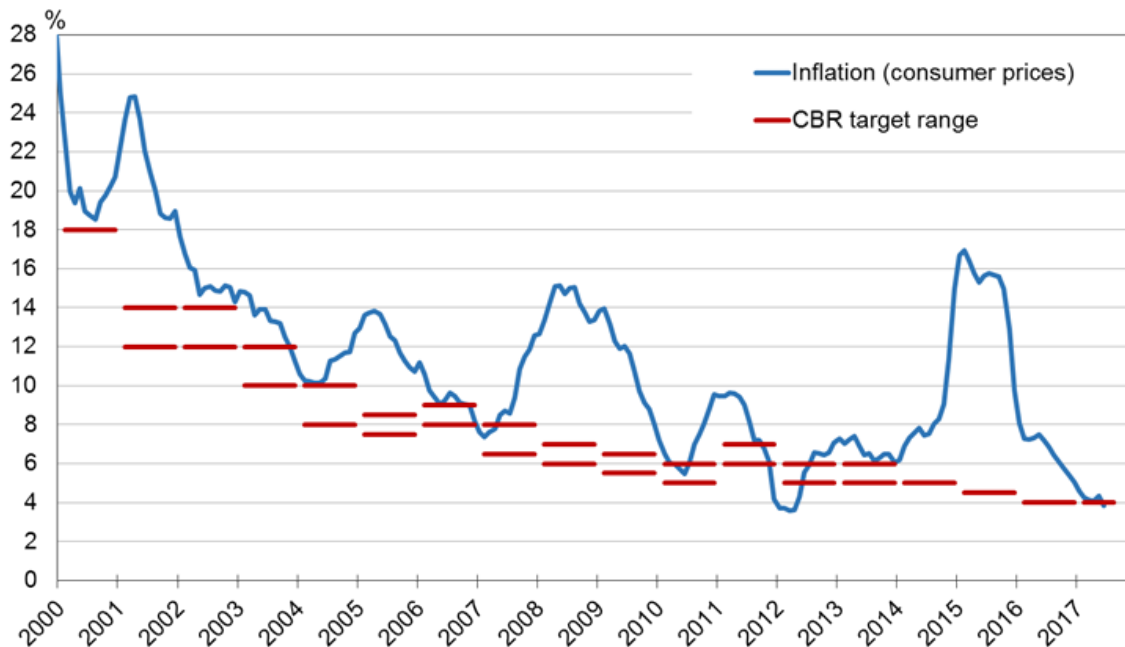
Our data sample runs from beginning of 2004 to August 2017. During this time the Bank of Russia has had several goals for its policy, although the whole period has been marked by a gradual shift towards more full-fledged inflation targeting, which was officially introduced from the beginning of 2015. At the same time, exchange rate stability has been explicitly mentioned as one of the key targets for the central bank for almost the whole sample period. Exchange rate target was only given up in November 2014, although the Bank of Russia announced then that it would stand ready to intervene in the foreign exchange markets to dampen undue volatility. However, it should be noted that the Bank of Russia had continuously widened the allowed fluctuation band around the central parity of its exchange rate basket and the targeted exchange rate was also allowed to change to reflect underlying market pressures, especially after 2008. The Bank of Russia first stated price stability as its primary policy objective in its 2007 monetary policy guidelines (Bank of Russia, 2006). This can be seen as the starting point to the gradual move towards inflation targeting in Russia.

Figure 1 shows inflation targets (or target ranges) of Bank of Russia as well as the realized inflation from 2000 to 2017. (It should be noted that especially during earlier periods it was sometimes difficult to discern inflation targets from inflation forecasts, although these ranges were called inflation targets in the Bank of Russia's annual monetary policy guidelines.) One can see that the realized inflation has overshoot inflation targets on several occasions, and that the largest deviations from inflation target have happened in the aftermath of large currency depreciations, for example in 2008 and 2015. This empirical regularity can be used to justify inclusion of an exchange rate variable

in the empirical estimates of Russia's monetary policy rules. Moreover, the official role of exchange rate basket also speaks for the importance of it.

While empirical estimates of different monetary policy rules are relatively common in advanced OECD countries, similar exercises for emerging market countries are still quite rare. Moreover, there are only a handful of published papers on monetary policy rules in Russia, and their data samples usually end more than a decade before our data. Previous literature for Russia (Esanov et al. 2005, Vdovichenko & Voronina 2006 and Drobyshevskiy et al. 2008) usually finds quantity-based McCallum-type rule to describe the policy well in the 1990s and early 2000. In Korhonen and Nuutilainen (2016, 2017) we found that, for the more recent time period, the Russian monetary policy conduction is better described by a Taylor-type interest rate rule. Fedorova et al. (2016) also use the Taylor rule to describe the Russian monetary policy in 2003–2015 and augment the rule to also include a financial stress indicator.

Figure 1. Inflation and annual inflation targets



Sources: IMF, Bank of Russia and Rosstat

3. Methodology and data

We estimate two types of monetary policy reaction functions using monthly data to evaluate the Bank of Russia behaviour from beginning of 2004 to August 2017. We follow Korhonen and Nuutilainen (2016) in the formulation of the estimated rules. Data and their original sources are listed in Table A1 in the Appendix.

The estimated interest rate rule is a version of the Taylor (1993, 2001) rule, where the central bank reacts to output gap and inflation deviation from a target level. Our version of the rule accounts also for exchange rate developments and oil prices that strongly impact the behavior of output, inflation and exchange rate in Russia. Following the empirical literature, policy smoothing is added to the estimated rules. The estimated Taylor interest rate rule is of a form:

$$i_t = \alpha_0 + \alpha_1(\pi - \pi^*)_{t-1} + \alpha_2\widehat{\Delta y}_{t-1} + \alpha_3\widehat{reer}_{t-1} + \alpha_4\widehat{oil}_{t-1} + \alpha_5\widehat{oil}_{t-2} + \alpha_6 i_{t-1} + \varepsilon_t, \quad (1)$$

where the central bank interest rate¹ (i) reacts to previous period's inflation deviation² ($\pi - \pi^*$) and output growth gap³ ($\widehat{\Delta y}$), as well as real effective exchange rate gap (\widehat{reer}) in the previous period and oil price gaps (\widehat{oil}) over the past two months⁴. Parameters α_1 to α_5 are the estimated policy reaction coefficients and α_6 measures the strength of policy smoothing. For the policy to be countercyclical, we should observe that $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_3 < 0$ and $\alpha_4, \alpha_5 > 0$.

In addition to the interest rate rule, we also estimate a money supply rule introduced by McCallum (1988, 2000) that is defined in nominal terms. The McCallum rule estimated is of the form:

$$\Delta bm_t = \beta_0 + \beta_1\widehat{\Delta x}_{t-1} + \beta_2\widehat{neer}_{t-1} + \beta_3\widehat{oil}_{t-1} + \beta_4\widehat{oil}_{t-2} + \beta_5\Delta bm_{t-1} + \varepsilon_t. \quad (2)$$

Central bank base money growth (Δbm) reacts to nominal output growth gap⁵ in the previous period ($\widehat{\Delta x}$) as well as past observations of exchange rate (\widehat{neer}) and oil price (\widehat{oil}) deviations⁶. Again, $\beta_1 - \beta_4$ measure the strength of policy reactions in base money supply to the macroeconomic variables and β_5 measures policy inertia. Increases in the base money supply indicate policy easing. Therefore the signs in contracyclical policy reaction are the opposite from the Taylor rule: $\beta_1 < 0$, $\beta_2 > 0$ and $\beta_3, \beta_4 > 0$.

The estimated policy rules are formulated to retain rules' operationality. Policy is assumed to react to the macroeconomic variables prevailed in the previous period and thus are available at time t . Furthermore, to maintain comparability with previous results for Russia, we also do not explicitly account for inflation expectations in the estimated rules. Another possibility would be to allow the central bank take into account expectations about the future inflation and output when making policy decisions (see, for example, Clarida et al. 1998, 2000), or react to forecasts of future inflation (see, for example, Batini & Haldane 1999, Levin et al. 2003, and Rudebusch & Svensson 1999). Traditionally, however, Taylor rules have been estimated with realized data, which is also one of the strengths of the approach, as one does not need to take a stand on expectation formation.

¹ We use the Bank of Russia key policy rate (the one week repo credit rate) as the policy interest rate from February 2011 onwards, when the central bank adopts this instrument and starts to publish the data. Prior to that refinancing rate is selected as the policy interest rate. The level of the policy rate is shifted up to match the refinancing rate in February 2011, so that only true policy changes affect the interest rate variable.

² Inflation deviation is determined as the y-o-y growth in consumer prices over the annual CPI growth target determined by the central bank for the year. We use the inflation target observed at the beginning of the year in question, as this should be the most relevant e.g. for formulating expectations for monetary policy.

³ Output growth deviation is calculated by removing the HP-filtered trend from the estimated monthly GDP y-o-y growth series published by the Economy Ministry for 2004–2016. In 2017, the monthly GDP estimate has not been available at the time of policy decisions, because of Rosstat's GDP data revisions. Therefore, for the real output growth in 2017 we use the growth in the Output Index for Key Economic Activities published by Rosstat. The correlation between the two series for the common sample in 2012–2016 is 0.94.

⁴ The exchange rate and oil price deviations are calculated by removing the HP-trend from the real effective exchange rate (REER) index, and the Urals oil dollar prices, respectively. In calculating the de-trended values we have used data starting in 1999/01 when available.

⁵ We use the monthly estimate for the GDP in roubles published by the Ministry of Finance to calculate the y-o-y nominal GDP growth rate and use the HP-filter to get the nominal output growth deviation.

⁶ The exchange rate gap and oil price gap are calculated similarly to (Eq. 1), but here the nominal effective exchange rate (NEER) index is used.

Figure A2 in the Appendix depicts the data series used in the empirical estimations. Descriptive statistics are presented in Table A2. All the variables used in the estimations can be considered to be stationary in levels.⁷

4. Estimation results for the full sample period

In this section we basically replicate monetary policy rule estimations from Korhonen and Nuutilainen (2016) with longer data sample. We can see that Taylor rule continues to be a reasonable approximation of Russia's monetary policy during our sample period, but McCallum rule does not find empirical support.

The policy reaction functions are empirically estimated using the general methods of moments (GMM) estimator. Our estimation period spans from January 2004 until August 2017. Estimation results are presented in Tables 1 and 2. We also present the estimation results without reactions to the exchange rate or oil price developments.

The estimated policy reactions of the Taylor rule (Eq. 1) for the full sample period are presented in Table 1. The policy reactions are generally in line with the theoretical assumptions showing a stabilizing policy in terms of reactions to both inflation and output growth deviations. The reactions are also statistically significant.

Table 1. Taylor rule estimation results.

	c	$(\pi - \pi^*)_{t-1}$	$\widehat{\Delta y}_{t-1}$	\widehat{reer}_{t-1}	\widehat{oil}_{t-1}	\widehat{oil}_{t-2}	i_{t-1}	SSR	$J - stat.$
i_t	0.426** (0.187)	0.037** (0.015)	0.047*** (0.015)	0.014* (0.008)	-0.035*** (0.008)	0.025*** (0.009)	0.947*** (0.018)	81.99	5.43 (0.71)
i_t	0.285** (0.129)	0.015 (0.012)	0.031*** (0.009)	-0.001 (0.006)			0.962*** (0.012)	80.21	5.72 (0.68)
i_t	0.459** (0.197)	0.027** (0.013)	0.043*** (0.016)		-0.035*** (0.009)	0.028*** (0.008)	0.946*** (0.019)	81.54	5.93 (0.43)

Notes: Table presents GMM estimates for estimation period 2004/01–2017/08. Standard errors are given in parenthesis. ***, ** and * denote the 1 %, 5 % and 10 % level of significance, respectively. The instrument list includes a constant and second, third and fourth lags of the independent variables. The instrument lag selection is based on the autocorrelation behavior of the dependent variable. Standard errors and covariances are computed using Newey-West weighting matrix.

The policy reactions to exchange rate developments and oil prices are harder to interpret, as these two variables are largely interrelated. The interest rate reactions to oil prices are statistically significant, but the sign of the estimated reactions to the first lag of the oil price are opposite from the one assumed beforehand. An increase in oil prices is assumed to lead to policy tightening, as it will boost future output growth and increase inflation. Here we find the reverse. However, the second oil price lag has an opposite sign and counteracts the negative response to the first lag.

⁷ Augmented Dickey-Fuller (ADF) unit root test cannot reject the null hypothesis of a unit root in the interest rate variable, but the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test does not reject the null for stationarity either. All other variables are stationary at least at 10% level of significance in the basis of the ADF test.

The sign of the estimated exchange rate reaction is opposite from the one assumed beforehand. In the policy rules literature, policy easing is assumed to follow exchange rate appreciation. Here we find the reverse. Oil price and the exchange rate are closely interconnected, and in our estimation we are perhaps not able to completely disentangle these two effects from each other.

Estimated McCallum rule (Eq. 2) policy reactions are presented in Table 2. In this specification, the Russian monetary policy reacts only to oil prices. Coefficient on nominal output growth deviation is not statistically significant, unlike in Korhonen and Nuutilainen (2016). This finding holds even when oil prices or the exchange rate is omitted from the estimated rules. Therefore the McCallum rule does not describe the Bank of Russia policy at least during our full sample period.

Table 2. McCallum rule estimation results.

	c	$\widehat{\Delta x}_{t-1}$	\widehat{neer}_{t-1}	\widehat{oil}_{t-1}	\widehat{oil}_{t-2}	Δbm_{t-1}	SSR	$J - stat.$
Δbm_t	0.883*	-0.124	0.017	0.217**	-0.128	0.944***	3647.2	8.00
	(0.518)	(0.128)	(0.118)	(0.109)	(0.109)	(0.036)		(0.63)
Δbm_t	1.024*	-0.181	0.146*			0.930***	3639.6	7.87
	(0.620)	(0.144)	(0.076)			(0.034)		(0.55)
Δbm_t	0.643	-0.155		0.302**	-0.191	0.954***	3841.9	5.93
	(0.531)	(0.148)		(0.119)	(0.121)	(0.036)		(0.55)

Notes: Table presents GMM estimates for estimation period 2004/01–2017/08. Standard errors are given in parenthesis. ***, ** and * denote the 1 %, 5 % and 10 % level of significance, respectively. The instrument list includes a constant and second, third, fourth and fifth lags of the independent variables. The instrument lag selection is based on the autocorrelation behavior of the dependent variable. Standard errors and covariances are computed using Newey-West weighting matrix.

5. Breaks in the monetary policy rules

During our estimation period from 2004 until August 2017 the Bank of Russia's monetary policy framework has gone through many changes in terms of both the policy instruments as well as the policy objectives, as described in section 2. Therefore, a single monetary policy rule may not fit well for the whole period, and presumably the policy rules are subject to structural breaks.

The existence of possible breaks in the estimated rules is studied using the Andrews-Fair Wald and LR-type tests that are suitable for GMM estimations. The test statistics show that indeed there are statistically significant breaks in the estimated rules. The most likely dates for the breaks are estimated by maximizing the value of the Andrews-Fair LR-type statistic. First we estimate the date for the most likely break, and given the most likely first breakpoint, test the possible subsequent breaks.⁸

For the Taylor rule the first breakpoint is February 2015, i.e. when the rapid interest rate increases were followed by interest rate cuts (see figure A1 in the appendix). We can interpret this as

⁸ We test the possible breaks for the monetary policy rules that are estimated for 2004/01–2017/08. In the estimations, we let the first possible breakpoint be 2006/06 and the last one 2015/03, allowing 30 observations in the subsamples before/after the breakpoint. This is based on a technical requirement to obtain sufficient number of observations for calculating the Andrews-Fair Wald and LR-type test statistics. The detailed breakpoint estimation results are available from the authors.

return to “normal times” given the extreme instability in the preceding months, large exchange rate swings and interest rate hikes. Given this breakpoint, the second most likely and statistically significant break occurs in July 2006. Table 3 shows the Taylor rule estimation results for the three different subsamples. In the period prior to the first break in mid-2006, the Taylor rule does not fit the Russian data. This is in line with the earlier literature as well as the CBR policy conduction, where central bank interest rate was not yet used as the main policy instrument.

Table 3. Taylor rule estimation results for different sub-periods

	c	$(\pi - \pi^*)_{t-1}$	$\widehat{\Delta y}_{t-1}$	\widehat{reer}_{t-1}	\widehat{ou}_{t-1}	\widehat{ou}_{t-2}	i_{t-1}	SSR	$J - stat.$
2004/01 – 2006/06									
i_t	3.100** (1.260)	0.022 (0.027)	-0.053 (0.048)	-0.030 (0.029)	0.011* (0.006)	-0.014 (0.009)	0.745*** (0.103)	3.19	5.70 (0.68)
2006/07 – 2015/01									
i_t	0.246 (0.252)	0.058** (0.024)	0.056*** (0.015)	0.032*** (0.009)	-0.040*** (0.014)	0.025* (0.014)	0.963*** (0.029)	69.42	6.59 (0.58)
2015/02 – 2017/08									
i_t	4.554*** (0.249)	0.066*** (0.021)	0.093* (0.053)	-0.011 (0.015)	0.009 (0.010)	-0.020*** (0.005)	0.622*** (0.023)	2.58	5.17 (0.74)

Notes: Table presents GMM estimates. Standard errors are given in parenthesis. ***, ** and * denote the 1 %, 5 % and 10 % level of significance, respectively. The instrument list includes a constant and second, third and fourth lags of the independent variables. The instrument lag selection is based on the autocorrelation behavior of the dependent variable. Standard errors and covariances are computed using Newey-West weighting matrix.

In the period 2006–2015, monetary policy in Russia moved more towards price stabilization and started using the interest rate as the predominant policy instrument. During this period, Taylor rule fits the data very well. Coefficients on both inflation and output gap have expected signs. In addition, the effective exchange rate is statistically significant for Bank of Russia’s interest rate formation. The sign of the estimated exchange rate reaction, however, is again opposite from the one assumed beforehand. Our results may have the following explanation. When oil price goes up, this also leads to exchange rate appreciation, and perhaps to expectations of further appreciation. In our estimation we are perhaps not able to completely disentangle these effects from each other, which may lead to observation that exchange rate appreciation is followed by monetary policy tightening, even if oil price increase is the ultimate cause of this.

Table 4 presents the Taylor rule long-run coefficients for inflation deviation and output gap for the periods when they are found statistically significant. During the period from 2006 until early 2015, the monetary policy rule fulfills the ‘Taylor principle’, i.e. the long-run reaction to inflation deviation is stronger than one. Interesting observation is that the long run coefficient for output gap is also above one, indicating that the CBR places relatively strong weight on output stabilization.

From the beginning of 2015, the Bank of Russia has been committed to full-fledged inflation targeting. Nonetheless, during this time, Russia has also been faced with severe economic downturn as well as rapidly accelerating inflation due to depreciation of the rouble. In this situation the

monetary policy had to balance between supporting the real economy and counteracting inflation. Our estimation results show that during the period after 2015, interest rate policy has followed the Taylor rule, and both reactions to inflation deviation and output gap are statistically significant. However, from Table 4 we can observe that the strength of policy reactions has been much weaker than in the earlier period. After 2015, monetary policy seems to place more weight to output stabilization, relative to balancing inflation.

Table 4. Taylor rule long-run coefficients

Period	Inflation gap	Output gap
2004/01 – 2017/07	0.70	0.89
2004/01 – 2006/06	-	-
2006/07 – 2015/01	1.57	1.51
2015/02 – 2017/08	0.17	0.25

Notes: The long run coefficients are calculated as $\alpha^{LR} = \alpha / (1 - \rho)$, where α is the short-run policy coefficient and ρ is the policy smoothing parameter. The values presented in the table are for the Taylor rules, where both exchange rate and oil prices are included. The presented values for the long-run inflation gap and output gap are statistically significant at least 10 % level of significance.

We can also identify two statistically significant breakpoints for the McCallum rule. The first breakpoint, maximizing the value of the Andrews-Fair LR-type statistic, is in March 2014. Given this break, the most likely second break is in January 2011. Table 5 presents the McCallum rule estimation results for the different sub-samples.

Table 5. McCallum rule estimation results for different sub-periods

	c	$\widehat{\Delta x}_{t-1}$	\widehat{neer}_{t-1}	\widehat{oil}_{t-1}	\widehat{oil}_{t-2}	Δbm_{t-1}	SSR	$J - stat.$
2004/01 – 2010/12								
i_t	2.930** (1.464)	-0.439** (0.181)	0.480 (0.340)	0.254* (0.140)	-0.118 (0.148)	0.905*** (0.057)	3330.4	6.62 (0.76)
2011/01 – 2014/02								
i_t	2.296** (1.024)	-0.217 (0.200)	0.038 (0.148)	-0.340*** (0.050)	0.176** (0.084)	0.836*** (0.109)	290.6	8.82 (0.55)
2014/03 – 2017/08								
i_t	2.088*** (0.678)	0.145** (0.057)	0.095 (0.132)	-0.035 (0.147)	0.024 (0.074)	0.685*** (0.077)	387.7	6.48 (0.77)

Notes: Table presents GMM estimates. Standard errors are given in parenthesis. ***, ** and * denote the 1 %, 5 % and 10 % level of significance, respectively. The instrument list includes a constant and second, third, fourth and fifth lags of the independent variables. The instrument lag selection is based on the autocorrelation behavior of the dependent variable. Standard errors and covariances are computed using Newey-West weighting matrix.

We find that for between 2004 and 2010 the McCallum rule indeed fits the Russian data, confirming the earlier findings in the literature. During this period, the monetary policy reacts counter-cyclically to nominal output deviations. In this period also the exchange rate reaction has the expected sign, even though it is not statistically significant.

After 2011 this is not the case. From 2011 to early 2014 the central bank base money supply reacts statistically significantly only to oil prices. After March 2014, the nominal output growth deviation is statistically significant, but the sign of the policy reaction is positive, indicating procyclical reactions in money supply to the nominal output growth. This is contrary to the theoretical assumptions in the monetary policy rules literature.

6. Concluding remarks

We have shown that Russia's monetary policy can be characterized by Taylor rule at least since 2006. This seems to be also consensus of more recent papers on the topic. We take explicitly into account possible breaks in the estimated monetary policy rules. As some earlier papers have found that Russia's monetary policy could be characterized by McCallum rule in late 1990s and early 2000s, our results may provide a way to link between these older and the newer papers on the topic.

When more data from recent period of full inflation targeting becomes available, it will be interesting to observe whether estimated coefficients on inflation and output variables have changed. We leave this for future work.

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Appendix

Table A1. Variables.

Variable	Measure	Source ^a
<i>Interest rate</i>		
Refinancing rate	% pa (end of period) until 2011/01	CBR
Central Bank Policy Rate	% pa (end of period) available after 2011/02	CBR
<i>Monetary aggregate</i>		
Monetary base growth	y-o-y change (%) in RUB monetary base (broad def.)	CBR
<i>Inflation</i>		
Consumer price inflation deviation	CPI y-o-y inflation (%), less the average of the annual target range for CPI inflation	FSSS, CBR
<i>Output gap</i>		
Real GDP growth gap	Real y-o-y GDP growth, less HP-trend ^b (prior 2017, GDP growth is the EM monthly estimate and in 2017 the FSSS key economic activity)	EM, FSSS
Nominal GDP growth gap	y-o-y change (%) in GDP in RUB, less HP-trend ^b	MF
<i>Exchange gap</i>		
Real effective exchange rate gap	REER index (2010=100), less HP-trend ^b	BIS
Nominal effective exchange rate gap	NEER index (2010=100), less HP-trend ^b	BIS
<i>Oil gap</i>		
Crude oil price gap	Urals oil price in USD, monthly average, less HP-trend ^b	OPEC

^a BIS= Bank for International Settlements, CBR=Central Bank of the Russian Federation, EM= Ministry of Economic Development of the Russian Federation, FSSS= Russian Federal State Statistics Service (Rosstat), MF=Ministry of Finance of the Russian Federation, OPEC=Organization of the Petroleum Exporting Countries.

^b Hodrick-Prescott filter applied to data series starting from 1999/01, when data available. Smoothing parameter $\lambda=14\,400$.

Inflation target may be changed during the year. In calculating the inflation deviation series we use the target inflation rate (range) available at the start of the year.

Table A2. Descriptive statistics.

Variable	Obs.	Mean	Min	Max	Std.dev.	ADF <i>t</i> -stat. ^a	KPSS <i>LM</i> -stat. ^b
<i>Interest rate</i>							
i	164	11.00	7.75	19.75	2.50	-2.707	0.279
<i>Base money growth</i>							
Δbm	164	15.22	-13.45	54.77	14.19	-3.482***	0.675**
<i>Inflation deviation</i>							
$(\pi - \pi^*)$	163	3.25	-1.93	12.42	3.23	-2.861*	0.079
<i>Output gaps</i>							
$\widehat{\Delta y}$	163	-0.01	-12.24	5.46	3.25	-3.529***	0.036
$\widehat{\Delta x}$	163	0.26	-36.90	35.77	8.44	-5.337***	0.044
<i>Exchange rate gaps</i>							
\widehat{reer}	163	0.00	-19.53	11.68	5.35	-6.241***	0.050
\widehat{neer}	163	0.06	-18.03	10.06	5.40	-4.101***	0.052
<i>Oil price gap</i>							
\widehat{oil}	163	0.03	-36.78	53.22	13.83	-4.312***	0.037

Data for 2004/01 – 2017/07, except for the policy instruments (interest rate and base money growth) for 2004/01 – 2017/08. ^a The table presents the Augmented Dickey-Fuller unit root test statistic with a maximum of 13 lags. Intercept is included in the test equation. ^b The Kwiatkowski-Phillips-Schmidt-Shin Lagrange Multiplier test statistic evaluates the null-hypothesis that the series is stationary. ***1%, **5% and *10% level of significance.

Figure A1. Data in levels.

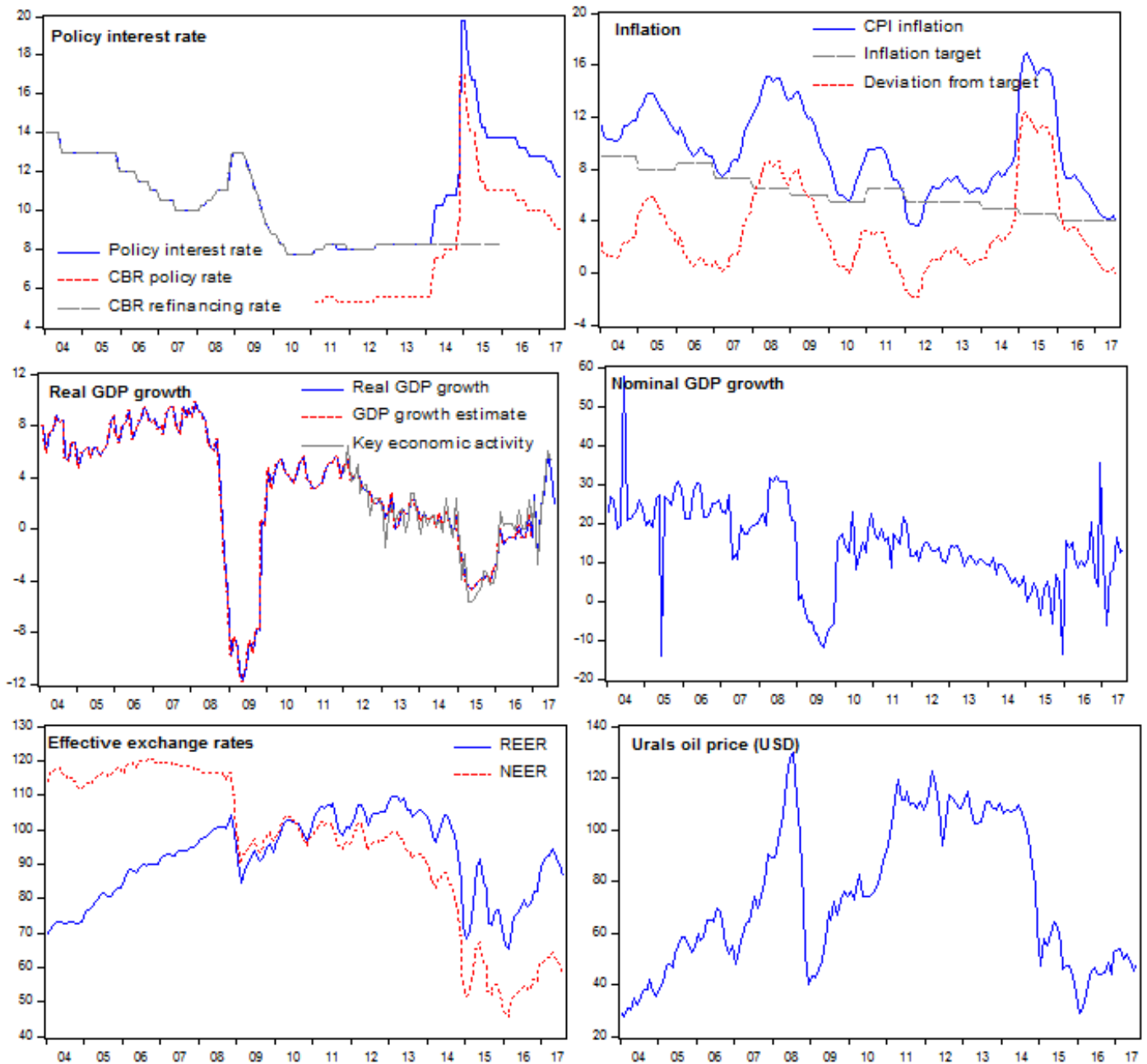
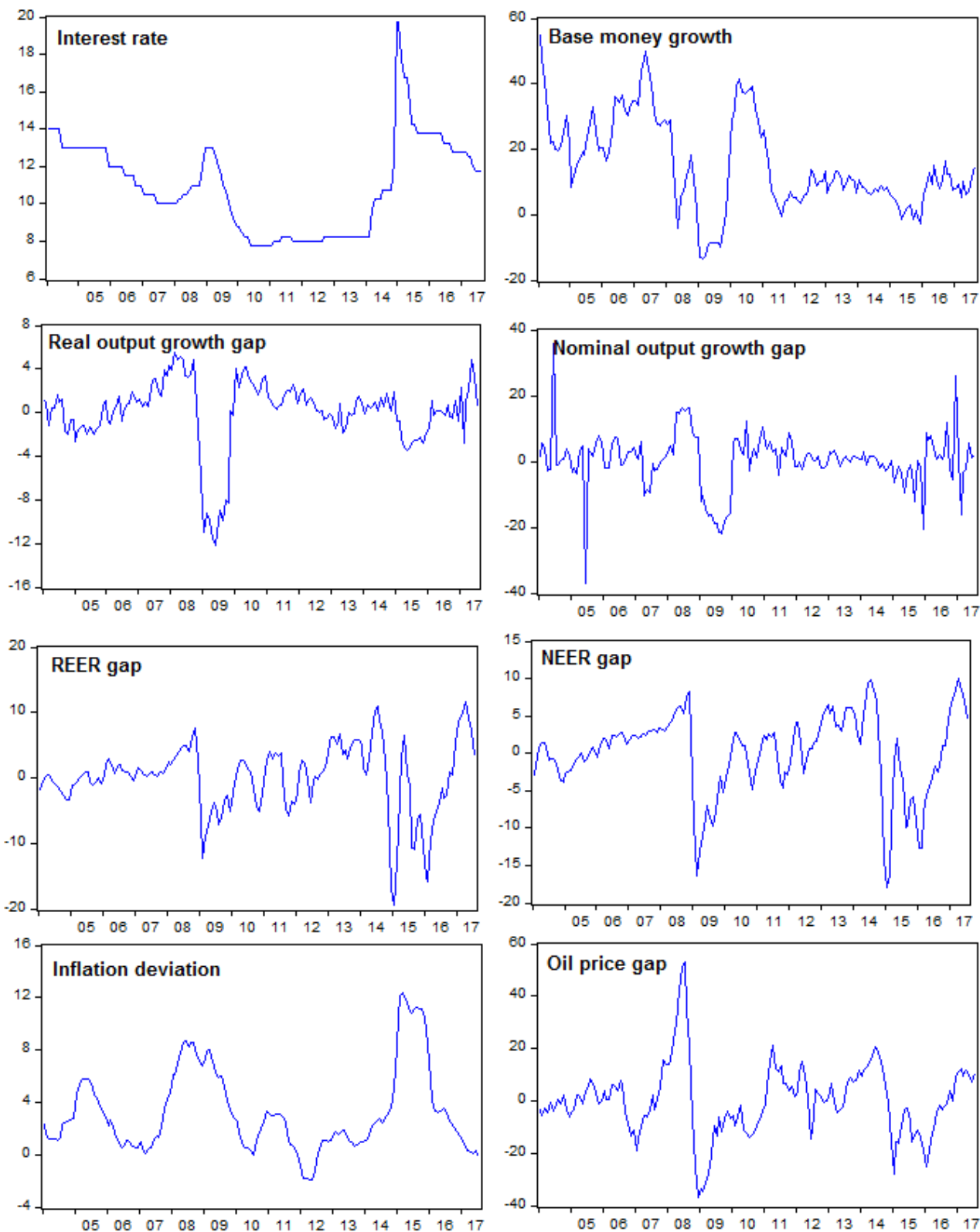


Figure A2. Data used in policy rule analysis.



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