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Anna Sokolova

EVALUATING THE HYBRID PHILLIPS CURVE FOR RUSSIA

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The aim of this research is to identify the process that guides the evolution of inflation expectations in Russia. The significance of this theoretical issue is stipulated by the fact that the characteristics of this process are the key determinants of both inflation dynamics and the effectiveness of disinflation measures introduced by the Central Bank.

This paper studies the degree to which inflation expectations appear forward-looking and backward-looking. We estimate the Hybrid Phillips curve which includes proxies for both backward- and forward-looking components of inflation expectations. Applying Generalized Method of Moments we asses, which of the two components play a predominant role in determining Russian inflation. The estimates are based on the monthly macroeconomic statistics for the period 1999–2013.

Our analysis suggests that to a large extent inflation expectations in Russia remain backward-looking. Hence, it is recommended to take action to enhance agent’s confidence in the Central Bank’s policy before switching to aggressive inflation targeting.

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Sokolova Anna – Laboratory for Macroeconomic Analysis, National Research University Higher School of Economics; E-mail: asokolova@hse.ru; Phone: 89168111104

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1. Introduction

The nature of inflation expectations markedly affects the results of disinflationary policies. Low speed of adjustment of the expectations leads to prolonged disinflation and to elevated output losses. For instance, when agents do not trust the monetary authority, changes in the central bank's policy have little impact on inflation expectations. This feature of inflation expectations makes disinflationary policies less efficient. In developing economies and economies in transition, where agents do not trust the statements of the government and the central banker, costs of disinflationary programs are particularly high. This paper attempts to establish whether or not this issue exists in Russia. In particular, we assess the degree to which inflation expectations in Russia appear to be backward- or forward-looking.

For this purpose we estimate the Hybrid Phillips curve, a specification that includes both forward-looking and backward-looking components of the inflation expectations, applying Generalized Method of Moments. We then compare the estimates of the corresponding coefficients to determine, which of the two components plays a predominant role in determining inflation dynamics. We use various sets of instruments and different data sets to check the robustness of our results; we also vary proxies for the business cycle. Finally, based on this comparative analysis, we conclude by stating which assumption concerning the expectations seems the most relevant for Russian economy. This particular strategy is used in Wimanda, Turner, and Hall (2010), who analyze the nature of inflation expectations in Indonesia. The advantage of this method is that it is applicable when quantitative estimates of inflation expectations are not available, which is the case for Russian dataset.

Our results indicate that models that assume purely forward-looking or backward-looking behavior perform worse than models relying on the alternative assumption, as both components were found to be significant – thus, the Hybrid Phillips curve outperforms Traditional and New Keynesian specifications. This finding suggests that the inflation expectations in Russia remain backward-looking to a significant extent.

1.1. Literature: tests based on the estimates of inflation expectations

Various empirical strategies can be used to establish properties of the expectations. For instance, to determine, whether or not the expectations are rational, it is useful to test for a systematic error. A common strategy is to estimate:

$$\pi_t = a_0 + a_1 E_{t-k}\left[\pi_t\right] + e_t, \qquad (1)$$

where $E_{t-k}(\pi_t)$ is the expectation of inflation in period *t* formed in period *t – k*; and e_t is a random variable with $E_{t-1}(e_t) = 0$.

From equation (1) we can derive the forecast error:

$$\pi_t - a_1 E_{t-k}(\pi_t) = a_0 + e_t. \qquad (2)$$

Taking expectations, we obtain the estimate of a systematic error:

$$E_{t-k}(\pi_t - a_1 E_{t-k}(\pi_t)) = a_0 \qquad (3)$$

Expectations are free from systematic errors only when α_0 equals zero; when α_0 does not equal zero, expectations are not rational. However, this test is not suitable for short samples, as the test tend to reject the null of the expectations being rational when the number of observations is small (see Andolfatto, Moran, Hendry (2006)).

Another common strategy used in the field presupposes studying whether or not the knowledge of past forecast errors helps to predict future forecast errors. The corresponding test estimates the autoregressive structure of the forecast error:

$$d_t = a_0 + a_1 d_{t-1} + a_2 d_{t-2} + ... + e_t, \qquad (4)$$

where $d_t = \pi_t - E_{t-1}(\pi_t)$ are deviations of actual inflation from its forecast.

Rationality of expectations implies that forecast errors must be random with zero mean. Thus, if coefficients in equation (4) are significant, the expectations are unlikely to be forward-looking.

Ball, Croushore (2003) introduce an alternative strategy – the information test, the test intended to estimate how inflation expectations respond to new information. Authors regress forecast errors on macroeconomic indicators that changed immediately before the forecast was made. Rational expectations are based on all relevant publicly available information, thus, under rational expectations forecast errors should decline as new information becomes available. Studying further how fast agents incorporate this new information into their forecasts plays an important role in uncovering the nature of inflation expectations.

With these strategies the following results where obtained. Bryan, Gavin (1986), Batchelor, Dua (1989) show that Livingston Survey forecasts are prone to systematic errors. Bryan, Gavin (1986), Rich (1989) study the period of 60^{th}-80^{th} and show that Michigan Survey forecasts were free from systematic errors during this period. However, Baghestani (1992), Englander, Stone (1989) show that when shorter time period is considered, the tests suggest that Michigan Survey forecasts are subject to systematic errors. Rich (1989) does not find significant correlation neither between the errors and their lags, nor between the errors and the lags of inflation. Batchelor, Dua (1989) conclude that agents do not fully utilize all available information when forecasting.

These tests require estimates of inflation expectations; such estimates can be obtained through various strategies – for instance, from survey data. However, for Russian economy it is impossible to obtain reliable survey data for long time spans, thus, survey-based quantitative estimates of inflation expectations are not available.

An alternative strategy which allows obtaining quantitative estimates of inflation expectations is based on Fisher's theory. According to Fisher relation, inflation expectations can be characterized as a difference between nominal and real interest rates (accounting for inflation risk premium, IRP)[1]:

$$E_t\pi(t,T) = i(t,T) - r(t,T) - \varphi^{\pi}(t,T)\,, \tag{5}$$

where i is nominal interest rate, r is real interest rate, φ is inflation risk premium, $E\pi$ is inflation expectations, T is maturity.

Thus, according to the Fisher equation, one can obtain an estimate for inflation expectations from estimates for nominal and real interest rates and inflation risk premium (IRP). Whereas the data on the nominal interest rate is usually available, statistics on real interest rates and IRP are harder to obtain. For the Russian economy, there is a lack of reliable data on IRP for long time spans. Some estimates of real interest rates are available – however, in most cases these are the ex-post estimates, obtained by subtracting actual inflation from nominal interest rates. That is to say, the expected inflation in equation (5) is replaced by the actual inflation, and the ex-post real interest rate is derived. However, ex-post real interest rates statistics can not be used to derive inflation expectations from equation (5) – only ex-ante real interest rates statistics are appropriate for this purpose, as the proxy for $r(t,T)$ from equation (5) must mirror the agent's expectations over real rates of return in period *t*. Such statistics are available for countries where governments issue

[1] This strategy was discussed in Svensson, Soderlind (1997).

inflation-indexed bonds, as the yields of those bonds should correspond to expected real rates of return. For the Russian economy, such data is not available at the moment, as the inflation-proof government securities do not exist. Other model-based estimates of real interest rates have high risk of turning out to be endogenous, resulting in biased estimates for inflation expectations.

Because of these difficulties, in this paper we apply a different strategy – one that involves the estimation of the Hybrid Phillips curve.

1.2. Literature: Phillips curves and inflation expectations

Empirical studies of inflation dynamics often point out that inflation is significantly correlated with its lagged values. For instance, Rudd, Whelan (2005) conclude that US inflation can be adequately approximated by the following process:

$$\pi_t = \alpha(L)\pi_{t-1} + \gamma(L)x_t + \varepsilon_t \,, \qquad (6)$$

where π_t is current inflation, $\alpha(L)\pi_{t-1}$ is a combination of the lagged values of inflation, ε_t is a non-systematic error term, and $\gamma(L)x_t$ can be represented by either lagged output gaps, deviations of unemployment from the natural level of unemployment or by marginal costs. Some empirical studies indicate that inflation in Russia depends on its lagged values as well (Citi, Russian macro view 09.2010).

Traditional Phillips curve approach attributes the significance of lagged inflation to adaptive nature of inflation expectations, suggesting that inflation evolves according to:

$$\pi_t = \beta E_{t-1}\pi_t + \gamma x_t \qquad (7)$$

If equation (7) characterizes the true process for inflation dynamics, disinflation can result in substantial output losses since inflation is very persistent. Another, perhaps more modern approach incorporates the rational expectations hypothesis into models where prices are sticky, as in Calvo (1983), Taylor (1980). Roberts (1995) shows that rational expectations paired with sticky prices result in the New Keynesian Phillips Curve, under which current inflation depends on the forward-looking component characterizing inflation expectations:

$$\pi_t = \beta E_t\pi_{t+1} + \gamma x_t \qquad (8)$$

Finally, the Hybrid Phillips curve incorporates features of both models to some extent – it embodies both forward- and backward-looking components:

$$\pi_t = \beta\pi_{t-1} + (1-\beta)E_t\pi_{t+1} + \gamma x_t \qquad (9)$$

Roberts (1997, 1998) introduces a theoretical underpinning of this relation, assuming that a proportion of firms make backward-looking inflation forecasts – as a result, lagged inflation emerges in the Phillips curve specification.

Comparative analysis of empirical performance of these models can shed light upon the nature of predominant inflation expectations within the given economy, and, hence, on the potential costs of disinflation programs. Fuhrer (1997) estimates Hybrid Phillips curve for the US and concludes that the forward-looking component from equation (9), $E_t\pi_{t+1}$, is not statistically significant, whereas the effect of the backward-looking component is significant and exceeds 0,75. However, Gali, Gertler (1999) conclude otherwise, finding that the New Keynesian Phillips Curve is an adequate fit for US data. Their GMM estimates of the Hybrid Phillips curve suggest that, although lagged inflation component is statistically significant, its quantitative impact on current inflation is very modest.

Rudd, Whelan (2005) challenge this finding by arguing that this statistical and quantitative significance of the forward-looking component arises because of the omitted variable bias. As the omitted variable correlates with both instruments in GMM and the proxy for the forward-looking expectations component (which is the actual inflation in the next period), the coefficient corresponding to forward-looking component is skewed upward. Rudd, Whelan (2005) on the other hand approximate the forward-looking components with the discounted sum of future costs and find that with such specification the backward-looking component is a major determinant of inflation expectations and that the New Keynesian Phillips Curve is a bad approximation for inflation dynamics. Results obtained by Dufour, Khalaf, Kichian (2006) support the relevance of the Hybrid Phillips curve for the US, but not for Canada. Wimanda, Turner, Hall (2010) study inflation in Indonesia and conclude that the Hybrid Phillips curve provides the most adequate approximation, while the New Keynesian and the Traditional Phillips curves fall behind. Within the Hybrid Phillips curve they find lagged component to be more quantitatively significant than the forward-looking component, which indicates that inflation expectations are likely to be mostly backward-looking. Abbas, Sgro (2011) claim that the New Keynesian Phillips Curve is the best fit for Australia, whereas Scheufele (2010) finds that forward-looking specification of the Phillips curve fits best the German data.

2. Empirical study, Russia

2.1. The strategy

In this section we estimate the Hybrid Phillips curve. We test for the significance of the coefficients corresponding to backward- and forward-looking components and decide, whether both components significantly impact inflation dynamics. We conclude by stating, which of the underlying assumptions about inflation expectations is the most relevant.

To proxy for the backward-looking component of inflation expectations we use lagged inflation. To quantify the forward-looking component we use actual inflation in the next period, π_{t+1}. This method was introduced by McCallum (1976) and was applied by Gali, Gertler (1999), Wimanda, Turner, Hall (2010) and others. To account for the endogeneity issue associated with the use of this method, we follow previous studies in employing the Generalized Method of Moments (GMM).

The Hybrid Phillips curve is approximated by the following model:

$$\pi_t = \beta_1 \pi_{t-1} + \beta_2 \pi_{t+1} + \beta_3 ygap_t \qquad (10)$$

where π_t is inflation in period *t*, π_{t-1} is lagged inflation which proxies for the backward-looking component of inflation expectations, π_{t+1} is the next-period inflation, proxying for the forward-looking component and $ygap_t$ stands for the output gap or other proxy for the business cycle.

Firms account for future inflation when they determine current prices. With sticky prices it is not always possible for a firm to adjust the price at a given date – therefore, the higher is inflation that the firm expects to realize in the future, the higher is the price it sets today, since there is a non-zero probability that tomorrow it will be impossible to reset the price as the overall inflation increases. Thus, there should be a positive correlation between inflation expectations and current inflation. As the lagged inflation and the next-period inflation in equation (10) proxy for inflation expectations, the theory underlying the Phillips curve predicts that $\beta_1 > 0$ and $\beta_2 > 0$.

The theory also suggests that inflation should rise as the output gap grows – in other words, there is a trade-off between lower inflation and higher economic activity (lower unemployment). It follows that the coefficient corresponding to the output gap should be positive, $\beta_3 > 0$.

As GMM estimates are sensitive to the omitted variable bias, to account for the mean effect of the omitted variables we also include constants in the estimated regressions, as do Wimanda, Turner and Hall (2010).

2.2. The data

This study uses series for monthly inflation for the period of 1999-2013, provided by the Rosstat.[2] We conclude that the monthly inflation series is stationary based on Dickey-Fuller and KPSS test results – hence, there is no need to add the trend or switch to first differences. However, the series is subject to significant seasonality – we will use seasonally adjusted series (Figure 1).[3]

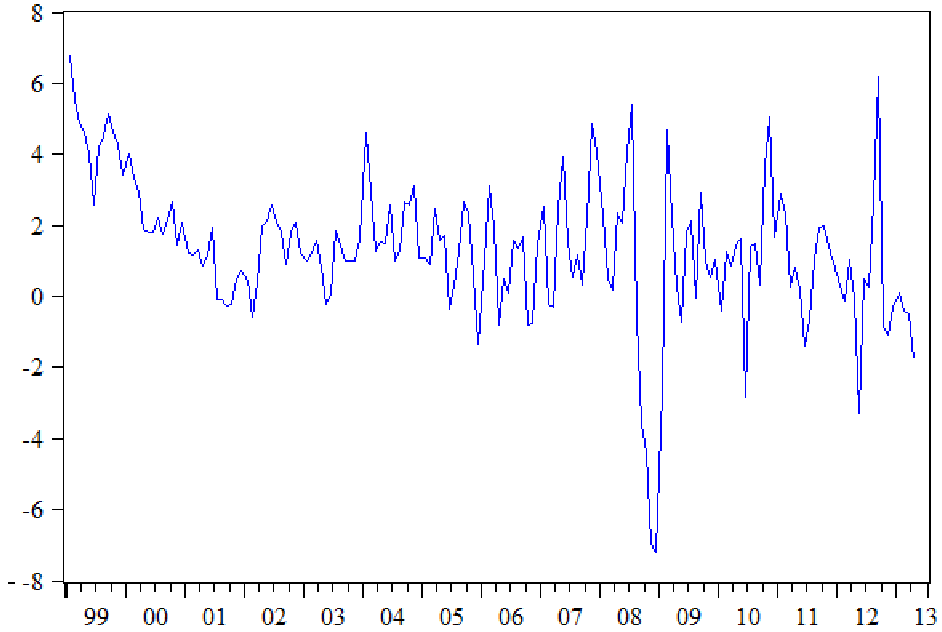

Fig. 1. Monthly inflation, seasonally adjusted

We use several proxies to account for the business cycle. We first calculate the output gap based on quarterly data provided by Rosstat on GDP in prices of 2008 for the period of 1995-2013. To estimate the cycle we use Hodrick-Prescott filter. For each data point we calculate the gap, applying the filter to the subset of all preceding data points. This procedure allows to avoid bias that arises in case the trend is estimated using the whole series, in which case the resulting estimates at each point reflect information about the future GDP growth (this procedure was also applied in Dufour, Khalaf, Kichian, 2006). We follow Wimanda, Turner, Hall (2010) in applying the quadratic-match-average method to transform quarterly output gap series into monthly series. Figure 2 depicts the resulting series.

[2] We use the price index for the producers of industrial commodities instead of CPI to exclude inflation of imported consumer goods.
[3] For seasonal adjustment we use Sensus X12.

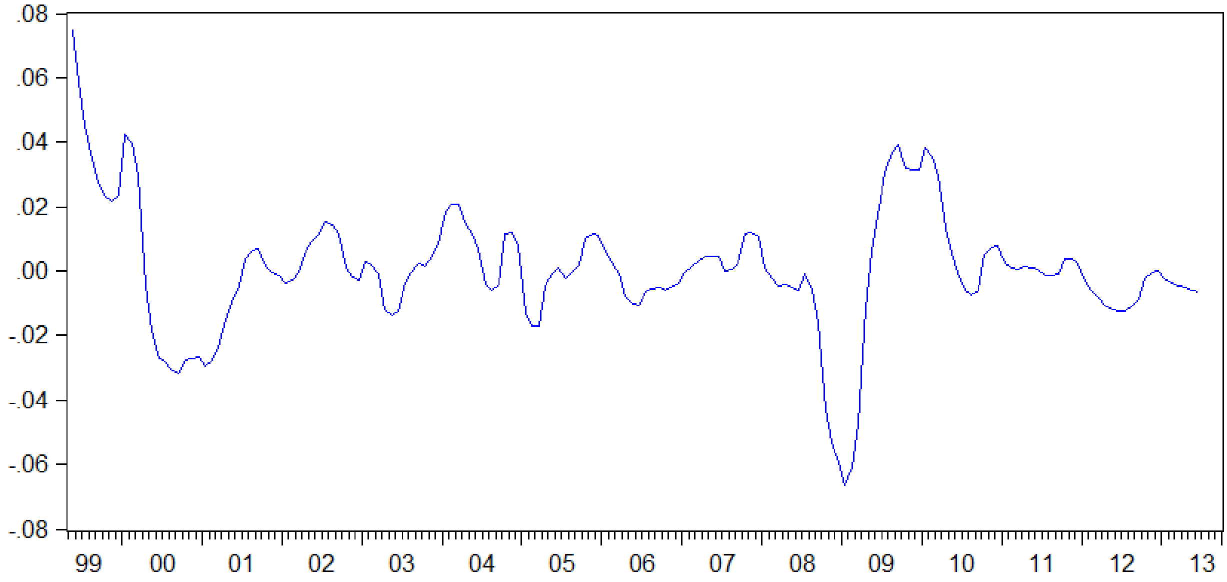

Fig. 2. Output gap proxy based on GDP

To construct the second proxy we use monthly data for the industrial production index for the period of 2000-2013. The gap is calculated with the Hodrick-Prescott filter through the procedure described above. Finally, we use monthly unemployment data to construct an alternative measure of the economic activity. We calculate deviation of logarithm of unemployment from its long run value by applying the Hodrick-Prescott filter to the preceding subset of data points.

For the GMM we need to choose a set of instruments that correlate with endogenous regressors (with π_{t+1} and $ygap_t$) and are orthogonal to the error term. Rudd, Whelan (2006) note that under rational expectations the error term from equation (10) should be uncorrelated with information available at time *t* – thus, variables at time *t* or earlier can serve as instruments for π_{t+1}. Our instrument sets include a constant, lags of the regressors, lags of the spread between credit and deposit rates, lagged changes in the ruble/dollar exchange rate, lagged growth of M0[4] and changes in the oil price.[5] As Russia is an oil exporter, nominal income is affected by changes in the oil price – thus, when oil prices rise, there occurs a boost of aggregate demand and inflation growth. We assume that there is at least a one month delay between an increase in the oil price and the resulting growth of nominal income due to the existence of contracts on oil purchases.[6] It follows that a change in the oil price in period *t* will boost aggregate demand in period *t+1* – thus, it is linked with inflation expectations for period *t+1*. At the same time, such an increase does not cause nominal income to rise instantly – thus, in period *t* it is only correlated with inflation because it impacts

[4] Following Wimanda, Turner, Hall (2010).
[5] Lagged regressors and spreads were also used in Gali, Gertler (1999), Abbas, Sgro (2011).
[6] This assumption is in line with the study of the Sberbank of Russia, Macroeconomic outlook: inflation, 2008.

expectations of the next period inflation. Therefore, we use current period changes in the oil price as an instrument for π_{t+1}, a forward-looking component of the inflation expectations.

To check the robustness of our results we use different combinations of instruments. To test whether given instruments are weak or not, we provide Cragg-Donald F-statistic. We also check values of J-statistic and compare moment selection criteria.

2.3. Results

For the estimation of the Hybrid Phillips Curve various sets of instruments are used. As argued above, changes in the oil price in period *t* may serve as an instrument for the forward-looking component of inflation expectations. In some of the sets we also include the second lag of the change in the oil price as an instrument for π_{t-1} and $ygap_t$ (we do not use the first lag because it is highly correlated with current inflation). For each instrument we determine the appropriate lag structure by comparing moment selection criteria.

We start by estimating the modal with the output gap as a cycle measure. We follow Gali, Gertler (1999), Rudd Whelan (2005) by treating the first lag of inflation as an exogenous regressor and including it in the instrument set. Table 1 reports estimates for the period of July 1999 – March 2013 based on 6 sets of instruments; each set contains four lags of inflation , three lags of the output gap, a constant and a change in the oil price (in USD). Five of the sets also contain instruments proxying for the monetary policy (changes in the exchange rate, spread between credit and deposit rates, changes in M0). The backward-looking component appears to have a prominent impact on inflation dynamics, averaging 0,48, whereas the effect of the forward-looking component is approximately 0,29; under given model specification both effects are significant at 1 percent. The effect of the output gap is positive and significant at 5(10) percent. All instrument sets pass Hansen test at 5 percent; instruments pass the relative bias test proposed by Stock and Yogo at 10(20) percent.[7] Comparison of the Relevant Moment Selection Criteria (RMSC)[8] suggests that the set that includes seventh lag of the change in the M0 outperforms other sets. We also report the p-values for the C-test[9], which indicate that there might be a problem with orthogonality of certain subsets of instruments.

[7] Exclusion of current change in the oil price causes Cragg-Donald statistic to drop significantly. Having studied various combinations of the remaining instruments (with changes in the oil price excluded), we did not find any combination that would pass the Stock and Yogo test; estimated coefficients varied significantly across instrument sets due to the weak instrument bias. This analysis indicates that current change in the oil price is strongly related to future inflation.
[8] The criteria was proposed by Hall, Inoue, Jana and Shin (2007).
[9] The Eichenbaum, Hansen and Singleton test.

Table 1. Instrument sets include inflation(-1)

	Set 1	**Set 2**	**Set 3**	**Set 4**	**Set 5**	**Set 6**
	lagged regressors, oil	lagged regressors, oil, oil(-2)	lagged regressors, oil, exchange rate (-1)	lagged regressors, oil, oil(-2), exchange rate (-1)	lagged regressors, oil, M0(-7)	lagged regressors, oil, spread(-2)
Constant	0,28*	0,28*	0,28*	0,28*	0,21	0,16
Inflation(-1)	0,48***	0,48***	0,48***	0,49***	0,48***	0,51***
Inflation(1)	0,29***	0,28***	0,29***	0,28***	0,34***	0,37***
Output gap	8,36**	8,31**	8,08**	8,01**	7,84**	6,22*
Adj R^2	0,52	0,52	0,52	0,52	0,53	0,54
J stat	9,18	9,19	9,24	9,51	10,47	12,2
P-value for J-stat	0,1	0,16	0,16	0,22	0,11	0,06
Cragg-Donald F-stat	10,56	9,16	9,27	8,31	10,29	11,05
Stock, Yogo (RB)	10%	20%	20%	20%	10%	10%
Relevant MSC	7,74	7,89	7,81	8,22	7,4	7,07
P-value for C-test	0,02	0,04	0,04	0,08	0,02	0,01

July 1999 – March 2013; ***/**/* – significance at 1/5/10 percent. C-test is performed on the subsets of instruments that include inflation(-1), oil, oil(-2), M0(-7), spread(-2) – thus, we assume that 2^{nd} to 4^{th} lags of inflation and three lags of the output gap are orthogonal to the error term.

To check robustness of our results, we exclude the first lag of inflation from the instrument sets and estimate the same specifications – this strategy is motivated by the inconclusive evidence concerning the orthogonality of the instruments. Table 2 reports the estimates. Note that the estimate of RMSC has dropped, suggesting that inflation(-1) is a meaningful instrument. However, p-values for the C-test have increased, indicating that the correlation of the instrument sets with the error term has decreased. The estimated coefficients vary more across instrument sets than in the previous case, which may be a result of the weak instrument bias arising from the exclusion of the first lag of inflation. However, regardless of the decrease in the RMSC, backward-looking component of inflation expectations remains a significant determinant of inflation dynamics.

Table 2. Instrument sets without inflation(-1)

	Set 1	**Set 2**	**Set 3**	**Set 4**	**Set 5**	**Set 6**
	lagged regressors, oil	lagged regressors, oil, oil(-2)	lagged regressors, oil, exchange rate (-1)	lagged regressors, oil, oil(-2), exchange rate (-1)	lagged regressors, oil, M0(-7)	lagged regressors, oil, spread(-2)
Constant	0,54**	0,47**	0,56**	0,48**	0,45**	0,33*
Inflation(-1)	0,2*	0,32***	0,22**	0,32***	0,23**	0,27***
Inflation(1)	0,36***	0,29***	0,34***	0,28***	0,43***	0,46***
Output gap	17,05**	11,52**	17,3**	12,51**	16,54**	16,77**
Adj	0,48	0,5	0,52	0,49	0,5	0,52
J stat	1,59	6,21	1,19	6,85	5,23	7,45
P-value for J-stat	0,81	0,29	0,95	0,34	0,39	0,19
Cragg-Donald F-stat	7,65	9,01	7,85	8,2	6,63	6,61
Stock, Yogo (RB)	20%	10%	20%	20%	20%	20%
Relevant MSC	11,46	9,95	11,1	10,06	11,24	10,79
P-value for C-test	0,22	0,07	0,62	0,12	0,12	0,04

July 1999 – March 2013; ***/**/* – significance at 1/5/10 percent. C-test is performed on the subsets of instruments that include oil, oil(-2), M0(-7), spread(-2) – thus, we assume that the orthogonality condition holds for the 2nd to 4th lags of inflation and three lags of the output gap

To clarify the results we perform the next robustness check, attempting to account for changes in the exchange rate policy of the Central Bank of Russia. Figure 3 depicts the changes in the nominal exchange rate over the period. Note that the exchange rate becomes significantly more volatile starting from the third quarter of 2008. At that point the Central Bank of Russia announced the upcoming switch of the monetary policy focus towards inflation targeting. Inflation targeting presupposes that the central bank loosens control of the exchange rate, because both inflation and the exchange rate are affected by the dynamics of the monetary aggregate, and policies, aimed at offsetting exchange rate shocks impact the dynamics of inflation as well. For instance, one way to offset the appreciation of the rubble is to increase money supply, which leads to acceleration of inflation. Under the fixed exchange rate regime and without capital controls, the central bank cannot conduct independent monetary policy. At the same time, independent monetary policy is the key ingredient for successful adoption of inflation targeting.

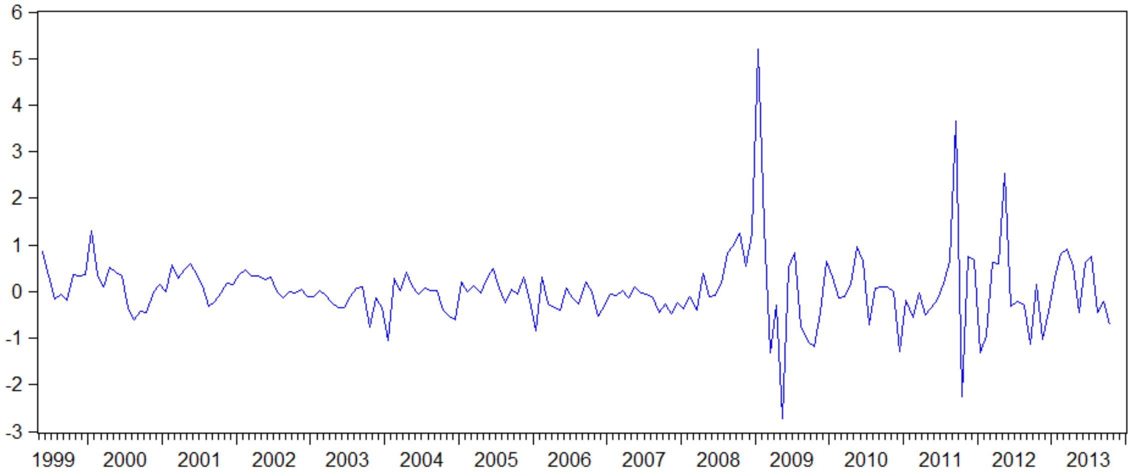

Fig. 3. Changes in the exchange rate

Thus, when the central bank allows high volatility of the exchange rate, disinflationary policy is likely to become more efficient. To account for this change in the monetary policy focus, we repeat our estimations for the subset preceding to July 2008.

Table 3 reports the results. As before, coefficients on both components are significant, with the effect of backward-looking component amounting to 0,49, which is larger than for previous estimations. P-values for C-tests have significantly increased in comparison with previous results – thus, for this subset the orthogonality conditions are likely to hold. Appendix (Table A1) shows the results of the estimations for instrument sets without the first lag of inflation – we document the same regularities for those estimations.

Table 3. Estimates for the July 1999 – June 2008 subset

	Set 1 lagged regressors, oil	**Set 2** lagged regressors, oil, oil(-2)	**Set 3** lagged regressors, oil, exchange rate (-1)	**Set 4** lagged regressors, oil, oil(-2), exchange rate (-1)	**Set 5** lagged regressors, oil, M0(-7)	**Set 6** lagged regressors, oil, spread(-2)
Constant	0,22*	0,22*	0,2	0,19	0,22*	0,21
Inflation(-1)	0,5***	0,49***	0,49***	0,49***	0,5***	0,5***
Inflation(1)	0,37***	0,38***	0,39***	0,4***	0,36***	0,38***
Output gap	7,04*	7,04*	6,85*	6,81*	6,98*	6,76*
Adj	0,58	0,58	0,59	0,59	0,58	0,58
J stat	7,68	8,13	7,7	8,14	7,7	7,81
P-value for J-stat	0,18	0,23	0,26	0,32	0,26	0,25
Cragg-Donald F-stat	7,24	6,41	6,6	5,74	6,53	6,22
Stock, Yogo (RB)	20%	20%	20%	30%	20%	20%
Relevant MSC	4,31	4,42	4,21	4,31	4,43	4,46
P-value for C-test	0,45	0,55	0,51	0,61	0,53	0,63

***/**/* – significance at 1/5/10 percent. C-test is performed on the subsets of instruments that include oil, oil(-2), M0(-7), spread(-2) – thus, we assume that 2^{nd} to 4^{th} lags of inflation and three lags of the output gap are orthogonal to the error term.

Comparison of the estimations based on the whole data set and on the subset before July 2008 indicate that the structure of the Phillips curve may have changed over the years with the backward-looking component of the inflation expectations becoming less significant after the shift in the monetary policy which occurred in 2008. However, these differences may also be caused by the 2008 financial crisis, which is associated with the outbursts in the majority of the financial series, adding noise to the data.

We further investigate how the proxy for the economic cycle impacts these results. Appendix (Tables A2, A3) shows analogous estimates for cases when the business cycle proxy is calculated based on the data for monthly unemployment and the industrial production index. Although the coefficients corresponding to the business cycle effect tend to vary, the critical results remain unchanged.

We arrive at the conclusion that the backward-looking component of inflation expectations plays an important role in driving inflation in Russia. The estimated effect ranges within $[0,3;0,5]$ interval. The impact of the forward-looking component was found to be significant as well. The exact values of the coefficients depend on the set of instruments used and on the data set in question – however, the effect of the backward-looking component remains significant regardless of the procedure applied. Thus, the New Keynesian Phillips curve may not be the best fit for Russian data.

In terms of policy implications we can conclude that in short run inflation expectations adjust slowly to changes in central bank's policy. Thus, disinflationary programs may result in high costs in terms of output losses. However, we find some evidence indicating that the expectations may have become more responsive to changes in the information set after the volatility of the exchange rate has increased.

3. Conclusion

The nature of inflation expectations impacts monetary policy outcomes. When expectations are not affected by recent changes in the information set, disinflationary policies are associated with high costs, as inflation is unresponsive to changes in the central bank's policy in the short run. Thus, even though chronic inflation has negative impact on the economy, disinflationary policy may result in even higher output losses. An effective disinflation program must account for these specific features of inflation expectations. In this paper we studied the process that guides the evolution of the inflation expectations in Russia.

As quantitative estimates of inflation expectations for Russia are unavailable, we employed the strategy that does not require this kind of data. Based on the monthly macroeconomic statistics for the 1999-2013 period provided by the Rosstat, we estimated the Hybrid Phillips curve to assess the relevance of the forward-looking against the backward-looking expectations hypotheses.

The empirical results suggest that both components play an important role in determining inflation dynamics – thus, the Hybrid Phillips curve outperforms New Keynesian and Traditional versions. Our analysis suggests that before 2008 the backward-looking component played a predominant role in determining inflation expectations; its impact remains significant for estimates based on the whole data set. We also find some evidence indicating that the expectations may have become more responsive to changes in the information set. However, it is recommended to take action to enhance the agent's confidence in the Central Bank's policy before switching to aggressive inflation targeting.

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Appendix

Table A1. Estimates for the July 1999 – June 2008 subset, first lag of inflation excluded

	Set 1 lagged regressors, oil	**Set 2** lagged regressors, oil, oil(-2)	**Set 3** lagged regressors, oil, exchange rate (-1)	**Set 4** lagged regressors, oil, oil(-2), exchange rate (-1)	**Set 5** lagged regressors, oil, M0(-7)	**Set 6** lagged regressors, oil, spread(-2)
Constant	0,27	0,17	0,21	0,15	0,27	0,25
Inflation(-1)	0,47***	0,52***	0,48***	0,52***	0,47***	0,47***
Inflation(1)	0,37***	0,38***	0,39***	0,39***	0,37***	0,38***
Output gap	8,31	5,86	7,15	5,49	8,11	7,93
Adj	0,58	0,58	0,59	0,58	0,58	0,58
J stat	7,44	7,94	7,6	7,96	7,47	7,51
P-value for J-stat	0,11	0,16	0,18	0,24	0,19	0,19
Cragg-Donald F-stat	6,69	6,41	6,25	5,72	5,87	5,77
Stock, Yogo (RB)	20%	20%	20%	30%	20%	20%
Relevant MSC	7,05	5,89	6,53	5,6	7,09	7,27
P-value for C-test	0,21	0,38	0,42	0,57	0,47	0,45

***/**/* – significance at 1/5/10 percent. C-test is performed on the subsets of instruments that include oil, oil(-2), M0(-7), spread(-2) – thus, we assume that 2nd to 4th lags of inflation and three lags of the output gap are orthogonal to the error term. The estimates suggest that for the period preceding to July 2008 the backward-looking component is significant, it averages 0,49, whereas the forward-looking component is 0.38 on average. The RMSC for these instrument sets are larger than for sets that include the 1st lag of inflation (estimates reported in Table 3).

Table A2. Estimates with the unemployment gap as proxy for economic activity

	Set 1 lagged regressors, oil	**Set 2** lagged regressors, oil, oil(-2)	**Set 3** lagged regressors, oil, exchange rate (-1)	**Set 4** lagged regressors, oil, oil(-2), exchange rate (-1)	**Set 5** lagged regressors, oil, M0(-7)	**Set 6** lagged regressors, oil, spread(-2)
Constant	0,34*	0,32**	0,24	0,24	0,31	0,3
Inflation(-1)	0,45***	0,45***	0,48***	0,48***	0,45***	0,47***
Inflation(1)	0,23**	0,23**	0,28***	0,28***	0,25**	0,27***
Unemployment gap	1,42	1,74	1,94	2,01	1,63	1,21
Adj	0,42	0,42	0,44	0,44	0,43	0,43
J stat	8,97	10,11	10,23	10,78	9,19	11,11
P-value for J-stat	0,11	0,12	0,12	0,15	0,16	0,08
Cragg-Donald F-stat	10,1	8,59	8,59	7,64	9,63	9,25
Stock, Yogo (RB)	10%	20%	20%	20%	20%	20%
Relevant MSC	7,87	8,14	7,87	8,12	7,82	7,68
P-value for C-test	0,03	0,05	0,05	0,07	0,07	0,03

July 1999 – March 2013, first lag of inflation included in the instrument sets. ***/**/* - significance at 1/5/10 percent. C-test is performed on the subsets of instruments that include oil, oil(-2), M0(-7), spread(-2) – thus, we assume that 2nd to 4th lags of inflation and three lags of the output gap are orthogonal to the error term. Note that under this specification the effect of lagged inflation remains within the $[0,3;0,5]$ interval with the coefficients corresponding to the forward-looking component being smaller. The unemployment gap remains insignificant – thus, we conclude that the output gap outperforms the unemployment gap as a proxy for economic activity in Russia.

Table A3. Estimates with the output gap calculated based on the industrial production index

	Set 1 lagged regressors, oil	**Set 2** lagged regressors, oil, oil(-2)	**Set 3** lagged regressors, oil, exchange rate (-1)	**Set 4** lagged regressors, oil, oil(-2), exchange rate (-1)	**Set 5** lagged regressors, oil, M0(-7)	**Set 6** lagged regressors, oil, spread(-2)
Constant	0,36**	0,35**	0,34**	0,32**	0,26*	0,36**
Inflation(-1)	0,38***	0,38***	0,38***	0,39***	0,42***	0,38***
Inflation(1)	0,29***	0,29***	0,3***	0,3***	0,34***	0,3***
Output gap: Industrial production	53,5	54,84*	55,14*	54,59*	32,71	58,07**
Adj	0,43	0,43	0,43	0,44	0,46	0,43
J stat	8,1	8,12	9,18	9,22	9,22	8,27
P-value for J-stat	0,15	0,23	0,16	0,24	0,16	0,22
Cragg-Donald F-stat	3,4	3,12	3,03	2,78	3,6	3,05
Stock, Yogo (RB) Relevant MSC	11,95	12,18	12,22	12,38	11,21	11,92
P-value for C-test	0,06	0,13	0,09	0,15	0,09	0,13

July 1999 – March 2013, first lag of inflation included in the instrument sets. ***/**/* – significance at 1/5/10 percent. C-test is performed on the subsets of instruments that include oil, oil(-2), M0(-7), spread(-2) – thus, we assume that 2nd to 4th lags of inflation and three lags of the output gap are orthogonal to the error term. Under this specification the effect of lagged inflation remains within the $[0,3;0,5]$ interval with the coefficients corresponding to the forward-looking component being smaller. However, the value of Cragg-Donald statistic has dropped significantly, suggesting that for this specification our instrument sets are weak. Thus, the results obtained with the GDP output gap measure (Tables 1–3, A1) are more reliable.

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Данное исследование посвящено оценке характера инфляционных ожиданий в России. Значимость данного вопроса обусловлена тем, что особенности инфляционных ожиданий сказываются на результатах дезинфляционных программ, проводимых Центральным банком.

Задача данной работы – определить, в какой степени инфляционные ожидания являются назад- либо вперёдсмотрящими. Мы оцениваем гибридную версию кривой Филлипса, включающую прокси для назад- и вперёдсмотрящей компонент инфляционных ожиданий. С помощью обобщенного метода моментов мы исследуем, какая из компонент играет основную роль в определении динамики инфляции в России. Оценки получены на основе помесячной макроэкономической статистики для периода с 1999 по 2013 г.

Полученные результаты свидетельствуют о том, что инфляционные ожидания в России в значительной мере остаются назадсмотрящими. Таким образом, чтобы подготовить почву для перехода к инфляционному таргетированию, рекомендуется принять меры по укреплению доверия населения к политике Центрального банка.

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Соколова Анна Валерьевна

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(на английском языке)