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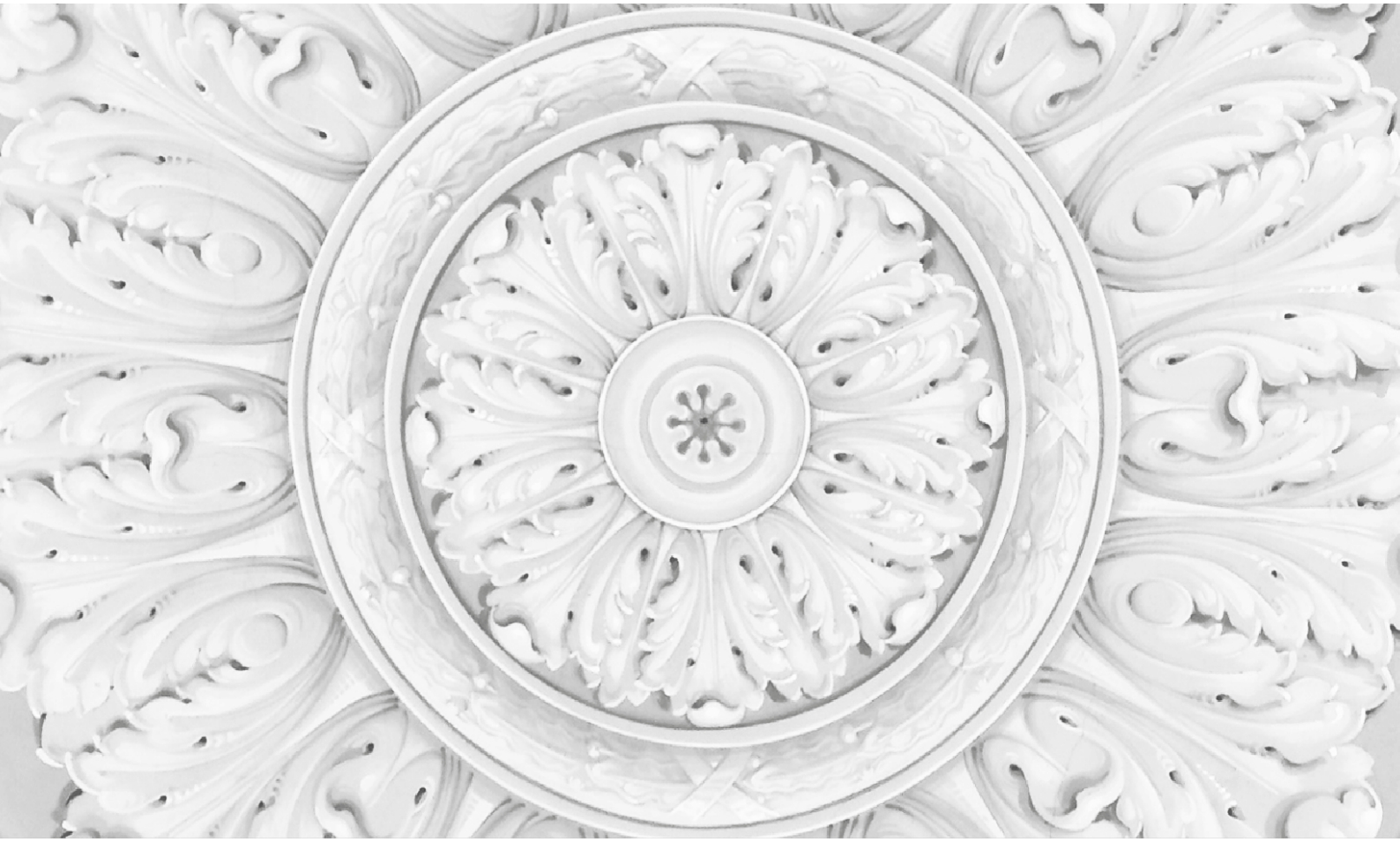

WORKING PAPER SERIES

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Nowcasting of the Russian GDP Using the Current Statistics: Approach Modification

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Abstract

This work presents a modification of the model of GDP short-term estimation based on current macroeconomic statistics initially offered in the paper titled 'Nowcasting and Short-Term Forecasting of Russian GDP with a Dynamic Factor Model' by Alexey Porshakov and co-authors [8]. The model modification presented in this work considers factors separately for each of the three groups of indicators – agents' expectations and their estimate of the current economic situation; financial variables, world market and foreign economic activity indicators; real sector indicators.

This model can be used to get GDP estimates for the previous and current quarters, which allows researchers to obtain information on output dynamics in the economy in addition to estimates under other models and expert judgments. Also, the model helps decompose GDP quarterly growth rates into various factors.

Key words: GDP short-term estimation, nowcast, dynamic factor models.

JEL classification: C38, C53, C82, E27.

INTRODUCTION

In 2015, the Bank of Russia switched to the policy of inflation targeting. The Bank of Russia takes monetary policy decisions proceeding from an estimate of the current situation and a medium-term forecast.

Time lags in the provision of information by statistical agencies are a standard problem in macroeconomic forecasting. Thus, the Russian Federal State Statistics Service (Rosstat) provides a preliminary estimate of the GDP physical volume index in a month and a half after the end of a quarter, while the first estimate of the produced GDP appears in two months and a half and the estimate of the use of GDP comes at the end of a quarter following the reporting quarter. Rosstat monthly estimates the output of goods and services in basic types of economic activity but publishes this estimate in the last days of a month following the reporting month.

Nevertheless, there are macroeconomic indicators, on which Rosstat provides data earlier. Specifically, industrial production data are available on the 12^{th}-14^{th} day of a month following the reporting month, while the data on retail trade, the volume of services provided to households, fixed capital investment, freight turnover, construction and agriculture, the unemployment rate and wages are released on the 18^{th}-21^{st} days respectively.

There are different methods to use these and other monthly data, as well as higher-frequency indicators for nowcasting the output: for example, they can be used as the basis to approximately restore the index of the basic types of economic activity. Also, the data on retail trade, the volume of paid services provided to the population and the balances of household incomes and expenditures can be used to estimate the current dynamics of household final consumption expenditure, while information on fixed capital investment, inventories of finished products in retail trade and grain stocks will be useful to predict gross capital formation. Economists can assess the index of export and import quantities, if they have an estimate of the balance of payments, the ruble exchange rate and oil prices. The data provided by the Federal Customs Service on the import and export of basic goods will also help analyse these indicators. However, these data are provided with a considerable time lag.

Aside from the aforementioned methods of estimating the current output dynamics, there are also methods based on econometric and statistical models. For example, the New Economic School (NES) uses jointly with Renaissance Capital (RenCap) Company the principal components method and the Kalman filter to estimate output dynamics [9]. In their report titled 'Nowcasting and Short-Term Forecasting of Russian GDP with a Dynamic Factor Model' (DFM), Bank of Russia specialists offer the DFM based on variables reflecting the state of the real sector of the economy, the financial market and external economic conditions, as well as leading indicators. The authors use these variables as the basis to restore unobserved factors and build bridge equations to obtain the current estimate of output (the methodology is described in greater detail in the paper [8, p. 8]). This allows the authors to get quite an accurate GDP estimate exceeding the estimates derived from alternative models [8, p. 27].

This research offers to modify to some extent this approach to GDP nowcasting. Section 2 will present the research methodology and describe indicators used in the research. Section 3 will study the quality of estimates obtained for the period from January 2012 to December 2014. In Section 4, we will analyse the contribution of various factors to GDP dynamics in 2015 Q1-Q4. The conclusion summarises the obtained results and gives a brief description of further areas of research.

2. RESEARCH METHODOLOGY

The model of GDP nowcasting is based on the use of dynamic factor models. This class of

econometric models allows using information on a large number of economic indicators, on the one hand, and avoiding 'the curse of dimensionality' (for details, see [3], [4], [5], [2]), on the other hand.

Following the example of the working paper [8], we focused on the analysis of the following groups of macrovariables: real sector indicators, agents' expectations and their estimate of the economic situation, and financial market and external demand indicators. The variables were cleared of the seasonal factor and converted to growth rates. A dynamic factor model based on the Kalman filter and the principal components method was built separately for each group of variables:

$$\begin{gathered} X_t^j = A^j F_t^j + \varepsilon_t^j \\ F_t^j = B^j F_{t-1}^j + u_t^j \\ E\left(\varepsilon_t^j\right) = E\left(u_t^j\right) = 0 \\ E\left(\varepsilon_t^j \varepsilon_t^{j\prime}\right) = \Sigma^{\mathrm{j}}, \qquad E\left(u_t^j u_t^{j\prime}\right) = \Omega^{\mathrm{j}}. \end{gathered} \tag{1}$$

$\mathrm{X}_{\mathrm{t}}^{\mathrm{j}}$ is the vector of macroindicators for the month t included in the group j, while $\mathrm{F}_{\mathrm{t}}^{\mathrm{j}}$ – is the vector of factors corresponding to the said group of variables. The number of factors for each group of indicators was selected using a share of the variance explained by these factors (a trace of the covariance matrix) for the said group of indicators relative to its total dispersion. The number of factors for each group was limited to three to avoid 'the curse of dimensionality' again.

The idea of dividing variables into groups is not new in literature. Specifically, Belviso, Milani [1] evaluate the model using 145 time series and dividing them into seven groups for a simpler interpretation of the results of the FAVAR (Factor Augmented Vector Autoregression) model.

Further on, the dynamic factor model was used to estimate the unobserved factors and also forecast them until the end of the current quarter. As the variables under study have monthly frequency, while the projected indicator (GDP) has the quarterly dimension, we averaged the factors that were obtained.

At the next step we built a bridge equation between GDP and factors. For this purpose, we used a simple linear regression model (2):

$$\mathrm{y}_\tau = \mu + \alpha \mathrm{y}_{\tau-1} + \beta_{\mathrm{f}1}\mathrm{f}_\tau^{\mathrm{f}} + \beta_{\mathrm{f}2}\mathrm{f}_{\tau-1}^{\mathrm{f}} + \beta_{\mathrm{e}1}\mathrm{f}_\tau^{\mathrm{e}} + \beta_{\mathrm{e}2}\mathrm{f}_{\tau-1}^{\mathrm{e}} + \beta_{\mathrm{r}1}\mathrm{f}_\tau^{\mathrm{r}} + \beta_{\mathrm{r}2}\mathrm{f}_{\tau-1}^{\mathrm{r}} + \omega_\tau. \tag{2}$$

The seasonally adjusted GDP growth rate in real prices relative to the previous quarter is used to indicate y_τ[1], while $\mathrm{f}_\tau^{\mathrm{j}}$ is the factor obtained from (1) for the **j** group of indicators (**f** denotes financial variables, **e** reflects expectations and the assessment of the current economic situation and **r** shows real sector indicators). As the first factor could not explain a sufficient share of the dispersion of indicators for the financial market and real sector data, we built several factors to select the one that ensured the best quality of fitting the data in the equation (2) in terms of the Schwarz information criterion based on full sample data. Thus, the first factor and its lag were used for real sector indicators in the bridge equation, while the third factor and its delayed value were used for financial market data. In the case with variables reflecting economic agents' expectations, the first factor was enough to explain a large share of indicators dispersion.

The autoregressive element $\mathrm{y}_{\tau-1}$ was added to the model because GDP demonstrates certain inertia related specifically to consumption habits and the formation of agents' savings from incomes of previous periods. We also considered the equation (2) specifications with a large number of lags for both the explainable variable and the factors but these specifications were worse by the Schwarz information criterion.

The model (1) and the bridge equation (2) are re-estimated monthly after the release of Infor-

[1] During the first month of a quarter when information on $y_{\tau-1}$is unavailable, its value derived from the model is used.

mation on the Social and Economic Position of Russia. The bridge equation (2) is also re-estimated after the GDP data are released.

3. QUALITY OF THE MODEL'S FORECAST

The model's prognostic quality was checked at the interval of 2012 Q1 – 2014 Q4. The quality was checked in pseudo-real time: for a forecast at the moment m, only information available as of that time was used.[2] Therefore, the forecasting process was as follows in each month m:

The data available as of the 20th day of the month *t* (i.e. the data for the period from January 2002 to the month *t-1* for most indicators) were seasonally adjusted and converted to growth rates.

The model (1) was used to obtain monthly factors, which were subsequently averaged to derive quarterly data. The bridge equation (2) was estimated on the basis of a sample from 2003 Q2 to the latest quarter, for which the GDP data were available.

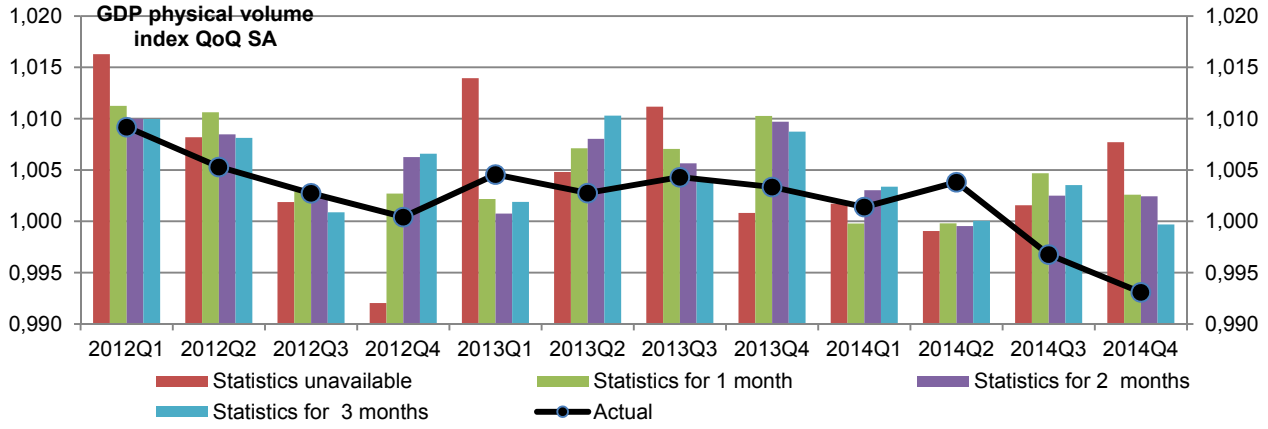

Figure 1. Forecasts of GDP physical volume index at various moments of time and its actual volume

Figure 1 gives estimates of the GDP physical volume index (QoQ SA) from 2012 Q1 to 2014 Q4, depending on the extent of fullness of short-term statistics, as well as its actual volume derived from the seasonally adjusted GDP in real prices published by Rosstat in 2015.

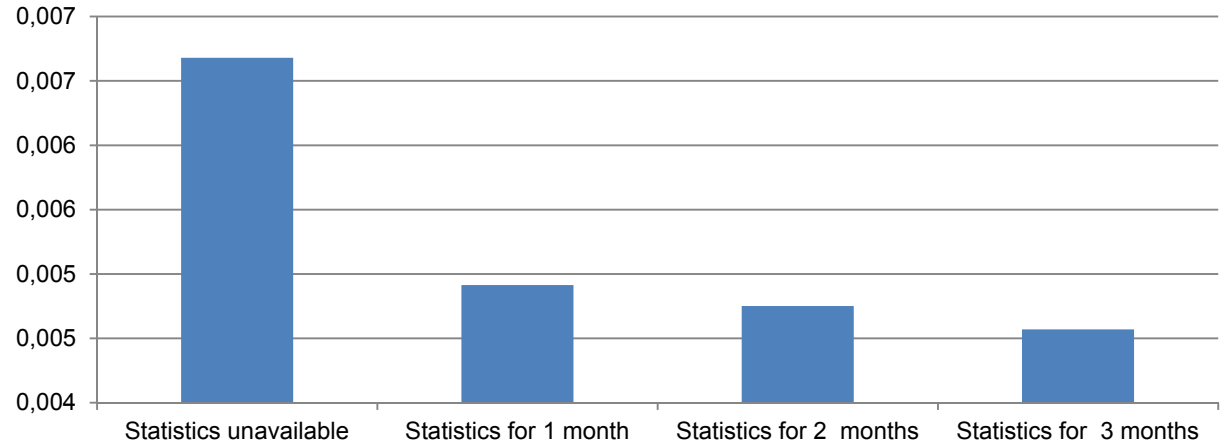

Figure 2. RMSE of the estimate depending on available information

[2] Despite the attempts to maximally converge the model-based forecast to real-time forecasting, we disregard data revisions by Rosstat and other statistical bodies for short-term indicators and likewise for seasonally-adjusted indices of the GDP physical volume.

The root mean square error (RMSE) was used as an indicator of the quality of forecasts. As Figure 2 shows, the estimate accuracy increases when additional statistical information becomes available. The root mean square error of forecasts decreases especially noticeably when statistics appear for the first month of a quarter together with the GDP data for the previous quarter.

In 2015 Q2-Q4, the model was used to obtain additional estimates of the GDP growth rates. When the data for the entire quarter were available, the estimate was quite accurate. In cases when information was available only for one or two months of the period under review, the quality of the estimate was seen to decrease considerably, probably due to the high volatility of economic indicators in 2015.

4. CONTRIBUTIONS BY VARIOUS GROUPS OF INDICATORS TO GDP QUARTERLY GROWTH RATES

The bridge equation (2) is linear and it allows decomposing the GDP quarterly growth rate into various groups of indicators. Let us consider that an estimate of the contribution by the group *j* of indicators is determined by the following formula:

$$\widehat{\mathrm{contr}}_\tau^j = \hat{\beta}_{j1} f_\tau^j + \hat{\beta}_{j2} f_{\tau-1}^j. \qquad (3)$$

Separately, the inertia contribution can be estimated as follows:

$$\widehat{\mathrm{contr}}_\tau^{IN} = \hat{\mu} + \hat{\alpha} y_{\tau-1}. \qquad (4)$$

Figure 3 shows decomposition of the GDP quarterly growth rate[3] from 2014 Q3 to 2015 Q4.

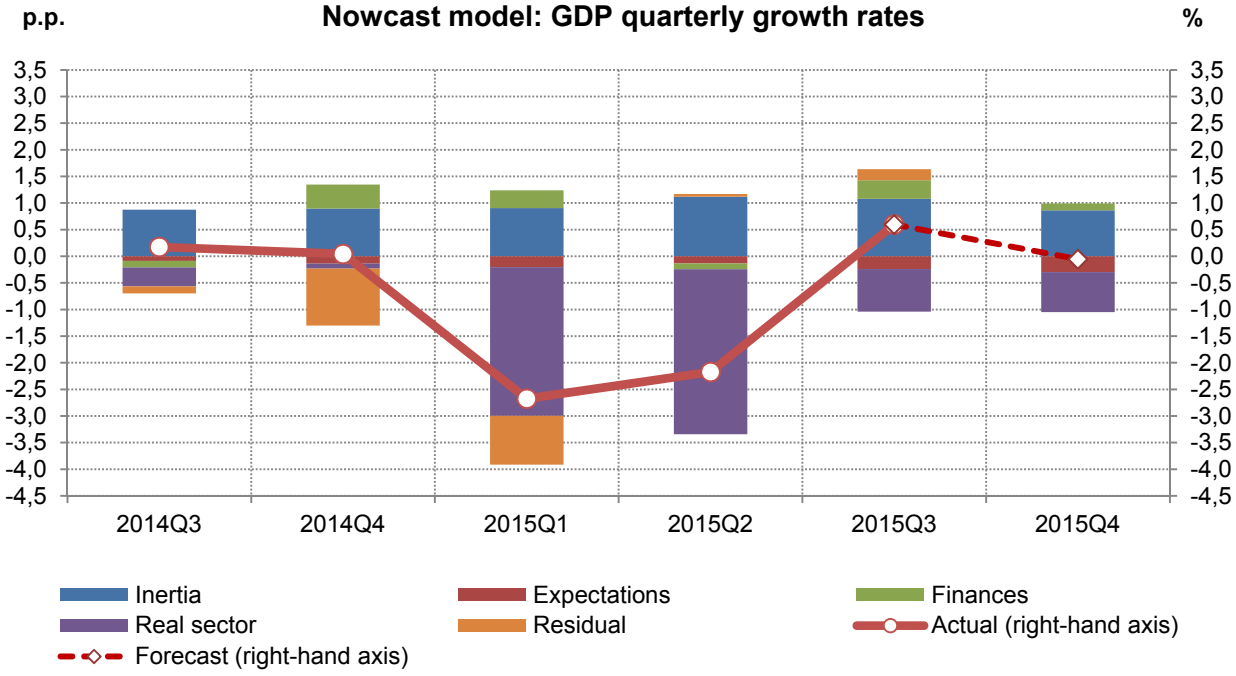

Figure 3. Contributions by various groups of indicators to GDP growth rates

As Figure 3 shows, the financial market variables render certain support to GDP in the period under review. The expectations indicator makes a steadily negative contribution to the GDP growth rates, which points to the companies' negative assessment of the economic activity. Iner-

[3] Considering that Rosstat publishes GDP data in constant prices with seasonal adjustment later than the first estimate of the annual GDP growth rate, the authors excluded the seasonal factor by using the standard X-12 multiplication procedure.

tia makes a weakly positive contribution to the GDP quarterly dynamics. The biggest negative contribution is made by the real sector indicators, which may evidence weak production activity of the Russian economy and suggest that no fundamental factors are observed for economic recovery, although the acute phase of the economic crisis is over, according to estimates.

CONCLUSION

The model of GDP nowcasting examined in this paper allows aggregating monthly statistics for obtaining a GDP forecast for a current quarter. The estimate accuracy increases as the volume of available statistical data grows. The root mean square error reaches its minimum after the 20th day of a month following the end of a reporting quarter when statistics for the last month of the quarter is published. This model can be used as an auxiliary method of estimating the GDP growth rate along with the models, which help restore the output of goods and services in the basic types of economic activity, and the models using information on exogenous parameters.

A larger volume of statistical information can be used for building the model (1) to further improve its prognostic power. The research can also be developed further by using the FAVAR model and the FAVAR structural model for GDP forecasting. Moreover, the research can focus on interpolating data, i.e. building GDP monthly growth rates by adding them to the model as supplementary unobserved factors.

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APPENDIX. DATA USED IN THE PAPER

Group 1: Agents' expectations and their estimate of the current economic situation

Diffusion index of finished goods inventory: Actual changes: % of enterprises with the rising indicator over 1 month

Diffusion index of output/input prices ratio: Actual changes: % of enterprises with the improved ratio over 1 month

Diffusion index of expenditures for equipment: Actual changes: % of enterprises with the rising indicator over 1 month

Capacity utilisation rate: normal monthly level = 100

Labour utilisation rate: normal monthly level = 100

Finished goods inventory: normal monthly level = 100

Order book: normal monthly level = 100

Amount outstanding to banks: normal monthly level = 100

Share of enterprises in 'good' or 'normal' financial condition

Share of enterprises not purchasing equipment for 2 and more consecutive months

Interest rates on bank loans (in rubles) to be taken out in coming 3 months

Share of enterprises not indebted to banks and not going to be indebted in coming 3 months

Share of enterprises not going to take out new bank loans in coming 3 months

Share of sales for cash in industry

Group 2: Real sector indicators

Industrial production index

Industrial production index: Mining and quarrying

Industrial production index: Manufacturing

Industrial production index: Electricity, gas and water supply

Agricultural production index: As % of previous month

Fixed capital investment: As % of previous month

Freight turnover: As % of previous month

Construction works: Dynamics: As % of previous month

Total floorspace of commissioned housing

Exports to CIS countries

Exports to non-CIS countries

Retail trade: As % of previous month: Non-food goods

Retail trade: As % of previous month: Foodstuffs, beverages, tobacco

Retail trade: As % of previous month

Unemployment rate

Economically active population: As of end of month: Employed persons

Index of the output of goods and services in the basic types of economic activity: As % of previous month

Real imputed wages: As % of previous month

Real size of pensions: As % of previous month

Group 3: Financial variables, world market and external sector indicators

Weighted average actual rate on overnight loans (MIACR)

Index of the nominal effective ruble exchange rate to foreign currencies: Growth as % of previous month

Index of the real effective ruble exchange rate to foreign currencies: Growth as % previous month

RTS index

MICEX index

Loans, deposits and other funds in rubles extended to organisations for a term of up to 30 days
Loans, deposits and other funds in rubles extended to organisations for a term of 31 to 90 days
Loans, deposits and other funds in foreign currency extended to organisations for a term of up to 30 days
Loans, deposits and other funds in foreign currency extended to organisations for a term of 31 to 90 days
Loans, deposits and other funds in foreign currency extended to organisations for a term of 91 to 180 days
Loans, deposits and other funds in foreign currency extended to organisations for a term of 181 days to one year
Loans, deposits and other funds in rubles extended to individuals
Loans, deposits and other funds in foreign currency extended to individuals
Money supply M2: M1: Cash M0
Interest rate on loans to non-financial organisations in rubles for a term of up to one year, including demand loans
Interest rate on household ruble deposits for a term of up to one year
Money supply M2
Price of natural gas
Price of aluminium
US PMI
Brent crude price