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Nowcasting of Russian GDP growth

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Abstract

Statistical agencies release their preliminary estimates of quarterly GDP growth with a publication delay that ranges from four to eight weeks. Given this lack of timeliness, nowcasting methods have been developed to produce early estimates of GDP growth during the ongoing quarter. As a practical illustration of these methods, I apply several small-scale nowcasting models, including a dynamic factor model, to produce estimates of Russian GDP growth for the first quarter of 2016. I then compare the nowcasting performance of the dynamic factor model against naïve AR- and ADL-models using pseudo out-of-sample forecasting errors. The results indicate Russia's GDP contraction slowed in the first quarter of 2016. The dynamic factor model outperforms the naïve models, displaying better nowcasting prediction accuracy for Russian GDP.

Keywords: dynamic factor models, nowcasting, Russian economy.

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1 Introduction

Statistical agencies release their official first estimates of quarterly GDP growth several weeks after the end of the quarter.[1] Economic policymakers and market participants, however, track the state of the economy in real time. To overcome with this publication lag, nowcasting models of quarterly GDP growth have become established tools in economic analysis and policymaking.

In this note, I consider several nowcasting models (naïve AR- and ADL-models, bivariate VAR models, bridge equations, and a dynamic factor model) in producing early estimates of Russian GDP growth for an ongoing quarter (2016Q1 in this case). Unlike nowcasting models that use large data sets of indicators (e.g. Giannone et al. (2008) for the US; Angelini et al. (2008) for the Euro Area; and Porshakov et al. (2015) for Russia), I rely on a small set of indicators. Not only can large-scale factor models underperform small-scale factor models (e.g. Watson, 2000; Boivin and Ng, 2003), but, as noted by Porshakov et al. (2015), dynamic factor nowcasting models based solely on hard economic data have been found to display similar accuracy to nowcasting models with large information sets that include hard data, financial indicators and survey data.

I focus on GDP growth in the first quarter of 2016 for two practical reasons. First, it mimics an actual nowcasting exercise (Rosstat released its preliminary estimate of GDP growth for the first quarter on May 16). Second, as Russian GDP fell 3.7% y-o-y in 2015, an up-to-date assessment of first-quarter GDP growth would provide valuable insight into whether Russia's GDP contraction had already begun to slow, and if so, by how much.

I calculate pseudo out-of-sample forecasting errors to evaluate the nowcasting performances of the AR-, ADL-, and dynamic factor models. The main difference between naïve forecast and dynamic factor models is that the former use purely quarterly data and disregard monthly data that become available during an ongoing quarter. Dynamic factor models, in contrast, use monthly data that "bridge" early releases of monthly indicators with quarterly GDP.

The note is structured as follows. Section 2 shortly reviews Russian GDP growth trends in the period 2000Q1–2015Q4. Section 3 presents the data and discusses the various empirical approaches. Section 4 shows the empirical findings. Section 5 concludes.

2 Russian GDP growth 2000Q1–2015Q4

Figure 1 shows the dynamics of Russian real GDP growth (q-o-q, SAAR) from the first quarter of 2000 to the fourth quarter of 2015. Four key points emerge.

First, *GDP annual growth averaged about 7% between 2000Q1 and 2008Q1*, an exceptionally high growth rate for any country. This reflects the global commodity boom, particularly the windfall earnings from high oil prices, and the fact that Russia's economic reforms started to bear fruit in the 2000s.[2]

[1] Russia's Federal State Statistics Service (Rosstat), for example, publishes its preliminary estimate of GDP growth about eight weeks after the ending of the quarter.

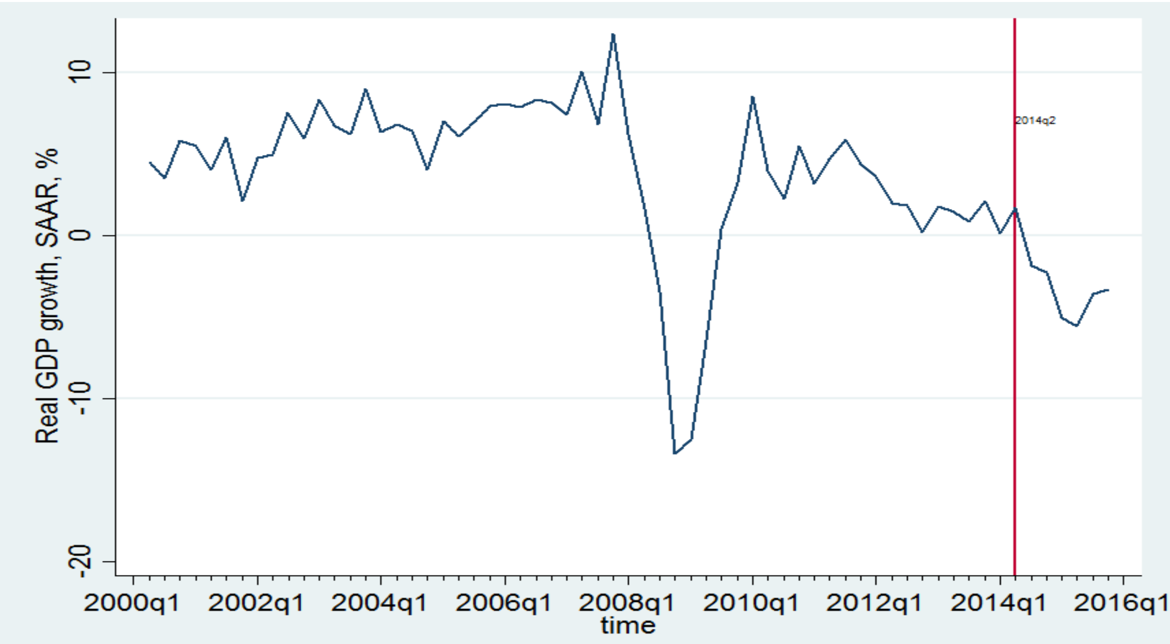
[2] According to Dabrowski (2015), Russia completed many overdue reforms in the early 2000s, including land reform, simplification of the tax system (the flat personal income tax of 13%), abolition of fiscal imbalances, keeping privatization programs in place, partial opening to foreign investors, financial deregulation, and adoption of market-oriented legislation.

Second, *GDP plunged sharply in the 2008 global financial crisis but climbed back to the recovery quite soon, after oil prices started to soar in 2009.*

Third, *the latest slowdown of GDP growth is more gradual than in the 2008 global financial crisis. The deterioration of GDP started about in 2012, in parallel with a deceleration in real gross fixed investment.* In other words, the economic slowdown started well before the collapse in oil prices, the annexation of Crimea and heightened tensions with Ukraine, Western sanctions against Russia (2014Q2) or Russian counter-sanctions. Importantly, this suggest that the roots of the current downturn are more systemic than cyclical.

Fourth, *the recent GDP contraction began to moderate during the second half of 2015.* This was due to a number of factors, including the floating of the ruble, the government's decision to refrain from heavy-handed austerity policies and use of the national rainy day funds (the National Welfare Fund and the Reserve Fund). The consensus estimate for Russian GDP contraction is 1.2% for this year. Most recent estimates put 2017 GDP growth at around 1%.

Figure 1 Russian real GDP growth (q-o-q, SAAR) from 2000Q1 to 2015Q4.



Source: Rosstat, author's calculations.

3 Data and empirical approaches

3.1 Data

The economic, financial, and survey data are taken from various sources. Russian quarterly GDP series in levels, at constant 2008 prices, are from Rosstat.[3] Other economic and financial data are extracted from Macrobond (original sources: Rosstat, the Central Bank of Russia, Russia's Ministry of Finance). Survey data are from the OECD database (original source: Gaidar Institute) and Markit. Note that the GDP series were subject to data revision after publication, so it is impossible here to perform a "true" real-time nowcasting exercise.

Nominal time series in rubles are deflated using Rosstat's CPI data. I seasonally adjust data in EViews with TRAMO/SEATS if the effects are significant. Data are logarithmized and first-differenced to be stationary. As such, the GDP growth rate here is seasonally adjusted annualized from one quarter to the next.[4] All variables used are reported in the Appendix.

3.2 Empirical approaches[5]

Quarterly vector autoregressive (VAR) models utilize the quarterly aggregate of a monthly indicator and quarterly GDP. The nowcast of this model is the average of the nowcasts from all single models (indicators). Overall, I estimate 19 bivariate quarterly vector autoregressive models, after quarterly data on economic and financial indicators were published for the last quarter of 2015. Following the nowcasting literature, I choose the set of economic and financial indicators that aim to capture real developments in the Russian economy. These include, for example, industrial production, retails sales, fixed investment, total exports, price of Urals oil, and REER. Supported by the Bayesian information criterion, I also include into the quarterly VAR models one-quarter lagged values of GDP growth and a monthly indicator. Note that this quarterly data nowcasting approach does not utilize information of monthly indicators of the current quarter. Nevertheless, quarterly VAR models have performed well, for example, for the UK (see Camba-Mendez et al. (2001)).

Bridge equations (BE) "bridge" monthly economic and financial indicators with quarterly GDP. Due to data limitations, I use a set of only 14 monthly indicators (compared to 19 in the QVAR models). The BE estimations are conducted in two steps. First, I estimate missing monthly indicators for the first quarter of 2016 using univariate autoregressive models.[6] Second, once I have a complete set of monthly indicators (observed or estimated) for 2016Q1, I calculate quarterly averages of monthly indicators, and perform single forecasts of quarterly GDP growth. Finally, to obtain the nowcast, I take the average of the nowcasts across the 14 models.

[3] Quarterly GDP data were extracted from Rosstat's website in early March 2016. At the time, Rosstat had published its preliminary estimate of GDP growth for *the whole of 2015*, but not 2015Q4, which was needed in the forecast models. I worked around this by calculating GDP growth in 2015Q4 using GDP figures for 2015 and 2015Q1–Q3. This turned out to be a minor limitation as the official GDP figure and the proxy GDP figure for 2015Q4 were quite similar. The bigger challenge from the nowcasting standpoint, however, was the fact that Rosstat *changed its calculation methodologies* as well as *base year* for quarterly GDP series in the early 2016. With Rosstat's quarterly GPD statistics currently fragmented, there was no way to take these changes into account in this note.

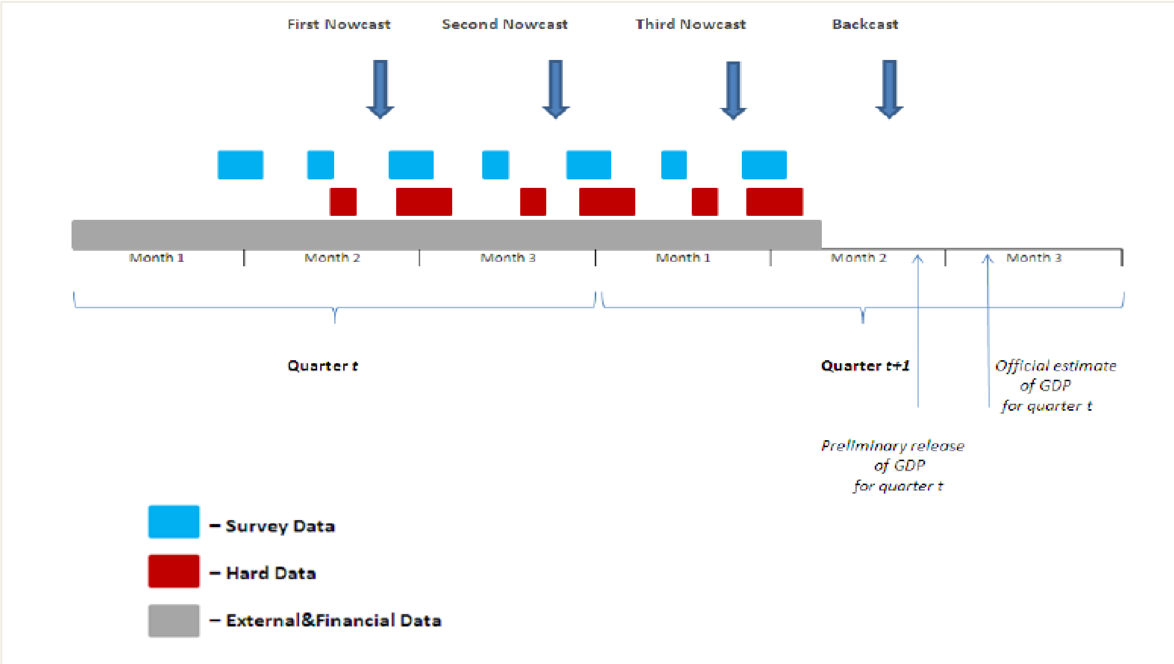
[4] One benefit of this action is that it adjusts the growth rate to reflect the amount GDP would have changed over a year's time had it continued to grow at the given rate.

[5] This section draws on Barhoumi et al. (2008), who also provide more details on nowcasting models used in this note.

[6] Data include missing values of indicators for 2016M3 and 2016M2. Nowcast estimation for 2016Q1 is approximately conducted at the beginning of 2016M3.

Bridging with factors is an approach that assumes a small number of quarterly factors drive monthly indicators. Doz et al. (2011) propose the two-step estimation method that is consistent with large *n*. I first transform monthly indicators to three-month differences, following Giannone et al. (2008), and then extract two factors (principal components) from a set of standardized monthly indicators (18). To take into account the dynamic properties of the factors, the factors are updated using the Kalman filter.[7] Finally, I estimate the parameters of the model from an OLS on the dynamic factors. Figure 2 shows monthly indicators' approximate release timing in the dynamic factor model.

Figure 2 Monthly indicators' approximate release timing in the dynamic factor model.



Source: Porshakov et al. (2015).

4 Empirical findings

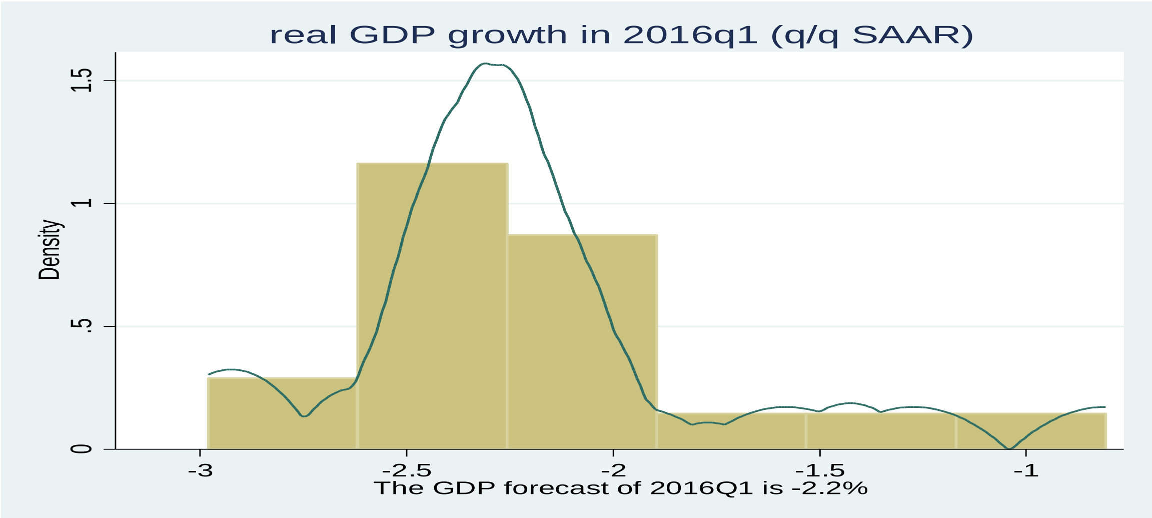
4.1 GDP growth in 2016Q1

Figure 3 shows the histogram and the kernel density estimates of GDP growth for 2016Q1 using quarterly data.[8] The average of the nowcasts from 19 single models, -2.2% (q-o-q, SAAR)[9], is the QVAR nowcast for the first quarter, suggesting that Russian GDP would decline about 2% in 2016 if GDP contraction continued at the same rate in the subsequent quarters of 2016 (2016Q2-Q4). Moreover, the QVAR nowcast for the first quarter, -2.2%, is about one percentage points higher than

[7] The dynamic factor model includes 14 monthly indicators. In addition, I include four survey variables, i.e. Markit's services and manufacturing PMIs and the manufacturing orders inflow and manufacturing capacity utilization figures from the OECD database (original source: Gaidar Institute).
[8] In an attempt to simulate a real-time nowcasting framework, I performed all estimations during March-April 2016, well ahead of Rosstat publication of its preliminary estimate of GDP growth for 2016Q1.
[9] At a non-annualized rate, the corresponding figure is -0.6% (q-o-q, SA).

Russian GDP contraction in the last quarter of 2015 (-3.3% q-o-q, SAAR), implying that GDP contraction slowed in the first quarter. The single QVAR nowcasts for the first quarter vary in the range of -1% to -3% (q-o-q, SAAR).

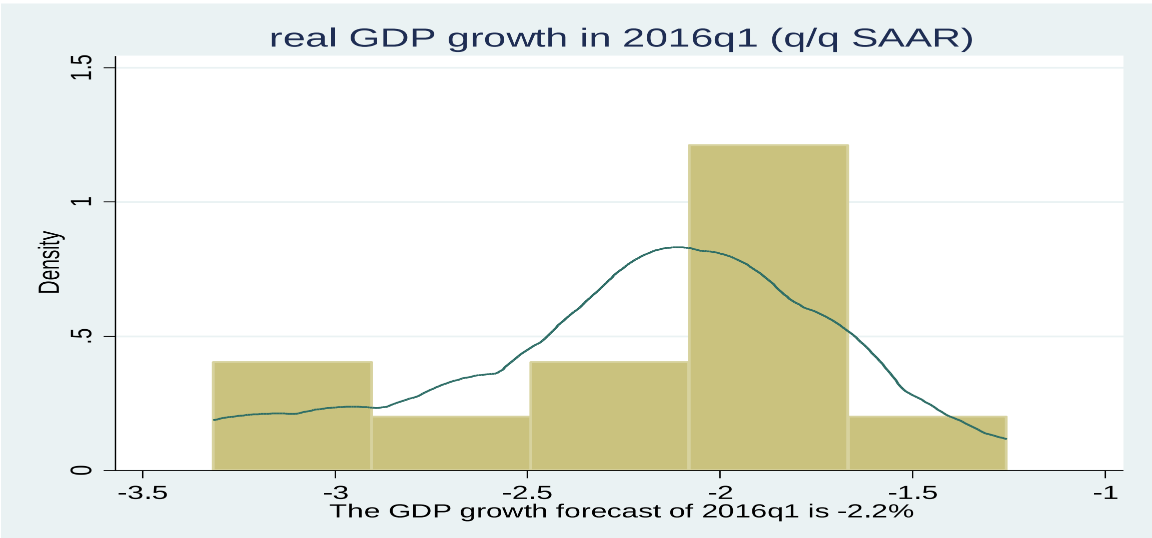
Figure 3 Bivariate QVAR nowcasts of Russian GDP growth for 2016Q1.



Source: Rosstat, Macrobond, author’s calculations.

Figure 4 shows the GDP nowcasts for the first quarter using traditional bridge equations that “bridge” monthly economic and financial indicators with quarterly GDP. Due to data limitations, I use 14 monthly indicators in the BE models. Nevertheless, the BE nowcasts for 2016Q1, -2.2% (q-o-q, SAAR) and -0.6% (q-o-q, SA), are the same as the QVAR nowcast estimate above. Single BE nowcasts roughly vary in the range of -1.3% to -3.3% (q-o-q, SAAR).

Figure 4 Bridge equation nowcasts of Russian GDP growth for 2016Q1



Source: Rosstat, Macrobond, author’s calculations.

The dynamic factor model (DFM) nowcast for 2016Q1 is -1.0% (q-o-q, SAAR). This suggests that Russian GDP would decline about 1% in 2016 if GDP contraction continued at the same rate in the remaining three quarters of 2016 (2016Q2–Q4). The corresponding non-annualized figure (q-o-q, SA) is -0.25%.

How well did these nowcast models perform in nowcasting Russian GDP contraction in 2016Q1? Unfortunately, the available data cannot confirm the answer.[10] Upon the release of Rosstat's GDP figure for the first quarter, however, Russia's economy ministry estimated that GDP contracted by 0.2% (q-o-q, SA) in the first quarter. The Central Bank of Russia subsequently estimated that GDP contracted by 0.1% in the first quarter (q-o-q, SA). Interestingly, these two estimates, based on updated monthly information sets from those used in the nowcasting model here, are within reasonable range from the dynamic factor model's nowcast for the first quarter (-0.25% q-o-q, SA).

4.2 Pseudo out-of-sample forecast errors

This section evaluates the forecasting performance of naïve AR(2)- and ADL(1,1)-models with respect to a small-scale dynamic factor model.[11] Pseudo out-of-sample forecast errors are calculated as follows. I first estimate the models' parameters using data from 2000Q1 to 2011Q4 (48 observations), then forecast GDP growth in the horizon from 2012Q1 to 2015Q4 (16 observations). To evaluate the forecasting performance of these three models, I calculate the root mean square errors (RMSE).[12]

Table 1 reports the RMSEs of the three models. The simple AR(2)-model has the poorest forecasting performance. The ADL(1,1)-model performs somewhat better than AR(2)-model. The small-scale dynamic factor model performs about 20–30% better than the naïve models. The RMSE of the small-scale dynamic factor model (0.28) is also in line with Porshakov et al. (2015), who, using large-scale nowcasting models, report RMSEs of 0.24 for nowcasts estimated in the second month of the quarter (M2) and 0.19 for nowcasts estimated in the third month of the quarter (M3), respectively.[13]

Table 1 RMSEs over the period of 2012Q1-2015Q4.

AR(2)	ADL(1,1)	DFM
0.40	0.34	0.28

[10] There are several challenges currently with Rosstat's GDP series. First, the Rosstat's preliminary GDP growth figure for 2016Q1 (-1.2%), published in May 16, is understandably year-over-year, not quarter-over-quarter that is used in this note. Second, the published GDP figure does not include the leap-year effect. Third, Rosstat's quarterly GDP series is fragmented due to methodological recalculations performed to take into account international revisions in the System of National Accounts. Fourth, Rosstat changed the base year in quarterly GDP series from 2008 to 2011. Currently, the quarterly GDP data at constant 2008 prices I use in this note are not fully available from Rosstat's website (only 1995Q1–2011Q4), and the new quarterly GDP series with 2011 as the base year is only available from 2011Q1.

[11] Specifically, AR(2)-model is a univariate autoregressive model of GDP with its two lags as predictors. ADL(1,1)-model is an autoregressive distributed lag model of GDP that includes lagged values of GDP and price of oil (Urals) as predictors.

[12] RMSEs are reported here on a non-annualized basis. This facilitates a straightforward comparison with Porshakov et al. (2015). Liebermann (2014) also presents his RMSEs on a non-annualized basis.

[13] The nowcasting models here were roughly estimated at the beginning of M3. Due perhaps to the larger set of monthly indicators and differences in time periods, the forecasting error is about 0.05 larger than in Porshakov et al. (2015).

5 Concluding remarks

Rosstat publishes its preliminary estimate of GDP growth about eight weeks after the end of the quarter. Here, I used several nowcasting models to evaluate GDP growth in the first quarter of 2016, ahead of Rosstat's release of its preliminary GDP estimate for the quarter. I then compared the nowcasting performance of naïve quarterly models against a dynamic factor model that exploits timely monthly data.

Based on the quarterly models, Russian GDP was estimated to fall by 2% (q-o-q, SAAR) in the first quarter of 2016. The dynamic factor model suggested that GDP contracted by 1.0% (q-o-q, SAAR) in the first quarter. Both models captured the fact that Russia's GDP contraction slowed in the first quarter.

When comparing the nowcasting performance of the dynamic factor model and the naïve AR- and ADL-models, the dynamic factor model results in considerable improvements in prediction accuracy. The main takeaway is that small-scale dynamic factor nowcasting models can be quite useful for policymakers and market participants in providing real-time assessment of the state of the Russian economy.

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Appendix. List of variables

1.	Financial data	BIS Locational Statistics, Reporting Banks, External Loans, Non-Bank Sector, Amounts Outstanding, RUB billion, real, SA (Q)
2.	Financial data	FX Indices, European Commission, Real Effective Exchange Rate Index, HICP Deflator (IC37) (Q, M)
3.	Economic data	Foreign Trade, Commodity, Export, Total, Crude Oil, Million Tons (Metric), SA (Q)
4.	Economic data	Foreign Trade, Commodity, Export, Natural Gas, CIS, Million Tons (Metric), SA (Q)
5.	Economic data	Expenditure Approach, Export, Total, RUB billion, real, SA (Q, M)
6.	Economic data	Expenditure Approach, Gross Capital Formation, Gross Fixed Capital Formation, RUB billion, real, SA (Q, M)
7.	Economic data	OECD MEI, Employment, All Persons (ages 15–74), SA (Q)
8.	Economic data	OECD MEI, Total Retail Trade (Volume), Index, SA (Q)
9.	Economic data	Current Account (Analytical Presentation), Total, Balance, RUB billion, real, SA (Q)
10.	Economic data	Federal Government Budget, Non-Interest Expenditure, Total, RUB billion, real, SA (Q, M)
11.	Financial data	M2, Total, RUB billion, real, SA (Q, M)
12.	Economic data	Retail Trade, Turnover, Total, RUB billion, real, SA (Q, M)
13.	Economic data	Industrial Production, Total, Index, 2010=100, SA (Q, M)
14.	Financial data	FX Spot Rates, Macrobond, RUB per USD, End of Period (Q, M)
15.	Economic data	Average Income Per Capita, RUB, real, SA (Q, M)
16.	Economic data	Construction by Status, Completed, All Forms of Construction, Value of Work, RUB billion, real, SA (Q, M)
17.	Economic data	Manufacturing, Passenger Cars, 1,000 cars, SA (Q, M)
18.	Economic data	Real Estate Stock, Dwellings, Total, 1,000 square meters, SA (Q, M)
19.	Financial data	Russia, Crude Oil, Urals, Average Price, USD (Q, M)
20.	Economic data	Quarterly GDP in 2008 rubles (Q)
21.	Survey data	Manufacturing, rate of capacity utilization. Based on response to "At what capacity is your company currently operating (as a percentage of full capacity)? The company is currently operating at ..., ... % of full capacity." (M)
22.	Survey data	Manufacturing, orders inflow. Based on response to "How have your orders developed over the past 3 months? They have ... (+) increased, (=) remained unchanged, or (-) decreased." (M)
23.	Survey data	Markit Services PMI (M)
24.	Survey data	Markit Manufacturing PMI (M)

Notes: The variables above are extracted from several data sources. Q=quarterly data, M=monthly data.

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