

What can we learn from the news? Macroeconomic nowcasting with the use of text data.¹

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The ability to forecast accurately the key macroeconomic variables is crucial to the central bank for the development of the efficient monetary policy and prompt reaction to the changes in economic conditions. In the recent years, more and more research is conducted in the interdisciplinary domain, combining the traditional econometric routines with machine learning and natural language processing techniques. Namely, the use of text mining in economic research is gaining momentum, fueled by the advances in computational capacities and NLP algorithms.

The aim of our research is to verify whether an information extracted from the text of the news can improve the prediction of the current dynamics of the key macroeconomic time series in Russia. With this aim, we construct a set of features extracted from the news articles and evaluate the forecasting performance of the standard and machine learning models built on the dataset of vintages and the extracted features.

The use of text mining in economic and central bank research is gaining momentum (Bholat et al., 2015). The research with the use of text data can be classified according to the source of the data: social media (Biorci et al., 2017), news (Ardia et al., 2019), financial transcripts (Feuerriegel, Gordon, 2019), central bank communications (Shapiro, Wilson, 2019), roughly speaking search requests (Baker, Fradkin, 2017). Alternatively, it can be classified by the research subject and forecasting target: stock market prices (Sardelich, Manandhar, 2018; Khedr et al., 2017; Caruso et al., 2018), macroeconomic time series (Shapiro et al., 2018; Ardia et al., 2019), systemic risk (Nyman et al., 2018), methods for the sentiment extraction (Levenberg et al., 2014) and others. Nassirtoussi et al. (2014) provides a systematic review of the text mining techniques, classifying them by the targeted financial index, the type of forecast, method for feature selection as well as by the type of applied machine learning algorithm.

The use of information extracted from the news articles in the forecasting of low-frequency macro time series becomes more and more popular in economic research. Conducted analysis shows that the news can be a valuable source of information in macroeconomic forecasting. Levenberg et al. (2014) use a Bayesian classifier combination model to forecast the nonfarm payroll index and show that the inclusion of the sentiment of text streams of Web data in the model can help achieving higher predictive accuracy. Goshima et al. (2018) use the data from daily newspaper articles to predict future inflation in Japan, showing that news leading indicator helps forecasting long-term inflation rate. Elshendy, Colladon (2017) show that the number of news, their tone, the network constraint of nations are important predictors in forecasting the GDP, business and consumer confidence indices. Shapiro et al. (2018) form four sentiment measures from

¹ The expressed views are solely those of the authors and do not necessarily reflect the official position of the Bank of Russia.

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economic articles of 16 newspapers and show that the constructed measures correlate with key business indicators and can help forecasting inflation and federal funds rate.

Among the research with the use of news-based features in the time-series forecasting the most related to the current research are Ardia et al. (2019) and Feuerriegel, Gordon (2019). Ardia et al. (2019) show that the use of news based sentiment information provides significant accuracy gains in the forecasting the nine months and annual growth rates of industrial production in the USA and that the optimization with respect to such sentiment index dimensions as the calculation method, topic and time period can help achieving higher forecasting accuracy. Feuerriegel, Gordon (2019) focus on the methods of feature engineering, investigating whether the disclosure announcements by firms listed on the German stock exchange can improve long-term macroeconomic forecasts of the GDP in Germany and the EU, unemployment rate, CPI, IP, Federal 10-year bond, business and consumer confidence. By applying different machine learning techniques³ to the word counts and comparing these models to the autoregressive benchmark they show that news-based models can lead to a statistically significant reduction in the forecast errors.

Data. Our research extends an existing literature by being one of the first research on the Russian news except for Yakovleva (2018) where a significantly smaller news dataset was used. The corpus of news contains over 260 thousands of news articles of the Russian newspaper “Vedomosti”, which covers the news on the Russian economy and finance, politics and foreign affairs. We use these data to form features from the texts of news. Apart from the unique news data, we use the vintages of key macroeconomic time series for the period from 2000 to 2018, which incorporates all the revisions of official estimates. Being widespread practice in the foreign research it is one of the first for the Russian data. The nowcasting of the Russian economic conditions is a challenging task as most of the macroeconomic aggregates are subject to substantial revisions. In this sense, the forecasting with the use of vintages of macro variables, news-based features and the application of the machine learning techniques is a promising way to increase the forecasting performance of benchmark models.

Methodology and the results. As opposed to Ardia et al. (2018) who used only one type of the sentiment index and predefined topics we build Latent Dirichlet Allocation, Latent Semantic Indexing and Doc2vec models to extract features from the texts of the news and construct two sentiment indexes, which treat neutral words in a different way. For each model we define the optimal number of topics and evaluate the sentiment of each topic, which we treat as features in the forecasting models additionally to the topics extracted by the models at the first stage.

To incorporate the extracted features in the forecasting routine we consider such standard forecasting models as dynamic factor model and autoregressions of different orders along with such machine leaning algorithms as elastic net, random forest, gradient boosting, and Bayesian neural networks. The models are

³ Among which are least squares absolute shrinkage operator, ridge regression, elastic net, gradient boosting, principal component regression, random forest and partial least squares regression.

built for GDP, IP, construction, real wage growth, unemployment, real sales and investment. For each ML model we choose the optimal set of hyperparameters via cross-validation procedure. We evaluate the forecasting performance of the models in pseudo-real time choosing for each year the optimal architecture of the model on the available data, treating next year data as a test sample. We calculate the out-of-sample RMSE of predictions and compare them with the forecasts based on the models of the same type constructed on the data, which exclude text and sentiment variables. We apply Diebold-Mariano test to evaluate whether the difference in the performance of the models is statistically significant. The results suggest that the models, which incorporate the additional text features in general, overperform those, which do not take into account the text data.

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