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Impact of Sanctions on Industry Indices

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ABSTRACT

Anti-Russian sanctions have an additional impact on Russian companies. Due to the rapid change in the situation and the development of information situations, it is becoming difficult for investors to make investment decisions. This determines the relevance of the study, the **purpose** of which is to determine the impact of information about sanctions on stock indices of lower industries. The empirical basis for the study of indicators includes 67 thousand news items from the Interfax platform for 2014–2023. The following were used as control measures: the price of Brent oil futures, the dollar-ruble exchange rate, and the RUONIA benchmark interest rate. The indices of MOEKEU (electric power industry), MOEKS (chemistry and oil chemistry), MOEKOG (oil and gas) are considered. All data were obtained for the period from 01.01.2014 to 31.12.2023. The research methodology is based on mathematical modeling using the BERTopic topic modeling algorithm. Four main topics of sanctions were identified: "Anti-sanctions policy and sanctions evasion", "Western sanctions", "Sanctions against industry-specific companies", "Financial market". The impact on industry indices was assessed using the random forest algorithm and GARCH analysis. It has been proven that sanctions have less impact on the indices of those industries that are sufficiently autonomous in Russia. Investors pay attention to entrepreneurial topic, and not to the sanctions rhetoric. Negative information can lead to their irrational behavior. The period of maximum impact of sanctions was also determined: a month from the date of release of information about the introduction of sanctions. As a result, the following **conclusions** were made: 1) when referring to industry indices, not all news about sanctions is taken into account, as are messages on the topic of manufacturers, taking into account industry specifics; 2) for the index of the chemical and petrochemical sector of the greatest initiative, which has an anti-sanction policy index; 3) the energy plumbing sector is less developed. The results of the study can be useful for determining investment directions.

Keywords: sanctions; text analysis; news feeds; econometric modeling; exchange rate

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INTRODCUTION

Domestic and foreign researchers assess the impact of sanctions on the economies of countries. It is consider that sanctions can have a demonstrative, preventive, or punitive effect and can be implemented using tools such as asset freezing, embargoes, export and import restrictions, travel bans, suspension of economic agreements, blocking, and termination of foreign aid [1]. In the study by foreign authors E. Gibbons and R. Garfield [2], it is demonstrated that sanctions negatively impact the economy of the target country, leading to a decrease in income, an increase in unemployment, higher child mortality rates, and a reduction in life expectancy [3]. Researchers A. Fuchs and N.-H. Klann [4] also share the same opinion. Having studied the sanctions against China, they identified their impact on trade flows in terms of the reduction of machinery and transport equipment exports.

A number of authors also believe that sanctions affect exchange rates and can be the cause of currency crises. D. Peksen and B. Son [5] analyzed panel data from several countries for the years 1970–2005 and proved that sanctions worsen the financial stability of the targeted countries. Sanctions affect the exchange rate and provide an additional opportunity for currency speculation by currency traders, creating additional risks. Sanctions also affect the economic growth of the targeted country. Authors K. Ohyun et al. [6], based on the analysis of 1101 sanctions from 1950 to 2019, found that they lead to a 0.39% reduction in the current level of GDP per capita. Regarding the special military operation, the introduction of sanctions against Russia has had negative consequences not only on its financial market but also on the entire global economy, as Russia plays a key role in such important sectors as metals and energy resources. The topic of the research is relevant.

The purpose of the research is to assess the impact of news about sanctions on the Russian stock market, taking into account industry specifics. Despite the popularity of this topic, the empirical assessments of the impact of sanctions presented in domestic and foreign studies differ. Our research contributes to the existing theoretical and empirical literature in the following areas:

1. Firstly, we are contributing to the literature on behavioral finance by assessing the impact of investors' expectations about sanctions on stock markets. We also test the theory of market efficiency. If news about sanctions affects the stock markets, then the market is inefficient, and this information can be used in the formation and management of investment portfolios, risk hedging, etc.

2. Extensive literature is dedicated to examining the impact of global shocks on financial markets, while few studies assess the impact of sanctions.

3. In our study, we evaluate news about sanctions based on the application of machine learning, unlike researchers where news about sanctions is selected through expert methods (see, for example, the work of V.V. Rychkov [7]). The empirical dataset includes 67 thousand news articles from the Interfax platform for the years 2014–2023.

4. In our study, unlike previous authors (see, for example, E. Fedorova et al. [8], V.V. Rychkov [9]), who form general sanction indices based on the number of publications on this topic, we form indices on individual sanction topics.

5. We apply the BERTopic thematic modeling algorithm [10], which identified 4 main themes of sanctions: anti-sanction policy and evasion of sanctions, Western sanctions, sanctions against companies, industry-specific, financial market.

6. Our research makes a significant contribution to the existing literature on asset pricing during periods of economic uncertainty. Our research makes a significant contribution to the existing literature on asset pricing during periods of economic uncertainty. We have proven that investors pay attention only to specific topics related to sanctions, rather than the general rhetoric about sanctions. This observation aligns with the assumption

that negative information about sanctions can lead to irrational behavior among investors. Thus, during times of geopolitical tension, the behavioral aspects of market participants play a key role.

LITERATURE REVIEW

As for the impact of sanctions on the financial market, all studies can be conditionally divided into several blocks: the impact on the financial activities of companies and the impact on the stock market.

Let's consider the first block related to the activities of domestic companies. The sanctions imposed against Russia were directed at specific enterprises, certain types of commercial transactions, and export-import flows. The sanctions affected both domestic and foreign companies; however, many of them did not fulfill their publicly announced commitments to exit the Russian markets. For example, according to KSE (2022)[1] as of 10 August 2023, out of 3 390 enterprises, only 265 companies have completed their exit from Russia. Many companies increased their sales in Russia after initially suspending them in early 2022 [11].

The issues of the impact of sanctions on the financial activities of companies have been raised repeatedly in domestic and foreign literature. Sanctions affect the company's supply chain, production costs, competitiveness, and profitability [12], as well as the international activities of companies by restricting market access, which can lead to companies exiting the market or reorganizing. It has also been found that the impact of sanctions depends on the size of the firm and the industry in which it operates.

Let's consider the second block related to the impact of sanctions on the stock market. The markets of developing countries, which include Russia, have high volatility and sensitivity to a multitude of various internal and external shocks, which, in turn, are largely determined by the level of institutional development, geopolitical tension, structural imbalances, low levels of diversification of the national economy, and macroeconomic policy. Western sanctions represent one of these shocks, capable of causing significant changes in the prices of financial assets due to direct restrictions imposed on specific entities, as well as the overall increase in country risk.

In most studies, sanctions are considered major exogenous shocks, and their impact on the Russian stock market is well-documented in both domestic and foreign literature. A. Ankundinov et al. [13], based on statistical analysis of the domestic stock market, proved the change in distribution regarding the heavy tails during the sanctions period. The author explains this by higher country risks due to geopolitical tensions, as well as oil price volatility. Whatever the reason, any increase in heavy tails can have serious consequences for corporate governance, economic modeling, and financial stability analysis.

Sanctions can affect not only the stock market of the target country but also global stock markets. Unlike countries such as Iran, Venezuela, and North Korea, which have previously been subjected to unilateral U.S. sanctions, Russia plays an important role in the global economy and food security, as it is one of the largest exporters of energy resources and food in the world. Sanctions against Russia have led to increased volatility in the global stock market [14] and a decrease in its efficiency [15].

Sanctions can affect the correlation of the stock market with other domestic financial markets. The impact of sanctions on the interdependence and integration of Iranian financial markets from July 2013 to May 2021 was studied using a wavelet approach [16]. The integration of the stock market with the exchange rate and the price of gold has been identified, which is strengthening

[1] News website Alarabiya news. URL: https://english.alarabiya.net/business/2022/05/31/Over-1–000-foreign-companies-left-Russia-since-Feb-24-Report (accessed on 02.08.2024).

in the long term. The greatest influence on the interdependence of financial markets in the short and medium term is related to the exchange rate and the price of gold; the integration of financial markets has increased since 2016.

The next aspect concerns the impact of news on the stock market. According to the efficient market hypothesis, it is assumed that stock prices do not depend on investor sentiment, as investors tend to be rational, and securities quickly incorporate all publicly available information into their prices [17, 18]. On the contrary, behavioral theories suggest that investors may act irrationally due to emotions when making decisions [19]. These emotional reactions can intensify when reading negative information about sanctions. There are a number of empirical studies on the impact of news about sanctions on stock markets. V.V. Rychkov [7] evaluates the impact of news about sanctions on the stock market, examining news about plans to impose sanctions, their actual implementation, and the subsequent reactions of the currency, stock, and credit markets in the Russian Federation to these events. The hypothesis that the news about sanctions and plans for their implementation have a negative impact and are a driving force in the market, regardless of their actual implementation, has been confirmed. The authors T.V. Teplova et al. [20] assess the impact of investor sentiment on social networks on the stock market characteristics of the Russian market and identify nonlinear effects. The main conclusion is that sentiment can be considered an explanatory factor in pricing and trading activity.

Based on the literature review, it was found that news about sanctions should affect the Russian stock market. We test this hypothesis in the following sections of the study.

DATA DESCRIPTION

To obtain the index dictionary and conduct the analysis, we collected news headlines from 2014 to 2023, focusing on the Interfax platform. In total, we uploaded 67thous. texts from the economics section, with their exact distribution by year presented in *Fig. 1*.

The number of publications over the past three years has sharply increased, which is related to the rise in the number of sanctions imposed against Russia.

RESEARCH METHODOLOGY

When global significant events occur, such as the imposition of sanctions, they are reflected in news publications. The more relevant the topic and the more serious the issue, the more frequently it will be mentioned. Thus, compiling an index of topic coverage based on news publications allows one to assess, for example, the index of sanction and anti-sanction activity over a specific period of time. In particular, this allows for the identification of the relevance of a topic or several related subtopics. The calculation of this index is carried out using the bag-of-words method. It has proven to be effective in this task, thanks to its transparency and efficiency. Based on it, information is extracted from textual data, transforming it into numerical data that can not only be visualized but also subjected to mathematical modeling.

To obtain the index of coverage for a specific topic, it is necessary to use a specially created dictionary for it, where each word is related to the research topic. The collection of words forms a dictionary, after which it is necessary to count how many times the words from this dictionary appear in the text. Such dictionaries exist for various fields, for example, for assessing risk levels [21].

Dictionaries are compiled to some extent using an expert method, meaning that an expert selects terms and optimizes their composition. However, various methods can be used to optimize the process of selecting terms, such as frequency analysis of words or correlations with a keyword (based on the frequency of co-occurrence). This approach is often used in scientific research, where it is necessary to analyze textual information.

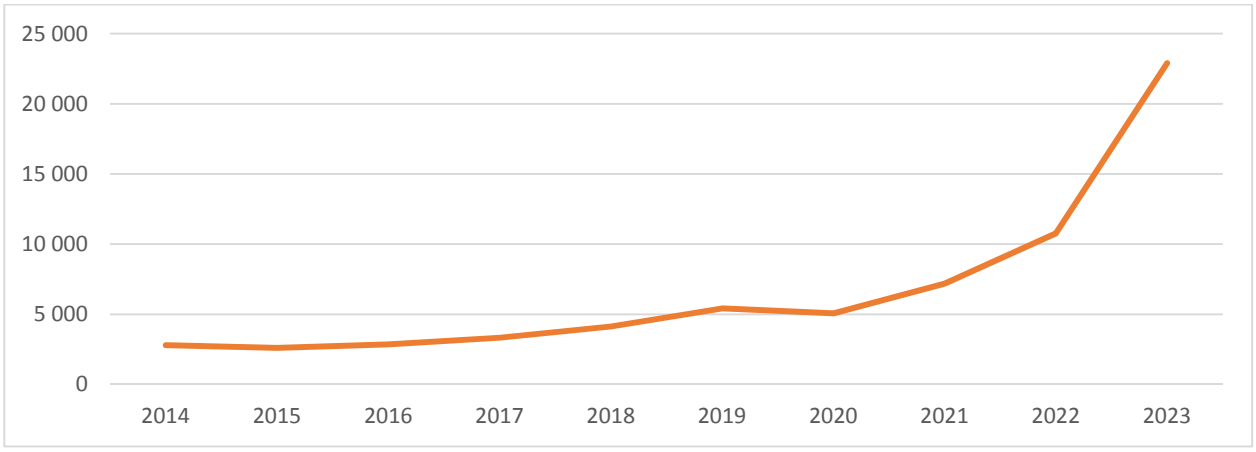

Fig. 1. **Dynamics of Texts about Sanctions in the Interfax News Portal**

Source: Author's calculations.

However, on their own, they can only help the expert identify key terms and decide whether they are needed in the dictionary. As for our research topic, in the work of E.A. Fedorova et al. [22], crisis and sanctions indices were compiled using a large corpus of texts by a linguist-expert. However, specific sanction topics were not identified there, and the topics were somewhat different, which is why this method is not suitable for the current study.

The next method involves topic modeling, usually LDA Latent Dirichlet allocation). This method allows for the identification of implicit thematic groups in a corpus of texts and the extraction of a specified number of topics. This method is not always effective on a large corpus of texts with a wide range of topics, so we use a more advanced method based on the BERT transformer network. He uses topic modeling with consideration of text semantics and is effective in topic separation. BERTopic automatically determines the number of topics in the text and highlights the frequency of words in each topic. Studies comparing various topic modeling methods show that this algorithm produces the most consistent results without topic repetitions and with a logical division of texts by topics [23]. This method automatically determines the number of topics, which reduces the need for manual tuning; we used it in our study.

The analysis of the received corpus of news related to sanctions using the BERTopic algorithm identified 219 topics. The analysis of their composition, combined with the expert method, allowed for the identification of four main themes of sanctions: anti-sanction policy and circumvention of sanctions, Western sanctions, sanctions against companies, industry-specific, financial market. Such division allows us to extract key information about sanctions, which we can obtain through dictionary analysis. Such an approach is typical when constructing index dictionaries [24]; moreover, we followed the recommendations of A.F. McKenny et al. [25] and manually analyzed the contextual usage of certain words and phrases to mitigate potential errors. The index dictionary will consist of a simple set of words or phrases for each topic, as like other similar dictionaries. The topics contain words and phrases, and our division allows us to highlight the most important subtopics in the news, which can be extracted when analyzing the bag of words, ignoring the semantic connections in the text. The results of the study are presented in *Table 1* (all words are given in their base form in lowercase).

Besides individual indices, we also calculate the overall sanction index by summing the assessment results of the four parts of the index.

The obtained news texts were preprocessed using the standard method for text analysis:

Table 1

Developed Methodology of Sanctions Indices on Individual Topics

Sanctions Indexes	Words
Anti-sanction policy and circumvention of sanctions	Anti-Russian, threat, Western, Western sanctions, imposition of sanctions, import substitution, parallel import, Chinese brand, Chinese energy resources, Chinese supply, China support, China cooperation, support Russian, support manufacturer, support project, domestic development, domestic analogue, domestic manufacturer, subsidy development, circumvent sanctions, Russia partnership, partner Russia
Western sanctions	Sanction, sanctions list, sanctions package, new sanction, European Union against, European Union discussing, leaving Russia, contract exit, leaving the market, America against
Sanctions against companies, industry specifics	Russian airplane, airline, import ban, flight ban, Russian oil, Russian gas pipeline, Russian gas, Russian energy resources, energy resources export, energy resources supply, company sanctions, sectoral sanctions, import ban, export ban

Source: Author's calculations.

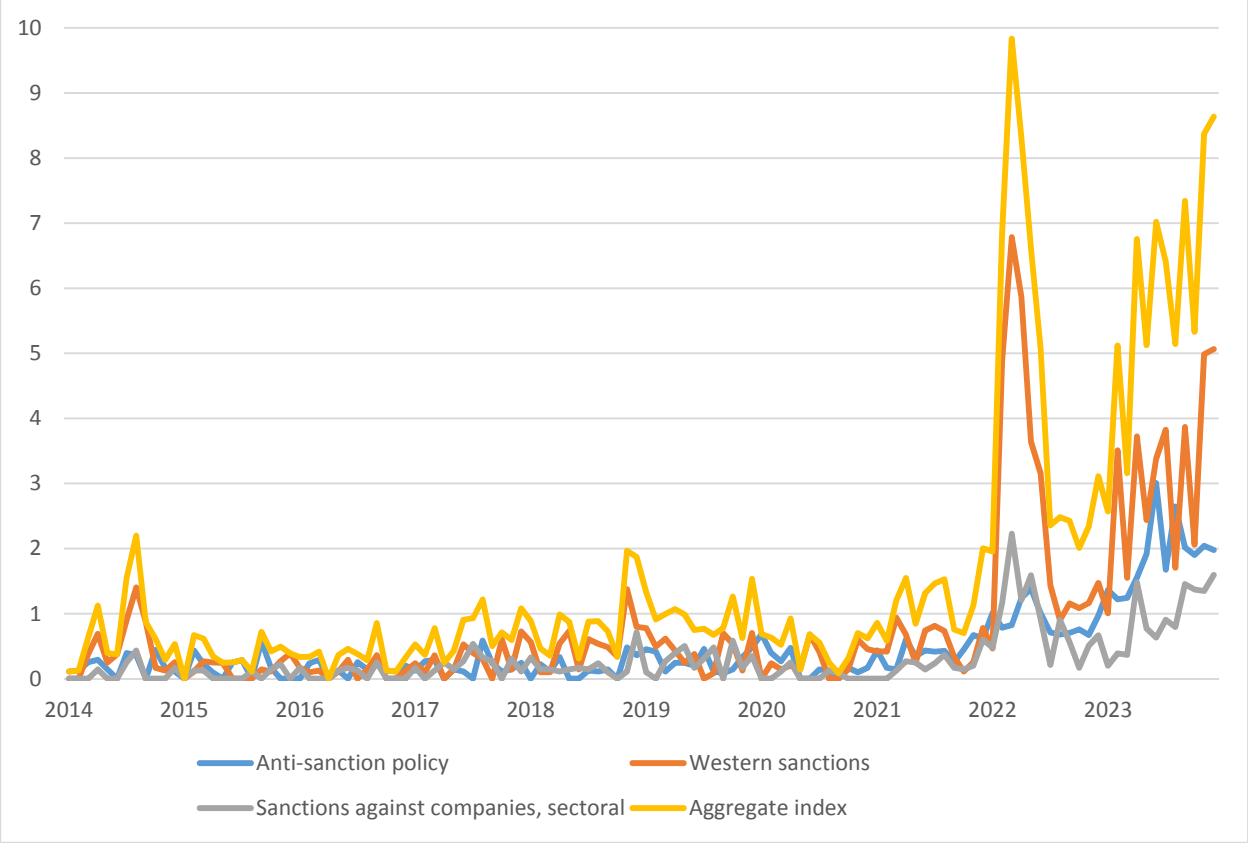

Fig. 2. **Dynamics of Sanctions Indices on the Interfax News Portal**

Source: Author's calculations.

Table 2

Descriptive Statistics

Title	mean	min	max	std	kurtosis	skewness
MOEXEU	1645.2	797.54	2292.4	452.68	−0.4962	−1.0839
MOEXCH	18709	6232.9	39483	9259.1	0.9134	−0.2747
MOEXOG	6158.1	3216.8	9558.2	1688.3	0.1241	−0.9855
Brent	67.992	18.378	122.42	21.858	0.4241	−0.3517
USD-RUB exchange rate	65.173	33.929	97.96	12.864	−0.3103	0.9795
RUONIA	8.5429	3.9961	19.36	3.0122	1.0901	1.4188
Anti-sanction policy	0.4530	0	3.0063	0.5711	2.2272	5.2375
Western sanctions	0.8514	0	6.7841	1.3094	2.5749	6.4818
Sanctions against companies and sectoral	0.2974	0	2.2265	0.4136	2.2435	5.3523
Aggregate index	1.6019	0	9.8341	2.1334	2.2061	4.0492

Source: Author's calculations.

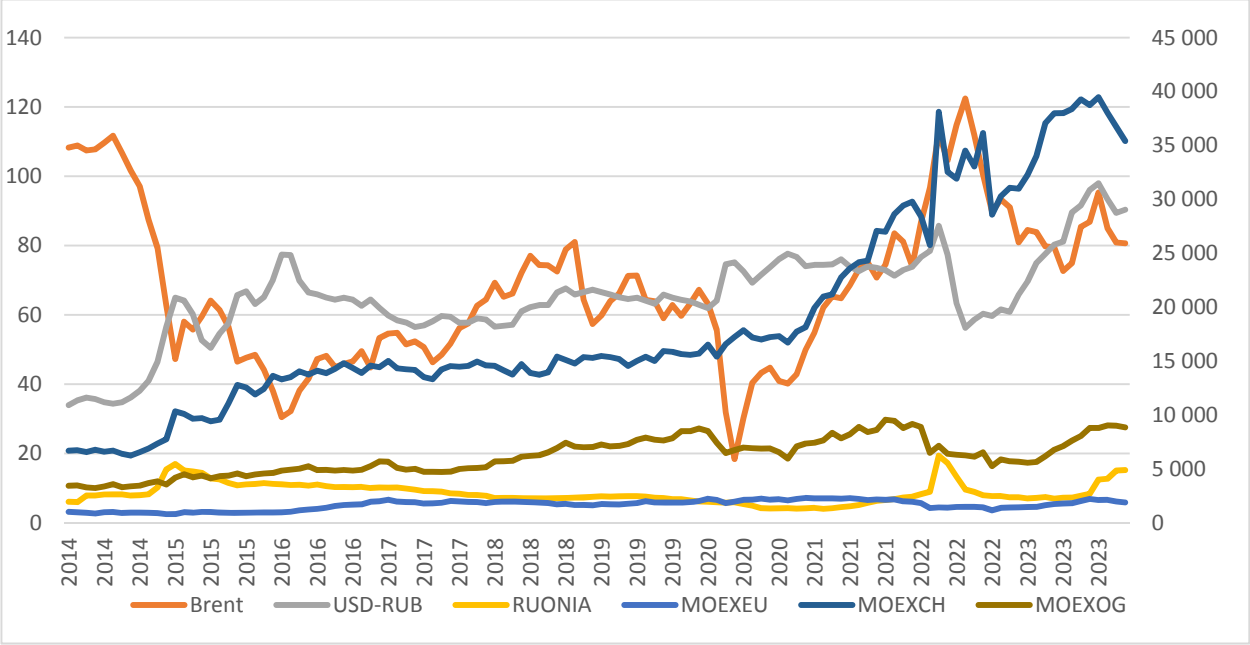

Fig. 3. **Dynamics of Fundamental Economic Indicators**

Source: Author's calculations.

Note: The price of Brent oil, the RUONIA rate, and the USD-RUB exchange rate are plotted on the main axis, while the sectoral indices of the Moscow Exchange are plotted on the auxiliary axis.

numbers and special characters were removed, and stop words (pronouns, prepositions, and other elements of the language that do not carry meaning by themselves) were removed using a dictionary. Next, the texts are broken down into arrays of individual words (tokenized) and lemmatized (returned to their original word forms).

With the help of the texts, an index dictionary was formed, based on which monthly indices were obtained by summing the indices of all individual texts for the month.

Table 3

Testing the Stationarity of Time Series

Time Series	Statistics	p-value	Lag
	Initial data in levels		
USD-RUB	–2.011	0.282	2
Brent	–2.64	0.088	1
RUONIA	–2.086	0.25	0
MOEXEU	–1.617	0.47	0
MOEXOG	–1.425	0.57	0
MOEXCH	0.1247	0.96	6
	Transformed data		
USD-RUB (log — profitability)	–7.546	0.0	1
Brent (log — profitability)	–8.353	0.0	1
RUONIA (increment)	–9,119	0.0	0
MOEXEU (increment)	–10.25	0.0	0
MOEXOG (increment)	–11.383	0.0	0
MOEXCH (increment)	–16.193	0.0	0

Source: Author's calculations.

Note: The null hypothesis of the ADF test is the presence of at least one unit root in the model with a constant and a trend.

The index itself represents the ratio of the total number of words in the dictionary to the total number of words in the text. Thus, the length of the texts does not matter; it is important only for the words from the vocabulary that reflect the theme. Daily indices fluctuate significantly, and sometimes news doesn't come out, so such information is too noisy. That is why we grouped the data by months, obtaining aggregated charts that accurately reflect the index dynamics. In *Fig. 2*, we presented the dynamics of the indices for the period 2014–2023.

The graph shown in *Fig. 2* indicates that the indices sharply increased in the first half of 2020, after which they slightly declined but then sharply increased again from 2023. Moreover, the growth of the index is not proportional to the increase in the number of publications in Interfax. Thus, the number of publications in 2022 only slightly increased, while the indices showed a record value. Peaks are also noticeable in 2014, when the first sanctions were introduced, and at the end of 2018, when another major package of sanctions from Europe and the US was imposed (the official reason was the Skripal poisoning incident). However, the main increase in indices is associated with the start of the special military operation, when many countries imposed sanctions and companies ceased doing business in Russia.

Regarding the differences in the parts of the index, it can be noted that, quite expectedly, the Western sanctions index, which covers

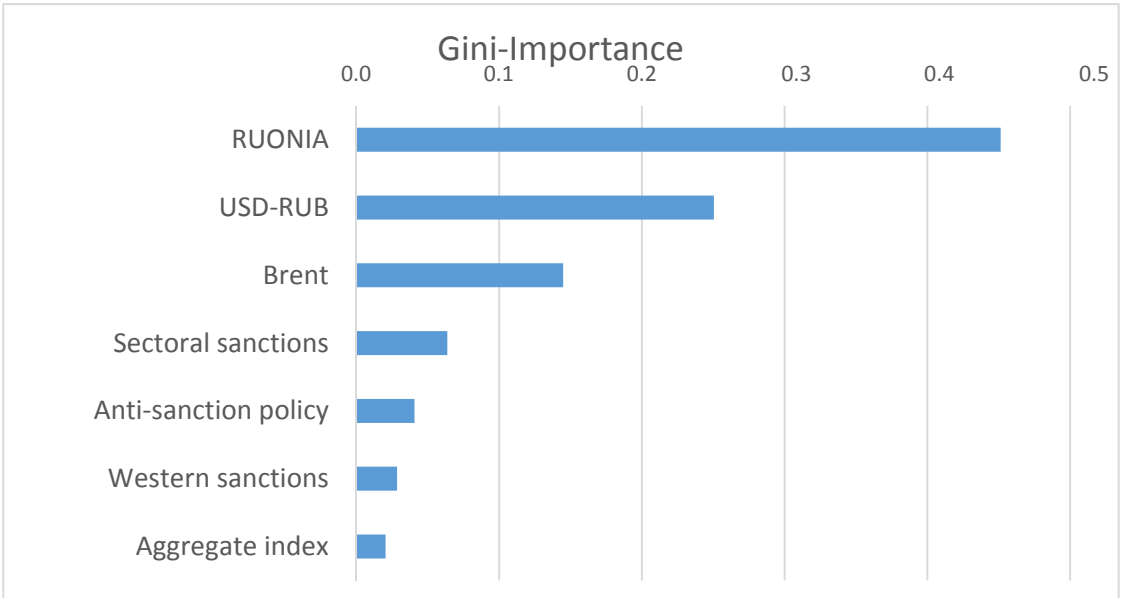

Fig. 4. **Significance of the Random Forest Model for the Dependent Variable MOEXEU (Electric Power Industry)**

Source: Author's calculations.

sanction packages and sanctions in general, predominates for most of the period. However, in some cases, it is evident that the index of anti-sanction policies and methods of circumventing sanctions exceeds it in certain months. Such cases exist both during the calm period between 2015 and early 2022, and during the new peak in 2023.

Russia has been preparing for new sanctions throughout the entire period and is looking for ways to circumvent them. Cooperation with China is being established, the development of domestic production is being subsidized, and an import substitution policy is being implemented. In some cases, it can be observed that the jump in the anti-sanction index occurs in the month following the jump in the main sanction index.

Also, a narrower and more specific index of sanctions against companies and industries, which is harder to distinguish from news headlines, sometimes exceeds the anti-sanction index. Overall, many Western sanctions are aimed at making it impossible for Russian companies to operate or cutting off their sales markets, which forces them to seek other markets.

The obtained indices are used in our further calculations.

CONTROL VARIABLES AND DESCRIPTIVE STATISTICS

To achieve the research objective, additional data were collected to form the research database. In particular, we added several important market indicators: the Brent crude oil futures price, the USD-RUB exchange rate, and the benchmark interest rate RUONIA [26]. We also used the sectoral indices of the Moscow Exchange (market capitalization-weighted composite price indices that include the most liquid indices of large Russian companies in a specific sector). We are considering the MOEXEU (electric power), MOEXCH (chemistry and petrochemistry), and MOEXOG (oil and gas) indices. We chose these indices because sanctions were imposed on these sectors.

All data was obtained for the period from 01.01.2014 to 31.12.2023 as it became available (trading on the exchange does not occur daily). To reduce data noise, we aggregated the indicators by month. *Table 2* presents the descriptive statistics of the collected empirical data and the index calculations.

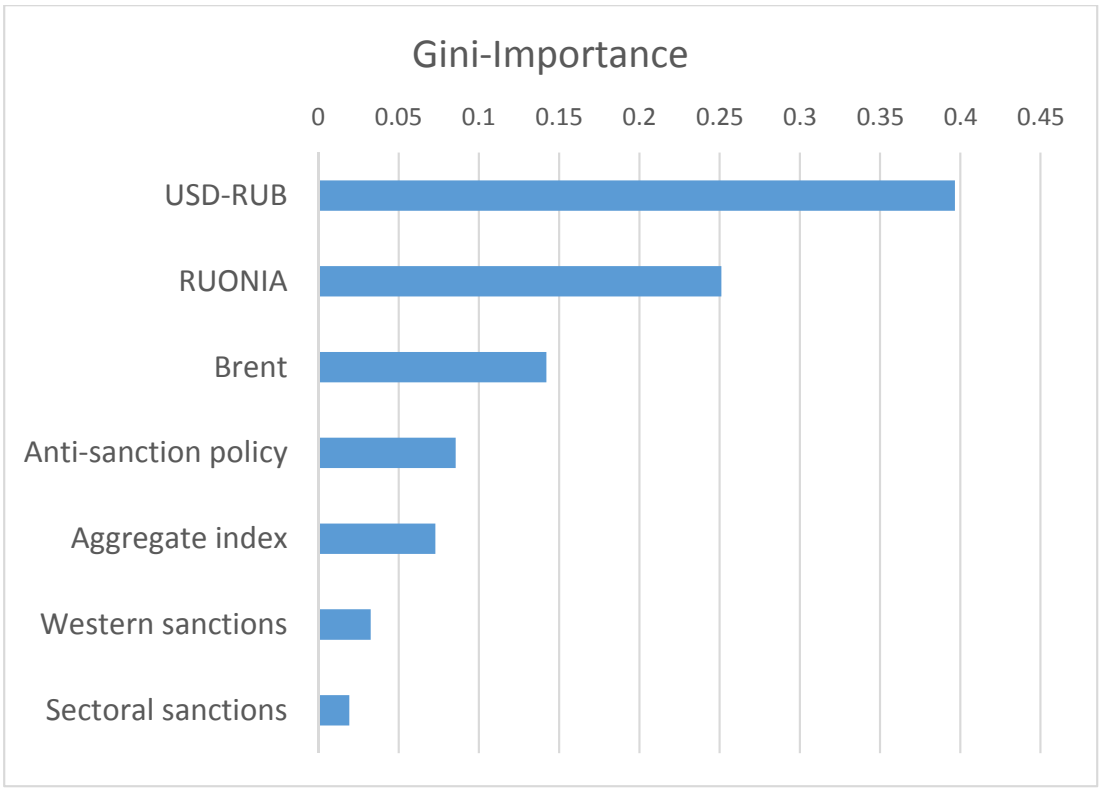

Fig. 5. **Significance of Random Forest Model for Dependent Variable MOEXOG (Oil and Gas)**

Source: Author's calculations.

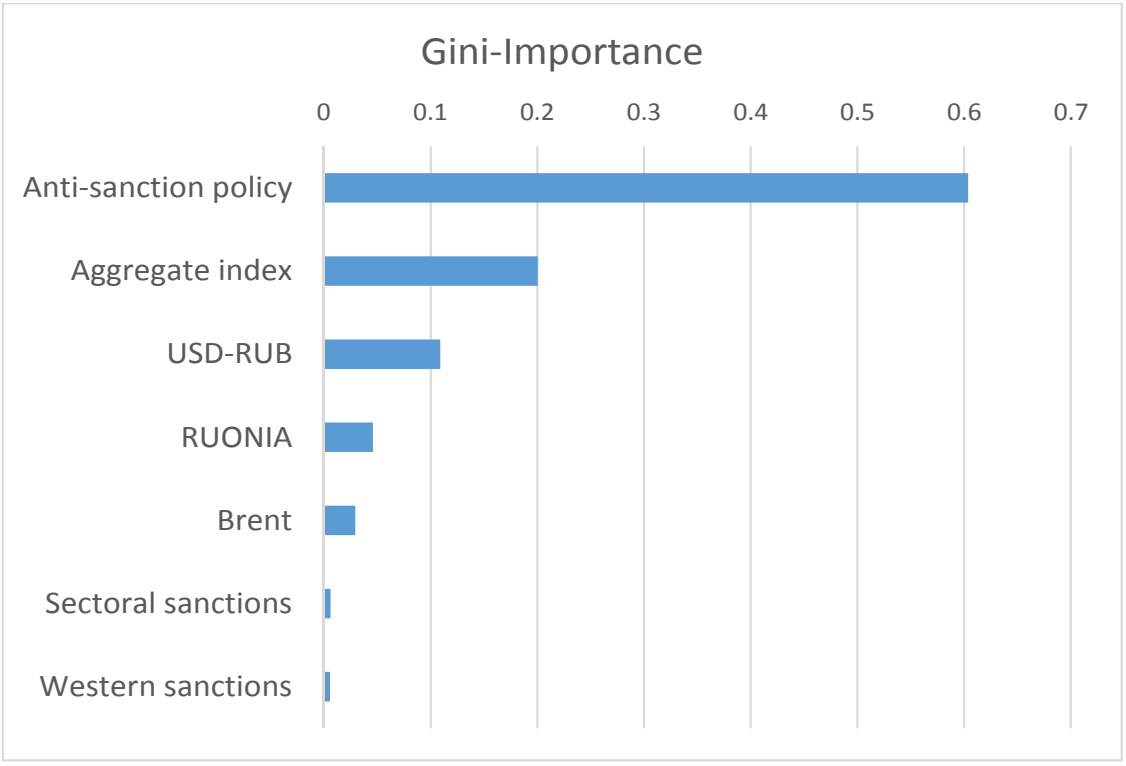

Fig. 6. **Significance of the Random Forest Model for the Dependent Variable MOEXCH (Chemistry and Petrochemistry)**

Source: Author's calculations.

Table 4

Results of Modeling the Impact of the Sanctions Index on MOEXEU (Electric Power Industry) in the Period from 01.01.2014 to 31.12.2023

Parameter	Sanctions indices			
	Anti-sanctions policy	Western sanctions	Sanctions against companies and sectorals	Aggregate index
Control economic variables				
USD-RUB (log — profitability)	901.1475*** (47.74111)	890.8900*** (38.25263)	897.0055*** (43.67303)	930.9593*** (46.46100)
Brent (log — profitability)	−111.8734** (48.58405)	−132.6377*** (44.07817)	−95.24765*** (46.14416)	−185.2012*** (50.57365)
RUONIA (increment)	−808.2726*** (58.61007)	−714.3464*** (65.30440)	−840.7698*** (39.07445)	−693.3575*** (70.43469)
Sanction indices				
Anti-sanction policy	−33.49382 (26.70509)			
Western sanctions		−25.16213* (14.29834)		
Sanctions against companies and sectorals			71.12051* (44.63939)	
Aggregate index				−13.00078 (9.601980)
GARCH-component coefficients				
C(5)	3.634336* (2.146151)	4.226743** (2.198161)	3.622536 (2.865369)	3.480297 (2.530251)
C(6)	1.508886*** (0.429179)	1.723809*** (0.523267)	1.473717*** (0.550287)	1.552271*** (0.490892)
C(7)	0.200895 (0.312448)	0.042062 (0.332808)	0.157286 (0.330347)	0.110365 (0.321029)
C(8)	0.542683*** (0.208685)	0.472001** (0.222364)	0.546734** (0.285438)	0.555758* (0.247908)
Model parameters				
LL	−821.9192	−823.2447	−821.2940	−823.5356
AIC	13.83199	13.85408	13.82157	13.85893
R-square	0.557641	0.572343	0.595469	0.562380

Source: Author's calculations.

Note: Statistical significance levels: *** — 1%, ** — 5%, * — 10%. Standard errors of the model coefficients are given in brackets. LL is the value of the logarithm of the likelihood function, AIC is the value of the Akaike information criterion.

Table 5

Results of Modeling the Impact of the Sanctions Index on MOEXOG (Oil and Gas) in the Period from 01.01.2014 to 31.12.2023

Parameter	Индексы санкций / Sanctions indices			
	Anti-sanctions policy	Western sanctions	Sanctions against companies and sectorals	Aggregate index
Control economic variables				
USD-RUB (log — profitability)	2730.395*** (127.5648)	2537.247*** (113.9950)	2688.612*** (116.1094)	2338.431*** (101.1711)
Brent (log — profitability)	−525.8164*** (123.2459)	−207.3462*** (114.8457)	−335.4771*** (102.2422)	224.1608* (102.1719)
RUONIA (increment)	−1793.879*** (127.7124)	−2084.143*** (112.7235)	−2147.060*** (119.1719)	−2438.219*** (98.93623)
Sanction indices				
Anti-sanction policy	519.3574*** (62.37387)			
Western sanctions		256.8964*** (48.47482)		
Sanctions against companies and sectorals			627.3140*** (130.0767)	
Aggregate index				264.4916*** (26.28771)
GARCH-component coefficients				
C(5)	3.003035 (2.156234)	1.961728 (2.371910)	2.443719 (2.143780)	3.239521 (2.122776)
C(6)	1.528662*** (0.430699)	1.889106*** (0.456189)	1.598831*** (0.496932)	1.583778*** (0.432544)
C(7)	0.229535 (0.267486)	0.241711 (0.272047)	0.334749 (0.252163)	0.184365 (0.249036)
C(8)	0.674840*** (0.145558)	0.722171*** (0.176446)	0.702947*** (0.150638)	0.651808*** (0.166266)
Model parameters				
LL	−974.5009	−963.7775	−964.8807	−963.8472
AIC	16.37502	16.19629	16.21468	16.19745
R-square	0.447908	0.418523	0.400153	0.579805

Source: Author's calculations.

Note: statistical significance levels: *** — 1%. Standard errors of the model coefficients are given in brackets. LL is the value of the logarithm of the likelihood function, AIC is the value of the Akaike information criterion.

Table 6

Results of Modeling the Impact of the Sanctions Index on MOEXCH (Chemicals and Petrochemicals) in the Period from 01.01.2014 to 31.12.2023

Parameter	Sanctions indices			
	Anti-sanctions policy	Western sanctions	Sanctions against companies and sectorals	Aggregate index
Control economic variables				
USD-RUB (log — profitability)	9998.333*** (289.2095)	10247.30*** (161.4734)	7806.470*** (38.59788)	7239.551*** (0.093723)
Brent (log — profitability)	−3401.454*** (189.6655)	−3487.287*** (173.5635)	−2735.645*** (212.6610)	−2456.844*** (1.386198)
RUONIA (increment)	−6279.372*** (349.5061)	−6558.308*** (231.9398)	−3930.111*** (357.3548)	−3380.176*** (38.71707)
Sanction indices				
Anti-sanction policy	1378.464*** (406.3960)			
Western sanctions		36.28521 (183.7713)		
Sanctions against companies and sectorals			10794.69*** (63.57521)	
Aggregate index				2874.283*** (38.00469)
GARCH-component coefficients				
C(5)	0.615556 (1.283508)	0.563656 (1.079852)	14.18199*** (0.035346)	13.69079*** (1.151224)
C(6)	1.694054*** (0.548072)	1.868043*** (0.371523)	1.288542*** (0.126577)	1.768181*** (0.256631)
C(7)	0.205998 (0.267432)	0.232255 (0.205322)	1.053649*** (0.197846)	0.662113*** (0.122267)
C(8)	0.868458*** (0.088845)	0.859557*** (0.073670)	0.058182*** (0.010035)	0.033924 (0.062488)
Model parameters				
LL	−1098.782	−1093.093	−1146.675	−1120.887
AIC	18.44636	18.35154	19.24458	18.81478
R-square	0.040966	0.130018	0.495219	0.700015

Source: Author's calculations.

Note: statistical significance levels: *** — 1%. Standard errors of the model coefficients are given in brackets. LL is the value of the logarithm of the likelihood function, AIC is the value of the Akaike information criterion.

During the described period, the indicators of the sectoral indices of the Moscow Exchange changed significantly, especially some of them. Thus, the oil and gas index rose from a minimum of 3 216 to 9 500, almost threefold, while the metals index fluctuated from 2 185 to 11 924, more than fivefold. The price of Brent oil also increased sevenfold, and there were significant fluctuations in the benchmark interest rate. Moreover, a more detailed analysis of the data reveals that the main peaks in its value coincided with periods when numerous sanctions were imposed and the economy was experiencing shock (late 2014 — early 2015 and the second half of 2023). After the crisis ended, the rate began to gradually decrease.

Sanction indices, in general, show strong fluctuations over the period. It can be noted that the maximum and average sanction indices are approximately twice as high as the anti-sanction index and three times higher than the industry-specific sanction index. As previously noted, the indices fluctuate significantly, and in some months, the anti-sanction index exceeded the sanction index.

For a better understanding of the dynamics of the market indicators used, we constructed a graph (*Fig. 3*).

Note: The price of Brent oil, the RUONIA rate, and the USD-RUB exchange rate are plotted on the main axis, while the sectoral indices of the Moscow Exchange are plotted on the auxiliary axis.

As seen in *Fig. 3*, many parameters fluctuated significantly. Thus, the price of oil was highest at the beginning of the period and dropped significantly when active sanctions were introduced, with a particularly sharp decline visible in the first half of 2020. However, in 2022, the price of oil reached its peak for the entire period. Overall, from 2020 to 2022, all indicators were growing (except for the ROUNA rate, which decreased, but that was also good). However, with the start of the special operation, many indices fell. Some of them, which had very low volatility, did not react to previous events; however, their values decreased in 2022 when sanctions affected absolutely all sectors of the economy. However, by the end of 2023, they had partially recovered their values. Moreover, the chemistry and petrochemistry index increased, thanks to effective anti-sanction policies.

The next stage of our research is to transform the data into a stationary form. To assess stationarity, we applied the Augmented Dickey-Fuller (ADF) test, and its results are reflected in *Table 3*. We performed the following transformations: we switched to the logarithmic returns of the dollar-to-ruble exchange rate and the price of Brent oil (first differences of the logarithms), as well as increments for the RUONIA rate and sectoral indices.

RESEARCH RESULTS

The main stages of our research include: variable selection based on random forest and evaluation of their significance based on the GARCH model for three industries.

To begin with, we will determine the significance of the indicators using the random forest algorithm. This supervised machine learning algorithm is based on decision trees combined into an ensemble. Its significant advantage is the high accuracy of predictions and classifications, surpassing many other models. In particular, this algorithm works excellently with complex market models, showing the best results. The random forest algorithm is applied to various tasks, for example, for stock market forecasting [27]. From the random forest model built by the algorithm, we obtain Gini variable importances, which reflect the degree of influence of changes in the explanatory variables on the dependent variable. For convenience, they were presented in the form of a graph in figure x, where the variables are sorted by decreasing importance.

Let's consider the significances for the three dependent variables of the industry indices, as reflected in *Fig. 4–6*.

From the first model, it is evident that the main influence, as expected, is exerted by market indicators and the bank rate. Text variables

have relatively low significance; even the linear model could not identify a strong correlation with the index of electric power companies. It can be expected that in further calculations their significance will be low, however, it is present, which indicates that the Russian electricity sector is not very sensitive to sanctions, which is quite logical. Sectoral sanctions turned out to be the most significant.

In this case, based on the analysis of *Fig. 5*, one can note the high influence of anti-sanction policies and the aggregate index, while sectoral sanctions (and sanctions against specific companies) have minimal influence. The maximum influence of the dollar exchange rate on oil and gas companies is quite expected.

For the chemical and petrochemical sector, the situation is radically different (*Fig. 6*): the most significant factors for the nonlinear random forest model turned out to be the sanction indices, with the anti-sanction policy index having the greatest influence. The fact that the aggregate index is lower is explained by its more complex structure, containing more information, and the difficulty in determining its impact on the model. It can also be noted that the impact of the sanctions themselves is minimal.

In order to determine the direction of the influence of the sanctions indices we obtained, we use the EGARCH model (1, 1). This model is used in a number of studies on the financial market, for example, in the study of stock market indices during the COVID-19 pandemic [28]. The modeling results are presented in *Tables 4–6*.

From *Table 4*, the expected results are visible: the significance of the control variables is high and unidirectional. Among the indices, the presence of the impact of general and sectoral sanctions can be noted, although it is low. We can conclude that the energy sector is less susceptible to sanctions.

The impact of sanctions on the oil and gas sector turned out to be the most significant. Although the nonlinear model is similar to that for the energy sector, here we see a strong connection between textual variables and the index. Most likely, the difference is due to the fact that the random forest evaluates individual data instances, whereas GARCH analyzes a time series, where the influence is much more noticeable.

From the analysis of *Table 6*, it can be noted that the field of chemistry and petrochemistry reacts the most to news about sanctions; it is influenced by news of anti-sanction policies, sanctions against companies, industries, and the overall index that includes all news about sanctions.

CONCLUSION

In conclusion, we can say that our research is consistent with previous studies indicating that sanctions affect the capitalization of companies from various sectors [13, 29]. The impact of sanctions on industries such as electricity, oil and gas, as well as chemistry and petrochemistry manifests in the short term — within a month after publication.

Sanctions have the least impact on the electricity sector, which is expected, as this industry in Russia has a high degree of autonomy, whereas oil and gas are extremely sensitive to all sectoral indices. In the chemical and petrochemical sector, the influence is complex and nonlinear, and although the linear model also detects high significance of the indices, in nonlinear random forest models, the significance of textual indices is particularly high.

In further research, the research base can be expanded by using more detailed information about sanctions and their nature. The number of information sources can also be expanded, and more advanced methods will be applied.

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REFERENCES

1. Morgan T.C., Bapat N., Kobayashi Y. Threat and imposition of economic sanctions 1945–2005: Updating the TIES dataset. *Conflict Management and Peace Science*. 2014;31(5):541–558. DOI: 10.1177/0738894213520379
2. Gibbons E., Garfield R. The impact of economic sanctions on health and human rights in Haiti, 1991–1994. *American Journal of Public Health*. 1999;89(10):1499–1504. DOI: 10.2105/ajph.89.10.1499
3. Ali M.M., Shah I.H. Sanctions and childhood mortality in Iraq. *The Lancet*. 2000;355(9218):1851–1857. DOI: 10.1016/S 0140–6736(00)02289–3
4. Fuchs A., Klann N.-H. Paying a visit: The Dalai Lama effect on international trade. *Journal of International Economics*. 2013;91(1):164–177. DOI: 10.1016/j.jinteco.2013.04.007
5. Peksen D., Son B. Economic coercion and currency crises in target countries. *Journal of Peace Research*. 2015;52(4):448–462. DOI: 10.1177/0022343314563636
6. Kwon O., Syropoulos C., Yotov Y.V. Do sanctions affect growth? CESifo Working Papers. 2022;(9818). URL: https://www.cesifo.org/DocDL/cesifo1_wp9818.pdf (accessed on 02.08.2024).
7. Rychkov V.V. Analysis of the impact of the sanctions news on Russian financial markets. *Vestnik Instituta ekonomiki Rossiiskoi akademii nauk = Bulletin of the Institute of Economics of the Russian Academy of Sciences*. 2024;(2):71–115. (In Russ). DOI: 10.52180/2073–6487_2024_2_71_115
8. Fedorova E., Nevredinov A., Chernikova L. The impact of sanctions on the capitalization of Russian companies: The sectoral aspect. *Korporativnye finansy = Journal of Corporate Finance Research*. 2023;17(2):50–67. (In Russ.). DOI: 10.17323/j.jcfr.2073–0438.17.2.2023.50–67
9. Rychkov V.V. Sanctions news index (SNI). *Permskii finansovyi zhurnal = Perm Financial Review*. 2021;(2):4–20. (In Russ.).
10. Xie Q., Zhang X., Ding Y., Song M. Monolingual and multilingual topic analysis using LDA and BERT embeddings. *Journal of Informetrics*. 2020;14(3):101055. DOI: 10.1016/j.joi.2020.101055
11. Chaudhuri S., MacDonald A. Bacardi's Russia business grows as other booze makers leave country. The Wall Street Journal. Aug. 08, 2023. URL: https://www.wsj.com/articles/bacardis-russia-business-grows-as-other-booze-makers-leave-country-6060993f (accessed on 02.08.2024).
12. Crozet M., Hinz J., Stammann A., Wanner J. Worth the pain? Firms' exporting behaviour to countries under sanctions. *European Economic Review*. 2021;134:10368. DOI: 10.1016/j.euroecorev.2021.103683
13. Ankudinov A., Ibragimov R., Lebedev O. Sanctions and the Russian stock market. *Research in International Business and Finance*. 2017;40:150–162. DOI: 10.1016/j.ribaf.2017.01.005
14. Wu F.-L., Zhan X.-D., Zhou J.-Q., Wang M.-H. Stock market volatility and Russia-Ukraine conflict. *Finance Research Letters*. 2023;55A:103919. DOI: 10.1016/j.frl.2023.103919
15. Gaio L.E., Stefanelli N.O., Júnior T.P., Bonacim C.A.G., Gatsios R.C. The impact of the Russia-Ukraine conflict on market efficiency: Evidence for the developed stock market. *Finance Research Letters*. 2022;50:103302. DOI: 10.1016/j.frl.2022.103302
16. Fattahi S., Nafisi-Moghadam M. Do oil sanctions affect the interdependence and integration of financial markets? *Heliyon*. 2023;9(2): e13793. DOI: 0.1016/j.heliyon.2023.e13793
17. Fama E.F. Efficient capital markets: A review of theory and empirical work. *The Journal of Finance*. 1970;25(2):383–417. DOI: 10.1111/j.1540–6261.1970.tb00518.x
18. Fama E.F. Random walks in stock market prices. *Financial Analysts Journal*. 1965:51(1):75–80. DOI:10.2469/FAJ.V51.N 1.1861
19. Shiller R.J. From efficient markets theory to behavioral finance. *Journal of Economic Perspectives*. 2003;17(1):83–104. DOI: 10.1257/089533003321164967
20. Teplova T.V., Sokolova T.V., Tomtosov A.F., Buchko D.V., Nikulin D.D. The sentiment of private investors in explaining the differences in the trade characteristics of the Russian market stocks. *Zhurnal Novoi ekonomicheskoi assotsiatsii = Journal of the New Economic Association*. 2022;(1):53–84. (In Russ.). DOI: 10.31737/2221–2264–2022–53–1–3

21. Kravet T., Muslu V. Textual risk disclosures and investors' risk perceptions. *Review of Accounting Studies*. 2013;18(4):1088–1122. DOI: 10.1007/s11142–013–9228–9
22. Fedorova E.A., Musienko S.O., Fedorov F. Yu., Vinogradova L.V. Impact of crisis coverage on the financial market of Russia. *Finance: Theory and Practice*. 2019;23(3):112–121. DOI: 10.26794/2587–5671–2019–23–3–112–121
23. Turan S.C., Yildiz K., Büyüktanir B. Comparison of LDA, NMF and BERTopic topic modeling techniques on Amazon product review dataset: A case study. In: García Márquez F.P., Jamil A., Ramirez I.S., Eken S., Hameed A.A., eds. Computing, Internet of things and data analytics (ICCIDA 2023). Cham: Springer-Verlag; 2024:23–31. (Studies in Computational Intelligence. Vol. 1145). DOI: 10.1007/978–3–031–53717–2_3
24. Loukachevitch N., Levchik A. Creating a general Russian sentiment lexicon. In: Calzolari N., Choukri K., Declerck T., et al., eds. Proc. 10th Int. conf. on language resources and evaluation (LREC-2016). Paris: European Language Resources Association (ELRA); 2016:1171–1176. URL: https://aclanthology.org/L16–1186.pdf
25. McKenny A.F., Aguinis H., Short J.C., Anglin A.H. What doesn't get measured does exist: Improving the accuracy of computer-aided text analysis. *Journal of Management*. 2018;44(7):2909–2933. DOI: 10.1177/0149206316657594
26. Afanasyev D., Fedorova E., Rogov O. On the impact of news tonality in international media on the Russian ruble exchange rate: Textual analysis. *Ekonomicheskii zhurnal Vysshei shkoly ekonomiki = The HSE Economic Journal*. 2019;23(2):264–289. (In Russ.). DOI: 10.17323/1813–8691–2019–23–2–264–289
27. Tariq A., Awan M., Alshudukhi J., Alam T.M., Alhamazani K.T., Meraf Z. Software measurement by using artificial intelligence. *Journal of Nanomaterials*. 2022;(3):7283171. DOI: 10.1155/2022/7283171
28. Puarattanaarunkorn O., Autchariyapanitkul K., Kiatmanaroch T. An analysis of dependency of stock markets after unlimited QE announcements during COVID-19 pandemic. *Asian Journal of Economics and Banking*. 2023;7(3):310–332. DOI: 10.1108/AJEB-04–2023–0037
29. Mahlstein K., McDaniel C., Schropp S., Tsigas M. Estimating the economic effects of sanctions on Russia: An Allied trade embargo. *The World Economy*. 2022;45(11):3344–3383. DOI: 10.1111/twec.13311

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