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Ups and Downs of Business Activity in the Waves of Crises, the Coronavirus Pandemic and Unprecedented Western Sanctions

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ABSTRACT

Subject of article — the dynamics of the integrated Business Activity Index of the Institute of Economics of the Russian Academy of Sciences in 10 main areas of the national economy and the Index of output of goods and services by basic types of economic activity of Rosstat (Rosstat Index) from 2018 to July 2022 inclusive. Growth factors and a list of key macro indicators that determine the level of business activity in the relevant sectors of the economy, as well as the results of calculating the weights of these sectors, are considered.

The **aim of the article** is to substantiate the advantages of the methodology for constructing the IE RAS Index, which includes development indicators of 10 areas of the national economy, in comparison with the Rosstat Index. Theoretical studies are based on practical calculations performed on the basis of official statistical reporting, and a comparative analysis of the results with the dynamics of the Rosstat Index. Research period: post-crisis 2018–2019, pandemic and post-pandemic 2020–2021 and initial stage of the mobilization period for the economy — January-July 2022**.** To calculate the IE RAS Index, the **method** of construction of integral estimates of macroeconomic dynamics, correlation analysis, as well as a matrix of coefficients of pair correlation for determination of index weights are used, which is a convincing justification of scientific novelty of the proposed methodology of construction and practical use of the IE RAS Index. Based on a comparative analysis of the dynamics of the indices, it was found that the maximum drop in the IE RAS Index and the Rosstat Index was observed in 2020, and the maximum growth was observed in the post-pandemic 2021. Moreover, according to the IE RAS methodology, larger parameters and earlier dates for the start of decline and growth of business activity in comparison with the Rosstat Index were recorded. As a **result**, new convincing evidence of the advantages of the IE RAS Index was obtained, the main of which is a more reliable and accurate determination of the critical moments of a change in the business activity trend and, accordingly, the timing of the onset and overcoming of crisis processes in socio-economic development. The authors **conclude** that, in the new geopolitical reality, it is necessary to include the IE RAS Index as a target indicator for the country's ability to secure state sovereignty.

Keywords: business activity; national economy; mobilization economy; macroeconomic dynamics; economic growth; fixed capital investment; IE RAS Index; Rosstat Index

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INTRODUCTION

Considered in the article the time period from January 2018 to July 2022 is characterized by high turbulence of strategic development, which requires the choice and use in public administration of new instruments for economic growth and social progress.

One of these tools, the importance of which is constantly increasing, becomes business activity, dynamics of which in the period also did not have sufficient stability, especially in the conditions of coronavirus pandemic and unprecedented western sanctions after the start of the special military operation in Donbas and Ukraine (SMO).

The index of business activity has a long history [1] and today there are many approaches to its definition both abroad [2–4], and in Russia [5–7].

An example of such an index in current practice is the Rosstat Index. The index is formed monthly on the basis of data of dynamics of mining volumes, manufacturing industries, production and distribution of electricity, gas and water, production of agricultural products, construction, transport, and also volume of retail and wholesale trade. However, the Rosstat Index is still incomplete, as a number of areas of the national economy with a significant impact on the volume and dynamics of value added and, consequently, GDP are not included.

Quite competitive and efficient methodical tools of construction of index of business activity can be considered "Economic activity aggregate" — Index published by the Centre for Macroeconomic Analysis and Short-term Forecasting (CMASF).[1] The CMASF aggregate is based on the formation and analysis of indicators of the dynamics of the value added of goods and services in a wider range of economic activities compared to the Rosstat Index. In particular, it includes, in addition to basic economic activities, paid services to the population, which allows estimate fully influence on the economic growth of the consumer sector.

In Russian practice, in addition to the construction of these indices, there are a number of approaches to the measure of business activity based mainly on the analysis of respondents' surveys. Since 2001 "Russian Economic Barometer" is published quarterly by Primakov National Research Institute of World Economy and International Relations, Russian Academy of Sciences (IMEMO RAS).

IMEMO RAS publications give the results of regular surveys of industrial and agricultural enterprises and other market economy subjects. However, specific methodological tools and calculations of dynamics indices of business activity are not given.

Centre for Business Tendency Studies of the National Research University "Higher School of Economics" (HSE) is published quarterly the Index of Economic Sentiment (IES HSE).[2] The index allows to promptly evaluate the business climate based on the heads of organizations assessments' of the basic sectors of the economy. IES HSE is based on the answers of the respondents.

Bank of Russia publishes "News index of business activity".[3] The index is based on recurrent economic news to measure economic activity in the country and is essentially based on an artificial intelligence platform. So, the most common economic terms in the news are estimated on the relevance to the economic topic and the semantic color, and then combined into an integral index by highlighting the general trend by method the main components.

In addition to domestic developments, global indicators are used to measure business activity. Quite often in this regard, the Purchasing Managers Index (PMI) is used to

[1] Analysis of macroeconomic trends. Analytical review. October 2022. URL: http://www.forecast.ru/_ARCHIVE/Mon_MK/2022/macro32.pdf (accessed on 12.12.2022).

[2] The index of economic sentiment (IES HSE). URL: https://www.hse.ru/monitoring/buscl/ (accessed on 12.12.2022).

[3] News index estimate in October 2022. URL: https://www.cbr.ru/Collection/Collection/File/43441/index_2210.pdf (accessed on 12.12.2022).

measure business activity in Russia through a system of indicators that characterize the state and development of production or services [8, 9]. PMI is based on surveys of business managers and is likely to be of an evaluative.

From the research of the various existing business indices, it can be concluded that in most cases they do not include the necessary information on the macroeconomic development of the national economy. Moreover, most of them are based only on expert assessments.

In this regard, the IE RAS is proposed to implement the formation of an integral Index of business activity by the main spheres of the national economy (IE RAS Index), taking into account the influence of key industries and spheres of life, especially basic sectors of the real economy, social, monetary, financial and consumer spheres.

As our calculations have shown, the IE RAS Index gives a more reliable and accurate definition of the critical moments of the change in the business trend and, accordingly, the timing of the onset and overcoming of the crisis in socio-economic development in comparison with the Index of output of goods and services by basic types of economic activity of Rosstat (Rosstat index).

The proposed scientifically based, proven on real statistical data method allows to draw a conclusion about the need to include measuring instruments of level of business activity in the target indicators that determine the ability of the country to ensure State sovereignty.

METHODICAL BASES FOR SELECTING AND FORMING INDICES OF BUSINESS ACTIVITY

Issues of countering that announced Russia's unprecedented sanctions of the collective West have become a priority in today's geopolitical reality.

To increase the effectiveness of this process, it is necessary to move to a model of management of strategic development, the basis of which should be formulated by the President of the Russian Federation at the Petersburg International Economic Forum principles and priorities of the State social-economic policy. This will require the development and use of new strategic planning tools.[4]

Of all indices and indicators measuring the efficiency of public administration of the economy, the most prominent is the index of business activity, that to describe the expectation of future economic developments [10].

The central place among these instruments should belong to the integral indicator of the level of business activity of business, the State and the population, including all main spheres of the national economy. First of all, this applies to the productive and social spheres, monetary and financial systems, high cross-cutting technologies, consumer, infrastructure, foreign trade and other spheres [11–13].

In contrast to the researching business activity mentioned above, the IE RAS Index currently has the maximum coverage of market subjects, because it takes into account macro-indicators of the development of main industries and spheres of national economy, forming the dynamics of value added and GDP growth [14, 15]. In addition, the IE RAS Index is based on monthly indicators, which allows you to quickly evaluate information on changes in the business activity of the State. The index is based on the actual data of statistical reporting of the development of relevant industries and spheres of the national economy.

The model includes a new indicator of total payables of organizations, which has increased dramatically.

As a result, the IE RAS Index takes into account the integral influence of macro-

[4] Information on the Plenary Meeting of the Petersburg International Economic Forum with the participation of the President of the Russian Federation, 17 June 2022. URL: http://kremlin.ru/events/president/news/68669 (accessed on 12.12.2022).

indicators of the dynamics of the development of ten spheres of the national economy: industrial, agricultural and construction production, cargo and passenger transport, wholesale and retail trade, paid services to the population, monetary aggregate M2 and total accounts payable by organizations.

Under conditions of high turbulence of socio-economic development there is a need to periodically adjust the composition of the national economy, taken into account in the formation of the IE RAS Index. However, it is important that this be done by including new, more relevant indicators and eliminating indicators that have lost their topicality.

Although this does not change the method of calculation IE RAS Index, but determines the analytical capabilities, completeness and depth of assessment of practical results of this indicator in the field of public accounting, forecasting and strategic planning of socio-economic development.

It is necessary to note the presence of a significant impact on business activity of a number of socio-political, social, shadow, informational and other factors that do not generally have a clear quantitative measurement in official statistical reporting. In this study they were not considered.

MATHEMATICAL MODEL FOR CALCULATING THE IE RAS INDEX

We will consider questions of mathematical modeling of the IE RAS Index.

Earlier, for the construction of the IE RAS Index, the approach related to the calculation of pairwise preference matrices was used (PPM) [14, 16]. Probabilistic approach was used when using PPM when constructing weights of integral index [17, 18], based on the Thurstone [19] model used to construct an integral indicator on the basis of its individual indicators [6]. However, given the mathematical basis requirements, there were some specific problems with the interpretation of the content side of PPM in the construction of weight coefficients. Thus, quite often the weights in the calculation could be negative, which required additional justification of such situations.

Past experience given and noted private problems, to construct an integral index of business activity in the future it is proposed to use a new method, which is based on the calculation of weights of private indicators of business activity by the coefficients of pair correlation between them [15].

Among the many ways to form weight coefficients the method we have proposed takes more fully into account the influence of the real economy and non-productive spheres on the dynamics of the index of business activity [20].

It should also be noted that IE RAS Index is not based on the values of the indicators, but on their growth rates. This is due to the fact that Rosstat often reviews the volumes of annual averages that are included in the index calculation, and the use of growth rates ensures a higher stability of their dynamics. In addition, the presented index is calculated as an aggregate growth rate from the same period of the previous year. In this case, monthly data is used for calculation.

The choice of pair correlation coefficients for the construction of weight coefficients of the integral index is due to the fact that it allows to evaluate the close relationship of the indicators used. The most important factor in this approach should be the private indicator, which is most closely related to the rest of the indicators, as its dynamics will change synchronously with the dynamics of the integral index. In order to find such private indicators, the sum of the coefficients of the pair correlation is estimated. The larger the amount, the stronger its connection to other indicators, and the higher its weight will be in the integral indicator.

The pair correlation coefficients allow the use of non-negative weights coefficients, since the weights of the partial indicators in this

Table 1

Weights of National Economy Spheres for Calculating the IE RAS Index

Indicator No.	Macro Indicators	Weights
		2018 — July 2022
1	Volume of industrial production	0.143
2	Volume of agricultural production	0.002
3	Volume of construction production	0.100
4	Freight turnover	0.127
5	Transport passenger turnover	0.148
6	Retail trade turnover	0.115
7	Wholesale trade turnover	0.111
8	Volume of paid services to the population	0.130
9	M2	0.042
10	Total accounts payable of organizations	0.083

Source: Developed by the authors.

case are defined as their share in the integral indicator. In addition, a weight coefficients condition is applied to the sum of weights equal to one.

In this case, the numerator uses the sum of the values of the pairwise preference matrices of the correlation, and the denominator uses the sum of all the elements of the matrix.

Let's r_{ij} — coefficient of the pair correlation between private indicators of business activity i and j (X) ($i, j = 1, 2, \ldots, m$), then the weights W_j are determined by the formula:

$$W_j = \frac{\sum_{j=1}^{m} |r_{ij}|}{\sum_{i=1}^{m} \sum_{j=1}^{m} |r_{ij}|},$$

where m — number of X.

In general, the integral index of business activity (Y) can be represented as follows:

$$Y = \sum_{j=1}^{m} X_j W_j,$$

where X_j — private indicator of business activity j; m — number of X.

In the practical application of this method $m = 10$ — the number of partial indicators used in the IE RAS Index.

The use of the matrix of coefficients of pair correlation is reasonable from a mathematical point of view, in this regard it is possible to speak about obtaining objective results of assessment of business activity.

This approach allows us to detect in advance the trends of economic development and accurately forecast the change in business activity trends and the emergence of new turning points in the dynamics of economic development in both positive and negative ways. In this way, the strategic development management system is provided with a reliable tool for timely decision-making, which is amply demonstrated by the results of practical calculations.

RESULTS OF PRACTICAL CALCULATIONS THE IE RAS INDEX AND COMPARISONS WITH THE ROSSTAT INDEX

In accordance with the proposed methodology, the weights of industries and sectors of the

Table 2

Dynamics of the IE RAS and Rosstat Indices in the Period 2018 — July 2022, (as a % of the Previous Year)

Month and year	IE RAS Index	Rosstat Index	Deviations of IE RAS Index from Rosstat Index
01.18	105.5	104.4	1.1
02.18	105.0	104.3	0.7
03.18	104.1	102.9	1.2
04.18	106.3	104.8	1.5
05.18	105.5	104.8	0.7
06.18	104.6	102.4	2.2
07.18	105.1	104.0	1.1
08.18	104.7	101.9	2.8
09.18	104.8	101.3	3.5
10.18	104.7	104.6	0.1
11.18	104.4	102.3	2.1
12.18	105.3	105.5	–0.2
Average value for a year	**105.0**	**103.6**	**1.4**
01.19	102.8	100.3	2.5
02.19	103.2	101.8	1.4
03.19	103.2	100.5	2.7
04.19	103.2	102.6	0.6
05.19	102.5	99.2	3.3
06.19	102.3	101.3	1.0
07.19	103.2	102.9	0.3
08.19	102.8	102.5	0.3
09.19	103.5	103.9	–0.4
10.19	104.3	104.0	0.3
11.19	103.0	101.8	1.2
12.19	102.9	102.1	0.8
Average value for a year	**103.1**	**101.9**	**1.2**
01.20	103.3	101.8	1.5
02.20	104.3	104.7	–0.4
03.20	98.4	102.3	–3.9
04.20	78.0	91.1	–13.1
05.20	78.1	90.8	–12.7

Table 2 (continued)

Month and year	IE RAS Index	Rosstat Index	Deviations of IE RAS Index from Rosstat Index
06.20	77.7	93.5	–15.8
07.20	88.7	95.8	–7.1
08.20	92.3	97.1	–4.8
09.20	94.8	98.2	–3.4
10.20	93.3	95.5	–2.2
11.20	93.3	98.8	–5.5
12.20	95.2	102.4	–7.2
Average value for a year	**91.5**	**97.7**	**–6.2**
01.21	95.0	98.5	–3.5
02.21	95.7	97.9	–2.2
03.21	103.2	103.4	–0.2
04.21	130.5	113.7	16.8
05.21	127.1	114.3	12.8
06.21	121.3	111.3	10.0
07.21	120.7	106.2	14.5
08.21	113.3	104.0	9.3
09.21	110.7	104.1	6.6
10.21	113.1	106.0	7.1
11.21	114.3	107.0	7.3
12.21	112.9	105.6	7.3
Average value for a year	**113.2**	**106.0**	**7.2**
01.22	112.5	107.7	4.8
02.22	109.1	104.8	4.3
03.22	104.0	101.6	2.4
04.22	98.8	97.1	1.7
05.22	98.1	96.5	1.6
06.22	96.9	95.3	1.6
07.22	97.7	97.0	0.7
Average value for 7 month	**102.5**	**100.0**	**2.5**

Source: Rosstat, developed by the authors.

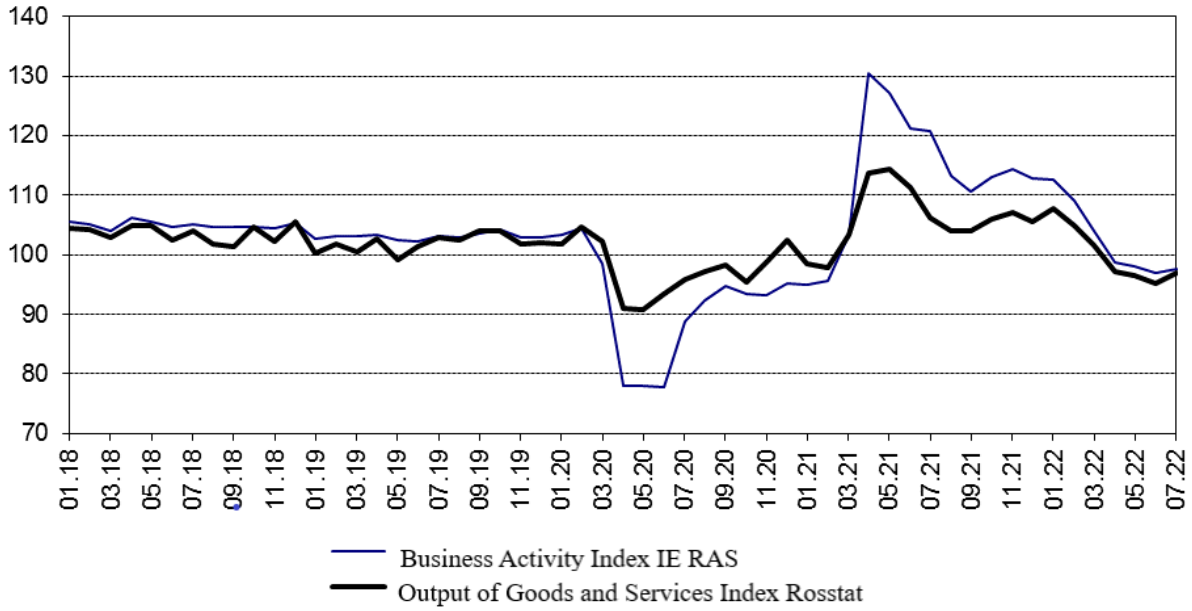

Fig. **Dynamics of the IE RAS and Rosstat Indices in the Period 2018 — July 2022 (as a % of the Previous Year)**

Source: Rosstat, developed by the authors.

national economy were calculated (*Table 1*) from 2018 to July 2022 inclusive.

This time interval includes the post-crisis 2018–2019, pandemic 2020–2021 and January–July 2022 (the initial stage of the mobilization period for the economy) and is characterized by high turbulence business activity caused by specific conditions of socio-economic development within each of these periods. The assessment of business activity in these periods has an additional important aspect to anticipate possible future behavior of the indicator in extreme conditions (such as a pandemic) [21].

Calculation of weights of the spheres of national economy showed that the first four places are accounted for by passenger transport turnover (0.148), industrial production (0.143), paid services to the population (0.130) and freight turnover (0.127), Reading by the highest instability of their growth dynamics, caused primarily by the coronavirus pandemic and unprecedented new western sanctions in 2022.

Fairly close weight coefficients received retail and wholesale trade (0.115 and 0.111 respectively), construction production (0.100) and total accounts payable by organizations (0.083). This is explained by the relatively unstable dynamics of their growth in the pandemic and mobilization for the economy periods.

The minimum weights belong to the monetary aggregate M2 (0.042) and agricultural production (0.002), which is a consequence of the most stable dynamics both in times of the worsening pandemic and the tightening of sanctions, and the recovery of growth after economic crises.

As a result of the calculation of monthly values of dynamics of IE RAS Index and their comparison with corresponding values of Rosstat Index (*Table 2 and Fig. 1*) were received strong evidence of the advantages of IE RAS Index.

The main advantages of the IE RAS Index are greater reliability and accuracy in determining the critical moments of changing the business activity trend and, accordingly, the timing of the occurrence and overcoming of the crisis processes in socio-economic development.

At the same time, despite the coincidence of trends, the growth rates of IE RAS and Rosstat

indices during the downturn and upturn of business activity are changing, which is especially evident in the graphical form (*Fig. 1*). Thus, during the fall IE RAS Index typically exhibits deeper dive into negative area, and in period of recovery business activity is outstripping the growth of the Rosstat Index.

A comparative analysis of the dynamics of both indices shows that in the post-crisis years of 2018 and 2019, there were minimal average annual growth of 1.4 and 1.2% respectively. At the same time, the orientation subannual monthly dynamics of the index coincides with a slightly higher IE RAS Index except in December 2018. This indicates stagnation of the economy due to damped business activity growth.

The highest average annual drop of the IE RAS Index and the Rosstat Index was observed in the pandemic in 2020 (by 8.5 and 2.3%, respectively), and the highest average annual growth in the post-pandemic 2021 (by 13.2 and 6.0%, respectively).

At the same time, according to the IE RAS method, more large-scale parameters of business decline and growth were recorded: June 2020 — maximum drop (22.3%) and April 2021 — maximum growth (30.5%) compared to the Rosstat Index: May 2020 — maximum drop (9.2%) and May 2021— maximum growth (14.3%).

At the same time, according to the IE RAS method, an earlier month of the beginning of the business activity decline in the pandemic year — March 2020 (a drop of 1.6%) compared to the Rosstat Index — April 2020 (a fall of 8.9%). At the same time, the IE RAS Index fell in March already 22%, and the same trend was maintained until December 2020, oriented on the fall of indices.

Instability of growth dynamics of IE RAS and Rosstat indices continued in the post-pandemic 2021, despite the coincidence of their growth trends. At the same time, at the beginning of the year the Rosstat Index showed more optimistic assessments of the transition to the growth dynamics of business activity than the IE RAS Index. However, starting from April, the dynamics of the IE RAS Index began to steadily outperform the Rosstat Index, which was a confirmation of the successful development of the economy during 2021 and at the initial stage of the mobilization period in 2022.

It is worth noting the special nature behavior of the IE RAS and Rosstat indices at the beginning of the period of mobilization for the economy.

First of all, this applies to the maximal synchronization of the dynamics of both indices, as evidenced by the exceptionally high correlation coefficient of indices dynamics for the seven months of 2022, equal to 0.997.

Another important feature of this period is the coincidence of the start of immersion of business activity in the negative — April 2022.

And the third feature is the coincidence of the maximum level of immersion indices in the negative area — June 2022: by 3.1 and 4.7% IE RAS Index and Rosstat index respectively.

However, the IE RAS Index showed a 2.5% increase in business activity over the period as a whole compared to the zero growth of the Rosstat Index.

This indicates a relatively higher level of mobilization by the State and business of anti-crisis measures related to the preparation and initiation of the SMO, based on the experience gained from the pandemic crisis. These facts have been widely corroborated by comparing the dynamics of the IE RAS and Rosstat indices in the 2020 pandemic and the initial mobilization period for the economy. The depth of immersion indexes in the negative region in 2020 exceeded its fall in the first seven months of 2022.

And the largest threat posed at the initial stage of counteraction large-scale Western sanctions in the monetary, financial, production and social spheres. At the same time, the greatest threat to the state sovereignty was the freezing of foreign currency reserves, the collapse of the national currency, capital flight,

the growth of accounts payable, the break in supply chains business processes.

However, as it turned out later the measures taken were still not enough. To give a systemic character to all work, the President of the Russian Federation formed a Coordination Council headed by the Chairman of the Government of the Russian Federation.[5]

CONCLUSION

Based on the research, it can be concluded that the IE RAS Index includes a fairly extensive list of economic, financial and social indicators, which allow to more fully reflect business activity in comparison with the Rosstat Index and business activity indices of other organizations.

A convincing justification of scientific novelty of the proposed methodology of construction and practical use of IE RAS Index are new models of determination of weights of indicators included in the Index and its calculation.

As the analysis of the results of practical calculations made on the basis of official statistics, the dynamics of the indices IE RAS and Rosstat are not contradictory and largely synchronized and single-directional.

However, IE RAS Index more precisely determines the beginning and end of systemic socio-economic crises, which allows predicting the duration of these processes.

The analysis of the dynamics of the IE RAS Index for the first seven months of 2022 leads to the conclusion that business activity fell less at the beginning of the mobilization period than the Rosstat Index. This also indicates a softer handling of economic, social, financial, monetary and other sanctions at this stage than during the pandemic period.

As a result, assessing the practical results and advantages of the proposed integral index of business activity, it may be considered that the use of the IE RAS Index in the management of strategic development in the new geopolitical reality requires its inclusion in the targets defining the ability of the country to ensure state sovereignty.

The IE RAS Index level can also serve as a criterion for assessing the efficiency of public administration of the country's economy as a whole, as well as its member industries and spheres of national economy in the respective period.

[5] Decree of the President of the Russian Federation No. 763 from 21.09.2022 "Coordination Council under the Government of the Russian Federation to meet the needs of the Armed Forces of the Russian Federation, other forces, military formations and organizations". URL: http://kremlin.ru/acts/news/69657 (accessed on 12.12.2022).

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A.A. Surkov — description of the methodology, collection of statistical data, description of the initial data, calculation, preparation of the article for submission to the editor.

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Game-Theoretic Model for Stimulating High Performance of Regional Civil Servants in Russia

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ABSTRACT

The priority goal of the country's top leadership is to ensure sustainable socio-economic development of all constituent entities of the Russian Federation and improve the quality of life of their population. In a challenging geopolitical situation, achieving this goal is difficult. Only under the condition of an effective system of public administration is it possible to solve the main socio-economic problems in the Russian regions. This requires linking the size of collective incentive payments to regional civil servants to the achieved level of socio-economic development of the constituent entities of the Russian Federation. The foregoing predetermined the **relevance** of the research topic. The **purpose** of the paper is to substantiate the bonus calculation mechanism for the executive branch employees of the Russian regions, depending on the assessment of their ability to work as part of a team to achieve results, i.e. to perform their duties to a high standard. This involves the use of modern **methods** of economic and mathematical modeling, designed in this case to ensure the objectivity of assessment of the collective and individual performance (efficiency) of regional civil servants. This is the main scientific **novelty** of the paper. The **practical** implementation of the mechanism of collective and individual incentives for regional civil servants will create the preconditions for increasing the wages of such employees in all regions of the Russian Federation. Thus, the coordinated actions of civil servants from different ministries and departments of the Russian subsidized regions in the future will help increase their financial security and transition to the group of donor regions, and ultimately will create the possibility of increasing budget expenditures on wages for the executive branch employees.

Keywords: efficiency and effectiveness; regional civil servants; collective and individual incentive payments; game-theoretic model

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INTRODUCTION

Further development of the civil service in Russia is possible based on the positive experience of Singapore. So, in Singapore, unlike Russia, there is a direct relationship between the level of remuneration of civil servants and its socio-economic development. In addition, in Singapore, the salaries of civil servants are high, which helps to reduce the level of corruption risks. The competence of such employees (when hiring, the academic knowledge of the applicant is first of all evaluated) is the key to their individual effectiveness. The author's approach to the possibility of applying this practice in Russia is presented in [1–3].

It should be noted that at present there are quite a lot of studies devoted to assessing the effectiveness of the national public administration system. Researchers pay much less attention to the development of the state civil service in the constituent entities of the Russian Federation. At the same time, there are no scientific articles that use the game-theoretic approach, both for collective and individual stimulation of regional civil servants to achieve results.

The foregoing confirms the relevance of the chosen research topic. At the same time, its main purpose is to determine the mechanism for the correct transition from individual to collective stimulation of regional civil servants to achieve results using a game-theoretic approach. This purpose predetermined the solution of some tasks and the logic of the presentation of the material, and ultimately the structure of the paper.

LITERATURE REVIEW

The country's top leadership, the scientific and expert community of Russia [4–7], as well as international organizations, show a consolidated position, believing that the main factor hindering the sustainable socio-economic development of the Russian Federation (in particular, improving the quality of life of the population) is the low efficiency of the national public administration systems. As part of the paper, relying on the studies of well-known Russian scientists, we focus on a critical analysis of such a system, clarifying the cause-and-effect relationships between the quality of public administration and the socio-economic development of the country.

For example, the Corresponding Member of the Russian Academy of Sciences V.A. Ilyin, who regularly assesses the effectiveness of the Russian public administration system, emphasizes that the course of national development proposed by the President of Russia V. V. Putin is opposed not only by the "fifth" but also by the "sixth" column. Developing the idea, V. A. Ilyin notes that while the country's top leadership managed to practically neutralize the negative influence of the "fifth" column, the "sixth" column "still continues to strengthen its position in the ruling elite of the country, largely due to the system of oligarchic capitalism it created" [8, p. 12].

It should be noted that a fairly large number of scientific papers are devoted to assessing the possibility of an effective response of the state to the main socio-economic challenges for Russia under the conditions of oligarchic capitalism [9–13]. At the same time, as a rule, researchers are of the opinion that it is impossible to effectively solve socio-economic problems (in particular, this concerns the fight against poverty) in the current situation. Moreover, they note a threat to the foundations of statehood and national security.

However, there is another opinion. For example, in scientific papers [14, 15] it is noted that even under the conditions of oligarchic capitalism in Russia, sustainable economic growth is possible and, as a result, the solution to the most acute social problems. But for this, it is necessary to ensure the effective functioning of the public administration system.

Table 1

Dynamics of the Number of State Civil Servants of the Russian Federation in 2014–2020

Indicator	2014	2015	2016	2017	2018	2019	2020
Number of employees in the federal state executive bodies of Russia, thousand people	1250	1226.2	1203.4	1231.5	1222.1	424.7	355
including:							
at the regional level of administration	1212.2	1188.9	1165.9	1193.9	1184.5	393.9	324.2
Number of employees in state executive bodies of the constituent entities of Russia, thousand people	205.9	204.1	203	206.5	203.5	166.1	168.1

Source: compiled by the authors Russian Statistical Yearbook 2021: Stat. book. M.: Rosstat; 2021. URL: https://rosstat.gov.ru/storage/mediabank/Ejegodnik_2021.pdf (accessed on 12.12.2022).

Note: Data at the end of each year.

At the same time, most researchers [11, 16, 17] believe that in addition to the patriotic policy implemented by the President of the Russian Federation V.V. Putin, the country is in dire need of an adequate model of socio-economic development, which, as a rule, offers its own "recipe" for the well-being of Russia. For example, the Academician of the Russian Academy of Sciences S. Yu. Glaz'ev [11] considers the possibility of sustainable economic growth in the country through the perspective of changing technological patterns.

The administrative reform being carried out in Russia does not affect the issues of changing the organization of regional executive authorities. Also, no attention was paid to such an important tool in a market economy as a tool to improve the efficiency of the public administration system, as material incentives for civil servants "based on results" [18, 19].

At the same time, it should be noted that in the scientific community, there is still a debatable question about the influence of the effectiveness of public administration on the socio-economic development of the country. Thus, in studies [20, 21], through empirical research, it was proved that not only the efficiency (effectiveness) of public administration but also the level of corruption control has a significant impact on the country's economic growth rates. A scientific article [22] asserts an inverse causal relationship between the quality of public administration and economic growth. The author, in the course of an empirical study, concluded that economic growth is a driver for increasing the efficiency (effectiveness) of the public service, and not vice versa. There are a number of papers [23–27], that focus on the fact that, along with the quality of public administration, a number of other factors also affect the rate of economic growth. At the same time, it can be significantly higher than the efficiency (effectiveness) of public administration. Finally, there are scientific articles [28], where the hypothesis about the relationship of the above categories (for a number of relevant indicators) is not confirmed.

Given the inconsistency of assessments of the relationship between the quality of public administration and socio-economic development, the authors conducted their own (thematic) empirical study as part of the study.

STATE CIVIL SERVICE IN RUSSIA: STATUS, PROBLEMS AND DEVELOPMENT PROSPECTS

The research will be limited to studying changes in such key indicators as the number of civil servants and the size of their wages. At the same time, civil servants are understood only as employees of the executive branch of the country.

Table 1 date (taking into account the change in the number of federal and regional civil servants) show that 2015–2018 can be considered a relatively stable period. In 2019, the situation changed dramatically: there was a sharp decrease (by 2.9 times) in the number of employees in the federal state executive bodies of the Russian Federation due to a threefold decrease in the number of employees at the regional level of governance. This was caused by the digitalization of the public administration system as a result of the implementation of the federal project of the same name (within the framework of the national program "Digital Economy"). Automation of public services rendered to legal entities and the population in the Russian regions has led to a significant release of labor resources from the territorial divisions of the federal executive authorities of the country. Also, significantly (by 22.5%) the number of employees in state executive bodies of the constituent entities of the Russian Federation decreased. In 2020, for the above reason, the trend of reducing the number of employees in the federal state executive bodies of the country continued. As a result, the value of this indicator decreased significantly (by 21.5%). At the same time, the number of employees in state executive bodies of the constituent entities of the Russian Federation has not practically changed.

Summarizing the above, we can conclude that in 2019–2020 there was a significant reduction in the number of predominantly federal civil servants in the country (due to the optimization of the number of employees in the territorial divisions). At the same time, the number of regional civil servants decreased significantly only in 2019. Hence, we can make a preliminary conclusion that at present there are prerequisites for increasing the level of remuneration, mainly for the federal civil servants of the country.

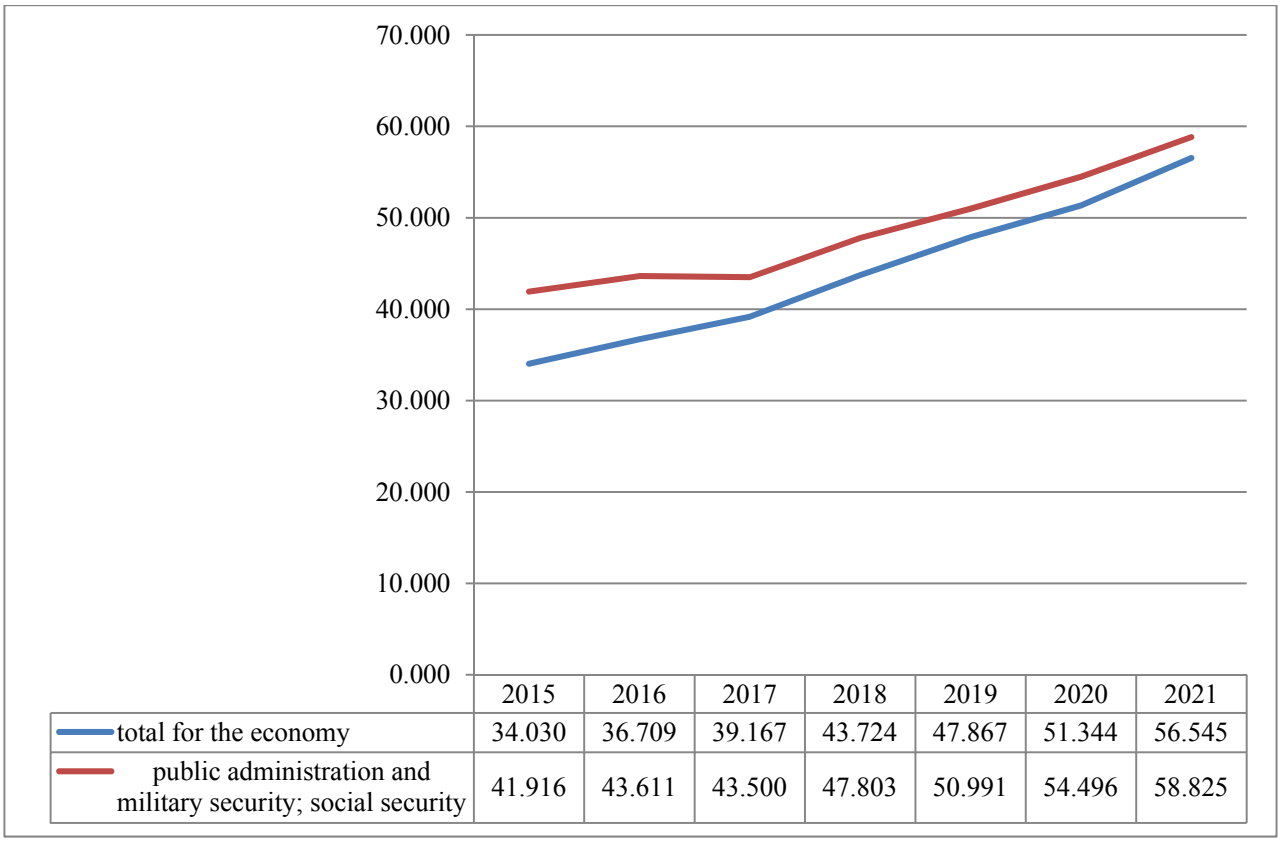
There are no statistics on the salaries of civil servants in the country. It is only possible to analyze the change in the level of wages of all those working in the country's public administration system (*Fig. 1*).

According to the data in *Fig. 1*, in general in the country's economy there was a steady upward trend in wages throughout the analyzed period, and in the public administration system growth began only in 2017. At the same time, it should be noted that the level of wages is higher than the national average. However, in 2015–2021, there was an annual decline in the ratio of indicators. So, if in 2015–2016 wages of employees of the public administration system exceeded the average Russian value of the indicator by 23.2 and 18.8%, respectively, then in 2020–2021 — only by 6.1 and 4%. In our opinion, such a relative decrease in the dynamics of the level of remuneration of workers in the public administration system of Russia is a negative trend.

Indeed, in conditions of relatively low wages, it becomes economically more profitable for a state civil servant to formally perform official duties and participate in corruption schemes.

GAME-THEORETICAL MODEL OF MATERIAL INCENTIVES OF REGIONAL CIVIL EMPLOYEES BASED ON ACHIEVED RESULTS

The main idea that should be taken into account when stimulating civil servants is that individual performance is assessed based on a system of key performance indicators (KPIs), but with the obligatory consideration of the achieved level of socio-economic development of the Russian region. At the same time, it is believed that any civil servant in the case of



	2015	2016	2017	2018	2019	2020	2021
total for the economy	34.030	36.709	39.167	43.724	47.867	51.344	56.545
public administration and military security; social security	41.916	43.611	43.500	47.803	50.991	54.496	58.825

Fig. **Dynamics of wages of employees of all organizations of the Russian Federation and those working in the public administration system, thous. rub**

Source: Compiled by the authors according to official statistics. URL: https://rosstat.gov.ru/labor_market_employment_salaries (accessed on 12.12.2022).

rational behavior seeks to increase the value of such indicators and receive a large bonus. It is also natural to assume that the task of the leadership of any region of Russia is to choose a motivation system that encourages civil servants to work not only efficiently (effectively) but also intensively (for example, they are motivated to perform to high standards and within short timeframes).

Due to the fact that civil servants carry out different types of professional service activities, for the correct application of the mechanism of individual incentives, a comprehensive assessment of their efficiency (effectiveness) is necessary.

Problem Statement

If the i-th civil servant performs b_i types of activities, then he, respectively, is characterized by the vector of indicators r_{ij}, $i \in N\{1,2,...,n\}$, $j = 1,2,...,b_i$, reflecting his competence (qualification) for each of them. Here N — a set of civil servants.

The analysis of the incentive system is proposed to be carried out on the team model, which is a two-level hierarchical system consisting of the Center (in our case, this is the top management of the region) — the upper-level and n lower-level agents (civil servants). We believe that when doing the job, the strategy of the i-th agent is to choose actions $x_i \in A_i$, $i \in N\{1,2,...,n\}$. In terms of content, the actions of an agent can be characterized by the following indicators: the number of hours worked, the number and quality of decisions made, the time for making them, etc. The agent's action x_i will be considered to belong to the set of non-negative real numbers. Hence, the indicator of the agent's activity υ — a certain function that depends on his actions.

We will also assume that the individual costs of the i-th agent when performing the j-th action are a function of the following form: $z_{ij} = f\left(x_{ij}, r_{ij}\right)$, where $i \in N$, $j = 1,2,\ldots,b_i$. Such a function decreases monotonically with increasing skill r_{ij}.

When stimulating agents, it is necessary to determine how the bonus fund should be formed. Considering that the amount of incentive payments to civil servants in Russia is not based on the achieved level of the country's socio-economic development [2], it is advisable to establish such a dependence.

Let the basic fund be F, formed for rewarding agents, I_c — an indicator of the level of socio-economic development of the country, I_{pq} — an indicator of the level of socio-economic development of the q-th region. In this case, for the bonuses for agents of the q-th region, the fund will be determined according to the following rule:

$$F_{pq} = \begin{cases} F\dfrac{I_{pq}}{I_c}, if\ I_{pq} \le I \\ F, if\ I_{pq} > I_c. \end{cases} \quad (1)$$

Accordingly, the bonus of the i-th agent of the q-th region is calculated by the formula:

$$P_{iq} = F_{pq}\frac{\upsilon_{iq}}{\sum\limits_{i=1}^{m}\upsilon_{iq}}, \quad (2)$$

where υ_{iq} — the performance indicator of the i-th agent of the q-th region, and m — the number of agents who claim a bonus from the fund F_{pq}.

The procedure for distributing the bonus fund among agents should contribute to solving the main task — increasing the efficiency of the entire team. In particular, it is designed to stimulate the quality of decisions made and reduce the time for their implementation.

Obviously, an increase in the intensity of the work of agents entails an increase in the cost of the actions performed. Without loss of generality, we will examine the actions of agents of one region considered for bonuses, based on the results of which an incentive fund was formed F_p.

In this case, we will proceed from the fact that all actions of the agent are carried out in accordance with his duties, reflected in the job description. Therefore, to determine the contribution of each agent to the final result of the team, an assessment of the performance of official duties by civil servants is used.

To distribute the bonus fund F_p the Center evaluates the performance of each agent in the performance of his duties as the ratio of the actual to the best result. We assume that in the job description of the i-th agent b_i items in order to perform the j-th item, the agent needs to perform the j-th action. The best result that can be achieved by the agent when performing the j-th action is denoted by X_{ij}, $i \in N$, $j = 1,2,\ldots,b_i$. If the action or the actual result of the agent is equal to x_{ij}, then the indicator of activity for this action is determined according to the following rule:

$$\upsilon_{ij} = \begin{cases} \dfrac{x_{ij}}{X_{ij}}, if\ X_{ij} = \max\left\{x_{ij}\right\} \\ \dfrac{X_{ij}}{x_{ij}}, if\ X_{ij} = \min\left\{x_{ij}\right\}. \end{cases} \quad (3)$$

The resulting performance indicator υ_i or a comprehensive assessment of the performance of all actions according to the job description of the i-th agent is characterized by the expression $\upsilon_i = f_i\left(\upsilon_{i1}, \upsilon_{i2}, \ldots, \upsilon_{ib_i}\right)$, where f_i — the convolution function, and the contribution of the i-th agent to the results of the activity of the entire team is defined as the ratio of the indicator of his activity to the total of the indicators of the activity of all agents.

Then we will assume that the agent's individual costs are linear and separable. When the i-th agent performs the j-th action x_{ij}, his costs are presented in the form $z_{ij} = \dfrac{x_{ij}}{r_{ij}}$, $j = 1,2,\ldots,b_i$, accordingly, the total costs of the

agent z_i in the performance of all items of duties from the job description are defined as

$$z_i = \sum_{j=1}^{b_i} \frac{x_{ij}}{r_{ij}},\ i \in N.$$

The difference between the bonus P_i and the costs of a civil servant z_i determines his target function:

$$F_i = F_p \frac{\upsilon_i}{\sum_{i=1}^{n} \upsilon_i} - \sum_{j=1}^{b_i} \frac{x_{ij}}{r_{ij}}. \quad (4)$$

Since the value of the target function of the i-th agent depends on his actions, which are estimated by the Center as υ_{ij}, $i \in N$, $j = 1,2,\ldots,b_i$, then, within the framework of the hypothesis of rational behavior, the agent will choose actions that, under the chosen incentive system, maximize his target function.

Let us assume that the efficiency of the simulation system when performing several jobs will be determined by the total of their complex assessments received by agents for each type of activity, i.e. calculated according to the formula:

$$K = \sum_{i=1}^{n} \upsilon_i, \quad (5)$$

To determine an effective incentive system, the Center can apply various options for the formation of a comprehensive assessment of the activity of the i-th agent.

We confine ourselves to considering four main procedures for determining a comprehensive assessment:

1. Comprehensive assessment — the total of all performance assessments:

$$\upsilon_i = f_i(\upsilon_{i1}, \upsilon_{i2}, \ldots, \upsilon_{ib_i}) = \sum_{j=1}^{b_i} \upsilon_{ij}. \quad (6)$$

2. Comprehensive assessment — the arithmetic mean of all assessments:

$$\upsilon_i = f_i(\upsilon_{i1}, \upsilon_{i2}, \ldots, \upsilon_{ib_i}) = \frac{1}{b_i} \sum_{j=1}^{b_i} \upsilon_{ij}. \quad (7)$$

3. Comprehensive assessment — the minimum value of all assessments:

$$\upsilon_i = f_i(\upsilon_{i1}, \upsilon_{i2}, \ldots, \upsilon_{ib_i}) = \min_j \{\upsilon_{ij}\}. \quad (8)$$

4. Comprehensive assessment — geometric mean of all assessments:

$$\upsilon_i = f_i(\upsilon_{i1}, \upsilon_{i2}, \ldots, \upsilon_{ib_i}) = \left[\prod_{j=1}^{b_i} \upsilon_{ij}\right]^{\frac{1}{b_i}}. \quad (9)$$

It should be noted that the method of constructing a complex assessment based on logical convolution matrices can also be applied to assess the activities of agents [29, 30].

Analysis of Procedures for Evaluating the Effectiveness of the Agent's Activities

The target function of the i-th agent (4) depends on both the individual and collective performance of civil servants, so the functioning of such a system is considered as a n-person game, and the effectiveness of its stimulation is determined based on the evaluation of the agents' activities obtained in the Nash equilibrium.

For the objective function (8), the Nash equilibrium is found as a result of solving the system of equations:

$$\begin{cases} \dfrac{\partial F_i}{\partial x_{ij}} = F_p \dfrac{\partial \upsilon_i}{\partial x_{ij}} \dfrac{\sum_{q=1}^{n} \upsilon_q - \upsilon_i}{\left[\sum_{q=1}^{n} \upsilon_q\right]^2} - \dfrac{1}{r_{ij}} = 0, \\ i \in N, \\ j = 1,2,\ldots,b_i \end{cases} \quad (10)$$

Without loss of generality, we will assume that $\upsilon_{ij} = \frac{x_{ij}}{X_{ij}}$. Let us consider the case when υ_i is determined in accordance with (6), i.e. $\upsilon_i = \sum_{j=1}^{b_i} \frac{x_{ij}}{X_{ij}}$, then

$\frac{\partial \upsilon_i}{\partial x_{ij}} = \frac{\partial \sum_{j=1}^{b_i} \frac{x_{ij}}{X_{ij}}}{\partial x_{ij}} = \frac{1}{X_{ij}}$, and the expression (10) can be rewritten as:

$$\begin{cases} F_p \dfrac{1}{X_{ij}} \dfrac{\sum_{q=1}^{n} \upsilon_p - \upsilon_i}{\left[\sum_{q=1}^{n} \upsilon_q\right]^2} = \dfrac{1}{r_{ij}}, \\ i \in N, \\ j = 1,2,\ldots,b_i. \end{cases} \quad (11)$$

or

$$\begin{cases} \dfrac{\sum_{q=1}^{n} \upsilon_q - \upsilon_i}{\left[\sum_{q=1}^{n} \upsilon_q\right]^2} = \dfrac{X_{ij}}{F_p r_{ij}}, \\ i \in N, \\ j = 1,2,\ldots,b_i. \end{cases} \quad (12)$$

Denoting $y_{ij} = \frac{X_{ij}}{r_{ij}}$, it is clear that these are the costs of the i-th agent when the agent obtains the best result in the course of performing the j-th action. In this case, the assessment of the activity of agents is found from the solution of the system of equations:

$$\begin{cases} \dfrac{\sum_{q=1}^{n} \upsilon_q - \upsilon_i}{\left[\sum_{q=1}^{n} \upsilon_q\right]^2} = \dfrac{y_{ij}}{F_p}, \\ \upsilon_{ij} \le 1, \\ i \in N, \\ j = 1,2,\ldots,b_i. \end{cases} \quad (13)$$

It is easy to see that when determining their actions in a Nash equilibrium, agents will first perform those actions that require the least cost to obtain the best result. In this case, it is beneficial for the agent to perform not all actions but only some of them.

A similar situation arises when the arithmetic means of all estimates (7) is used to build a comprehensive performance assessment. It follows that even if the efficiency of the simulation system $K^{(6)} = K^{(7)} = \sum_{i=1}^{n} \upsilon_i$ takes on a sufficiently high value, the agents do not perform all activities.

Let us further consider the case when υ_i is determined in accordance with (8), i.e.

$$\upsilon_i = f_i\left(\upsilon_{i1}, \upsilon_{i2}, \ldots, \upsilon_{ib_i}\right) = \min_j \left\{\upsilon_{ij}\right\}.$$

Obviously, in this case, the agent chooses such actions in order to provide the same ratings for all items of the job description, i.e. $x_{i1} = x_{i2} = \ldots = x_{ib_i}$. Let us denote $\hat{\upsilon}_i = \min_j \upsilon_{ij}$, $j = 1,2,\ldots,b_i$.

Hence, the objective function of the agent can be represented as:

$$\begin{cases} F_p = F\left(\dfrac{\hat{\upsilon}_i}{\sum_{q=1}^{n} \hat{\upsilon}_q^i} - \hat{\upsilon}_{ij} \sum_{j=1}^{b_i} y\right), \\ i \in N. \end{cases} \quad (14)$$

The values $\hat{\upsilon}_i$, $i \in N$ in the Nash equilibrium are found based on the solution of the system of equations:

$$\begin{cases} F_p \dfrac{\sum_{q=1}^{n} \hat{\upsilon}_q - \hat{\upsilon}_i}{\left(\sum_{q=1}^{n} \hat{\upsilon}_q\right)^2} - \sum_{j=1}^{b_i} y_{ij} = 0, \\ i \in N. \end{cases} \quad (15)$$

The solution to system (15) is written as:

$$\begin{cases} \hat{\upsilon}_p = F\left(\dfrac{n-1}{\sum_{q=1}^{n}\sum_{j=1}^{b_i} y_{ij}}\left(1 - \dfrac{n-1}{\sum_{q=1}^{n}\sum_{j=1}^{b_i} y_{ij}} \sum_{j=1}^{b_i} y\right)\right), \\ i \in N. \end{cases} \quad (16)$$

We denote $A_i = \frac{1}{b_i}\sum_{j=1}^{b_i} y_{ij}$ (the arithmetic mean of the costs when agents obtain the best result), then

$$\begin{cases} \hat{\upsilon}_{\dot{p}} = F\ \dfrac{n-1}{\sum\limits_{q=1}^{n} b_q A_q}\left(1-\dfrac{n-1}{\sum\limits_{q=1}^{n} b_q A_q}\right). \\ i \in N. \end{cases}$$

Given the above, the following equality is logical:

$$\upsilon_{\dot{p}1} = \upsilon_{i2} = \ldots = \upsilon_{ib_i} = F\ \frac{n-1}{\sum\limits_{q=1}^{n} b_q A_q}\left(1-\frac{n-1}{\sum\limits_{q=1}^{n} b_q A_q} b\,A\right). \quad (17)$$

In this case, it is obvious that the condition must be satisfied $\hat{\upsilon}_i \le 1$, which allows us to determine the restriction on the fund F_p:

$$F_p \le \frac{\left(\sum\limits_{q=1}^{n} b_q A_q\right)^2}{(n-1)\left(\sum\limits_{q=1}^{n} b_q A_q - (n-1)\min\limits_{i}\{b_i A_i\}\right)}. \quad (18)$$

Hence, the effectiveness of the incentive system is calculated as follows:

$$K^{(8)} = F_p\ \frac{n-1}{\sum\limits_{i=1}^{n} b_i A_i}. \quad (19)$$

Let us now consider the case when the performance assessment υ_i is determined in accordance with formula (9), we obtain

$$\frac{\partial \upsilon_i}{\partial x_{ij}} = \frac{1}{x_{ij} b_i}\left[\prod_{q=1}^{n} \upsilon_{iq}\right]^{\frac{1}{b_i}},$$

and expression (10) in this case can be represented as:

$$\frac{\partial F_i}{\partial x_{ij}} = F_p\ \frac{1}{b_i}\left[\prod_{q=1}^{b_i} \upsilon_{iq}\right]^{\frac{1}{b_i}} \frac{\sum\limits_{q=1}^{n} v_q - \upsilon_i}{\left[\sum\limits_{q=1}^{n} \upsilon_q\right]^2} - \frac{x_{ij}}{r_{ij}} = 0 \quad (20)$$

or

$$F_p\ \frac{1}{b_i}\left[\prod_{q=1}^{b_i} \upsilon_{iq}\right]^{\frac{1}{b_i}} \frac{\sum\limits_{q=1}^{n} \upsilon_q - \upsilon_i}{\left[\sum\limits_{q=1}^{n} \upsilon_q\right]^2} = \upsilon_{ij} y_{ij}. \quad (21)$$

The solution of system (21) is written as follows:

$$\tilde{\upsilon}_{\dot{p}} = F\ \frac{n-1}{\sum\limits_{q=1}^{n} b_q G_q}\left(i\,1 - \bar{i}\,b\,G\ \frac{n-1}{\sum\limits_{q=1}^{n} b_q G_q}\right). \quad (22)$$

Here $G_i = \left(\prod\limits_{j=1}^{b_q} y_{iq}\right)^{\frac{1}{b_i}}$.

In this case, the condition must also be satisfied $\tilde{\upsilon}_i \le 1$, which also allows us to determine the restriction on the fund F_p:

$$F_p \le \frac{\left(\sum\limits_{q=1}^{n} b_q G_q\right)^2}{(n-1)\left(\sum\limits_{q=1}^{n} b_q G_q - (n-1)\min\limits_{i}\{b_i G_i\}\right)}. \quad (23)$$

In this case, the effectiveness of the incentive system is determined as follows:

$$K^{(5)} = F_p\ \frac{n-1}{\sum\limits_{i=1}^{n} b_i G_i}. \quad (24)$$

Values $\{\upsilon_{ij}\}$, $i \in N$, $j = 1,2,\ldots,b_i$ can be calculated by solving the problem:

$$\begin{cases} \sum\limits_{j=1}^{b_i} \dfrac{x_{ij}}{r_{ij}} = \sum\limits_{j=1}^{b_i} \dfrac{x_{ij}}{X_{ij}} \dfrac{X_{ij}}{r_{ij}} = \sum\limits_{j=1}^{b_i} \upsilon_{ij} y_{ij} \to \min, \\ \prod\limits_{j=1}^{b_i} \upsilon_{ij} = \upsilon_i^{b_i}. \end{cases} \quad (25)$$

Table 2

Evaluation of the Effectiveness of the Agent Incentive System

Comprehensive assessment	x_{11}	x_{12}	x_{13}	x_{21}	x_{22}	υ_{11}	υ_{12}	υ_{13}	υ_{21}	υ_{22}	υ_1	υ_2	K
Comprehensive assessment – the total of all performance assessments	0	6.2	12	0	13.9	0	0.62	1	0	0.93	1.62	0.93	2.55
Comprehensive assessment – the minimum value of all assessments	4.56	5.7	6.85	4.98	7.47	0.57	0.57	0.57	0.5	0.5	0.57	0.498	1.068
Comprehensive assessment – geometric mean of all assessments	4.15	5.81	7.46	4.98	7.46	0.52	0.58	0.62	0.5	0.5	0.57	0.5	1.07

Source: Compiled by the authors.

In turn, the solution to this problem can be written as follows:

$$\upsilon_{ij} = \frac{G_i}{y_{ij}}\upsilon_i . \qquad (26)$$

Assertion. The effectiveness of the incentive system for integrated assessment (9) is higher than for integrated assessment (8).

Proof. Comparing $K^{(9)}$ and $K^{(8)}$, we obtain the following inequality:

$$F_p \frac{n-1}{\sum_{i=1}^{n} b_i G_i} > F_p \frac{n-1}{\sum_{i=1}^{n} b_i A_i} . \qquad (27)$$

In this case, the value F_p satisfies the condition:

$$F_p \le \min\left\{ \frac{\left(\sum_{q=1}^{n} b_q G_q\right)^2}{(n-1)\left(\sum_{q=1}^{n} b_q G_q - (n-1)\min\limits_i \{b_i G_i\}\right)} \right\};$$

$$\frac{\left(\sum_{q=1}^{n} b_q A_q\right)^2}{(n-1)\left(\sum_{q=1}^{n} b_q A_q - (n-1)\min\limits_i \{b_i A_i\}\right)}$$

From (27) follows the fulfillment of the inequality:

$$\sum_{i=1}^{n} b_i A_i > \sum_{i=1}^{n} b_i G_i . \qquad (28)$$

Cauchy's mean inequality allows us to state that $K^{(9)} > K^{(8)}$. This means that the incentive system when constructing a comprehensive assessment in the form of a geometric mean of the agents' activity (9) gives a greater effect than the incentive system when constructing a comprehensive assessment in the form of the minimum value of all obtained assessments of the agents' activity (8). We will support the previously given theoretical calculations with calculations.

Example. Let $n=2$, $b_1=3$, $b_2=2$, $F_p=100$, $r_{11}=0,5$, $r_{12}=0,7$, $r_{13}=0,9$, $r_{21}=0,4$, $r_{22}=0,6$, $X_{11}=8$, $X_{12}=10$, $X_{13}=12$, $X_{21}=10$ and $X_{22}=15$.

Table 2 shows the values of agents' actions (x_{ij}), their performance assessment (υ_{ij}), a comprehensive assessment (υ_i) and the indicator of the effectiveness of the incentive system (K) in a Nash equilibrium for various methods of forming a comprehensive performance assessment.

It should be emphasized that the choice of various convolution functions in the formation of a comprehensive assessment of the activities of agents allows the Center to influence their strategy, i.e. if necessary, adjust, and regulate the situation development. Thus, the game-theoretic approach makes it possible to correctly establish the relationship between the size of the collective-individual bonuses for regional civil servants and the achieved level of socio-economic development of the constituent entity of the Russian Federation.

CONCLUSION

A literature review allows us to make an unambiguous conclusion about the relevance for modern Russia of improving the efficiency of the management system, and above all at the regional level.

At present, most of the constituent entities of the Russian Federation are subsidized, and this does not allow their top management to solve the problem of raising the wages of regional civil servants. This is possible through the introduction of a new (mixed or hybrid) wage system based on performance. At the same time, bonus payments make it possible to interest regional civil servants in ensuring sustainable socio-economic development of the constituent entities of the Russian Federation and ultimately contribute to their transition from the subsidized group to donor regions. In the framework of this study, in contrast to the previous studies of the author, attention is focused on ensuring the correct determination of the amount of collective-individual incentive payments to civil regional employees by applying the game-theoretic approach.

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R.V. Gubarev — literature review.
E.I. Dzyuba — an empirical study on the development of the state civil service in the Russian regions.
F.S. Fayzullin — abstract, introduction, conclusions, general version of the article.
A.G. Chkhartishvili — problem statement (economic and mathematical modeling).
A.V. Shchepkin — evaluation of the performance of civil servants (agents) based on a game-theoretic approach.

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Effectiveness of Macroprudential Policy: Problems of Measurement and Evaluation

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ABSTRACT

The macroprudential policy of central banks plays a key role in ensuring financial stability not only at the level of individual states but also on the scale of the entire global economy. In this regard, adequate measurement of its effectiveness is an **urgent** task for national and supranational financial regulatory authorities. The present study is focused on solving this problem. **The purpose** of the study is to develop indicators and criteria for a comprehensive assessment of the effectiveness of countries' macroprudential policies, allowing for a cross-country analysis of this effectiveness and identifying the best global practices in macroprudential regulation. The study is based on the consolidation of the market and institutional approaches to measuring financial stability, as well as on the use of normative **methods** and methods of comparative economic analysis. **As a result** of the study, new indicators for diagnosing the effectiveness of macroprudential policy have been developed. Criteria are proposed to determine the international positions of countries in terms of the level of general, market, and institutional effectiveness of the macroprudential policy. Testing of the developed indicators and criteria was carried out for 180 countries for the period 1998–2019. The developed indicators and criteria for the effectiveness of macroprudential policy differ from the existing ones in a comprehensive manner, since they take into account the stability of financial markets and financial systems at the same time. They are also more representative as they include a wider range of parameters taken into account in financial stability calculations.

Keywords: financial market; financial institutions; financial stability; comparative analysis; macroprudential policy; policy effectiveness; central bank

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INTRODUCTION

Based on a knowledge-intensive review of the literature [1], in recent years there has been an increase in scientific interest in the problems of the effectiveness of macroprudential policies of central banks. This is due to the fact that a high-quality macroprudential policy can ensure financial stability and thus create conditions for economic growth [2]. However, as noted in some publications [3–4], public understanding of the essence and effectiveness of the macroprudential policy is still limited. In particular, scientific studies of macroprudential policy and practice of regulating financial stability do not provide exhaustive answers regarding its goals, regimes, transmission mechanism, and rules for making decisions by state authorities, and evaluating the effectiveness of these decisions. The unresolved problems are largely due to the versatility of the macroprudential policy and the duality of its goal: ensuring the stability of financial markets and financial systems [4].

In scientific research, a fragmented approach to assessing the effectiveness of macroprudential policies prevails. The fragmentation of ongoing research hinders the development of a methodology for effective state regulation of financial stability. International standards for the formation and application of financial regulation instruments are advisory in nature and allow for their adjustment at the level of national jurisdictions. The desire to eliminate the problem of fragmentation in assessing the effectiveness of macroprudential policies encouraged this study.

The purpose of the study is to develop indicators and criteria for a comprehensive assessment of the effectiveness of countries' macroprudential policies, allowing for a cross-country analysis of this effectiveness and identifying the best global practices of macroprudential regulation.

This study consists of several sections. The first section includes an overview of current research related to measuring and evaluating the effectiveness of central bank macroprudential policies. The second section is a presentation of a new concept for measuring this effectiveness, an algorithm for calculating the integral indicator and criteria that allow building ratings and determining the international positions of countries in terms of the level of effectiveness of the macroprudential policy. The third section contains testing of the developed system of indicators and criteria using a database of 180 countries for the period 1998–2019. The next section is devoted to a discussion of the research results. The last section presents the main conclusions.

LITERATURE REVIEW

An analysis of the scientific and specialized literature on the topic of the study shows that at present there are *three main approaches* to the analysis and evaluation of the effectiveness of the macroprudential policy.

In the *first approach*, the effectiveness of macroprudential policies is assessed by the achieved level of financial stability. At the same time, the issue of measuring financial stability at the macroeconomic level continues to be the subject of heated scientific discussions. This is evidenced by the presence of many different concepts for determining financial stability, used in scientific research and in the practice of regulating financial stability [5]. This complicates the cross-country analysis of the effectiveness of macroprudential policies and does not allow for identifying the best world practices and extending them to countries that generate threats to financial stability.

The *second approach* examines the effectiveness of individual macroprudential policy instruments. The essence of these studies is to analyze the impact of regulatory instruments on the stability of the economy, financial markets, and financial systems. At the same time, as a rule, the requirements for bank capital and the debt burden of financial corporations are considered regulatory instruments.

Studies of the effectiveness of bank capital requirements are mainly focused on the analysis of the impact of these requirements on the cyclical nature of the economy and the stability of the banking sector.

The results of studies of the procyclical nature of the capital requirements of banks have formed two points of view regarding the effectiveness of this regulatory tool. According to the first point of view, the capital adequacy requirements of banks are an effective regulatory tool, as they have a positive effect on financial stability. This point of view is shared by Hodbod A. et al. [6]. According to the second point of view, banks' capital adequacy ratios are of limited effectiveness, and therefore there is no reason to increase these requirements. This point of view is shared by J. Mankart et al. [7].

The research results of the impact of bank capital requirements on the stability of the banking sector also show two points of view. According to the first point of view [8, 9], an increase in requirements for bank capital increases the stability of banks. According to the second point of view [10, 11], the effectiveness of regulatory capital as a tool to ensure the stability of the banking system is called into question.

Studies of the effectiveness of financial corporations' debt burden ratios are based mainly on the analysis of the impact of financial corporations' debt burden on financial stability.

Studies of the effectiveness of financial corporations' debt burden ratios are based mainly on the analysis of the impact of financial corporations' debt burden on financial stability.

According to the results of a number of studies [12–15], financial leverage is the main indicator of banking crises and the cyclical nature of the economy. In particular, M. Gross et al. [15] found that leverage is procyclical. Leverage procyclicality can trigger financial and credit cycles during periods of growth in bank assets. And during the economic downturn, the most significant risk is the rate of decrease in the share of borrowed funds [12]. As a result of studying the impact of the debt of financial corporations on financial stability, A. Haldane and V. Madouros [13] came to the conclusion that it is necessary to limit this debt. In the development of this topic, a number of scientists and experts conducted a comparative analysis of the effectiveness of regulatory instruments and found that debt regulation has a stronger impact on risk than capital regulation [14].

The advantage of this approach is that it makes it possible to identify the advantages and disadvantages of the regulatory instruments used and, on this basis, to develop recommendations for improving macroprudential policies. At the same time, the ongoing studies are fragmentary, as they focus on the analysis of the relationship between regulatory instruments and the stability of credit markets and banking systems. In addition, the research results sometimes contain conflicting conclusions, which requires further research in this direction.

The *third approach* examines the effectiveness of macroprudential policy transmission channels and provides recommendations for optimizing the portfolio of regulatory instruments and the conditions for their application.

In particular, W. Wang and S. Huang [16] studied the effectiveness of the transmission mechanism of interest rates and came to the conclusion that interest rates can act as an economic stabilizer. As noted by X. Freixas and D. Perez-Reyna [17], a sharp drop in real interest rates can provoke a systemic crisis. At the same time, A. Mehrotra and R. Moessner [18] found that the tightening of macroprudential policy instruments in the form of restrictions on foreign currency positions helps to temporarily protect countries from the side effects of interest rates.

Analyzing the effectiveness of the portfolio of macroprudential instruments, R. Herring [19] came to the conclusion that it is expedient to exclude from it a part of the mandatory capital adequacy ratios of banks without compromising the effectiveness of the entire portfolio. L. Pfeifer et al. [20], on the contrary, proposed to increase the portfolio of regulatory instruments by introducing leverage ratios.

Analyzing the effectiveness of the macroprudential policy, A. Admati [21] drew attention to the low quality of financial stability management and therefore proposed to evaluate its effectiveness based on the ratings of responsibility and transparency of government bodies. Continuing this topic, S. Juhro et al. [22] noted the importance of combining macroprudential and monetary policies.

Developing recommendations to improve the effectiveness of the macroprudential policy, L. Donath et al. [23] emphasized the need for comprehensive monitoring of financial stability risks, covering all elements of financial systems and financial markets. According to these authors, such supervision allows for a comprehensive diagnosis and elimination of systemic vulnerabilities in the financial sector. M. Chen et al. [24] suggested taking into account the competing effects of macroprudential policies on financial markets and financial systems.

The advantage of this approach is that it allows us to evaluate the effectiveness of the transmission mechanism of the macroprudential policy and, on this basis, develop proposals for its improvement. At the same time, ongoing studies are focused on the analysis of the effectiveness of individual channels of the transmission mechanism without considering their relationship. At the same time, the need to take into account such a relationship is recognized and justified.

Summing up the analysis of publications, it should be noted that studies of the effectiveness of the macroprudential policy

are carried out in three relatively independent areas; are mostly fragmented and do not allow for a comprehensive assessment of the effectiveness of the policy. Meanwhile, as follows from scientific publications, the need for such a comprehensive assessment is long overdue. There is an obvious need to search for new, more informative indicators and criteria for measuring and evaluating the effectiveness of macroprudential policies of central banks.

RESEARCH METHODOLOGY

The hypothesis of this study is that the comprehensive nature of assessing the effectiveness of macroprudential policies is ensured by consolidating the results of achieving its two goals (ensuring the stability of financial markets and the stability of financial systems).

The following assumptions were made during the study:

1. The effectiveness of the macroprudential policy (GS) is understood as the degree to which financial stability is achieved simultaneously in the financial markets and in the financial systems of countries, which corresponds to its two goals.

2. Consolidation of the goals of the macroprudential policy is carried out on the basis of the principle of their equality. In this regard, the indicator of the general effectiveness of the macroprudential policy (GS) is calculated as the average of two indicators: market efficiency (MS) and institutional efficiency (IS).

3. A modified indicator of real interest rates is used as an indicator of market efficiency. The essence of the modification is that when calculating nominal interest rates in the financial market, in addition to the rates in the credit market, the rates in the bond market are additionally used. And when determining the level of inflation, along with the consumer price index, it is proposed to take into account the price index in the real estate market and the share price index. This modification allows us to get a more accurate description of the state of financial markets.

4. The ratio of total income (profit) to the total risk of the financial system is used as an indicator of the financial stability of the institution. This indicator shows how many unaccounted risks the financial system can cover if necessary.

The study is based on a combination of two methodological approaches to assessing financial stability: market (market stability) and institutional (sustainability of institutional units). The market approach will be applied to the valuation of MS, and the institutional approach to the valuation of IS.

The study uses the normative method of qualitative performance assessment, as well as comparative analysis methods to determine the international position of countries in terms of the effectiveness of macroprudential policies.

Approbation of the developed indicators and criteria is carried out on a sample of 180 countries for the period 1998–2019. For testing, statistical data posted on the website of the World Bank[1] and the European Central Bank are used.[2]

Indicators for Quantifying the Effectiveness of Macroprudential Policy

Taking into account the assumptions made, the index of the general macroprudential policy effectiveness (GS) is proposed to be calculated using the formulas (1)–(3):

$$GS = (MS + IS) / 2, \quad (1)$$

$$MS = (NC * C + NB * B) / (C + B) - (Ip * Q + In * N + Ia * A) / (Q + N + A), \quad (2)$$

$$IS = (ISb * Ab + ISk * Ak + ISf * Af) / (Ab + Ak + Af), \quad (3)$$

where MS — market stability index (real weighted average of the cost of debt instruments); IS — index of institutional stability (stability of the financial system);

[1] World Bank Open Data. The World Bank. URL: https://data.worldbank.org/ (accessed on 12.12.2022).

[2] Statistical Data Warehous. European Central Bank. URL: https://sdw.ecb.europa.eu/ (accessed on 12.12.2022).

NC — the nominal weighted average rate on the credit market; *C* — the volume of outstanding loans; *NB* — the nominal weighted average rate on the bond market; *B* — the capitalization of the bond market; *Ip* — consumer price index; *Q* — the volume of real GDP; *In* — price index in the real estate market; *N* — the volume of the real estate market; *Ia* — stock price index; *A* — capitalization of the stock market, US dollars; *ISb* — the ratio of the bank's profit to risk-weighted assets; *Ab* — banking assets; *ISk* — the ratio of profit of non-banking credit institutions to risk-weighted assets; *Ak* — assets of non-bank credit institutions; *ISf* — the ratio of profits of non-banking financial institutions (funds, brokers, dealers) to risk-weighted assets; *Af* — assets of non-banking financial institutions.

Indicators for Qualitative Evaluation of the Effectiveness of Macroprudential Policy

To qualitatively characterize the effectiveness of the macroprudential policies of central banks, it is proposed to use an evaluation scale (*Table 1*). The rating scale includes five levels of international position: high, above average, average, below average, and low.

Table 1 shows that the international positions of countries in terms of the effectiveness of macroprudential policies depend on the criteria corresponding to the values *n*1–*n*3, *m*1–*m*3, *k*1–*k*3. These criteria mean the following:

1. The criterion of low market effectiveness of macroprudential policy (*MS* < 0) means that real interest rates should be positive. Negative interest rates encourage speculation in a wide range of leveraged goods and can lead to high inflation and pyramid schemes. The value of one step of the scale is *n*1 and corresponds to the minimum margin required to prevent such speculation.

2. When assessing the institutional effectiveness of macroprudential policy (*IS*) the *m*1 criterion corresponds to a situation where financial institutions are not able to fully cover the expected risks. The *m*3 criterion characterizes the maximum level of unforeseen risks that may arise in the global financial system during a crisis. Based on this, the step size should be equal to one-third of *m*3.

3. When assessing the general effectiveness of macroprudential policy (*GS*), the values of criteria *k*1–*k*3 are calculated as the average value of criteria *n*1–*n*3, *m*1–*m*3.

RESULTS

To determine the numerical values of the criteria for the effectiveness of macroprudential policies of central banks, the statistical data of the World Bank[3] and the European Central Bank[4] for 180 countries for the period 1998–2019 were used. Due to the lack of open access to some aggregated statistical data (*NB, B, N, Ia, A, ISk, ISf*), used in formulas (1)–(3), a simplified version was used:

$$GS = (MS + IS) / 2 = ((NC - Ip) + ISb) / 2. \quad (4)$$

When forming the levels of market effectiveness of macroprudential policy (*MS*), a step equal to 2% was used. The value of 2% was chosen based on the results of studies that determine the range of the real neutral rate of central banks. These studies have shown that, in general, this interval tends to 2%. For example, D. Kreptsev et al. [25] allocate an interval from 1 to 3.2%, and the International Monetary Fund[5] — from 1% to 3%.

When forming the levels of institutional effectiveness of macroprudential policy (*IS*), the *m*3 criterion was set at 4.5%, which corresponds to the minimum capital requirements for banks under Basel. This value (4.5%) indicates that, if necessary, banking systems will be able to cover unforeseen losses in the same volume as the risks they take into account. This is a

[3] World Bank Open Data. The World Bank. URL: https://data.worldbank.org/ (accessed on 12.12.2022).

[4] Statistical Data Warehous. European Central Bank. URL: https://sdw.ecb.europa.eu/ (accessed on 12.12.2022).

[5] International Monetary Fund. 2019. Article IV consultation press release for Russian Federation. Country Report. URL: https://www.imf.org/en/Publications/CR/Issues/2019/08/01/Russian-Federation-2019-Article-IV–Consultation-Press-Release-Staff-Report-48549 (accessed on 12.12.2022).

Table 1

Criteria for Assessing the International Position of Countries on the Effectiveness of Macroprudential Policy, %

International positions	Market efficiency (*MS*)	Institutional efficiency (*IS*)	General efficiency (*GS*)
High	$MS \geq n3$	$IS \geq m3$	$GS \geq k3$
Above average	$n2 \leq MS < n3$	$m2 \leq IS < m3$	$k2 \leq GS < k3$
Average	$2n1 \leq MS < n2$	$m1 \leq IS < m2$	$k1 \leq GS < k2$
Below average	$0 \leq MS < n1$	$0 \leq IS < m1$	$0 \leq GS < k1$
Low	$MS < 0$	$IS < 0$	$GS < 0$

Source: Compiled by the authors.

Table 2

Values of Criteria for Assessing the International Position of Countries on the Effectiveness of Macroprudential Policy, %

International positions	Market efficiency (*MS*)	Institutional efficiency (*IS*)	General efficiency (*GS*)
High	$MS \geq 6{,}0$	$IS \geq 4{,}5$	$GS \geq 5{,}25$
Above average	$4{,}0 \leq MS < 6{,}0$	$3{,}0 \leq IS < 4{,}5$	$3{,}5 \leq GS < 5{,}25$
Average	$2{,}0 \leq MS < 4{,}0$	$1{,}5 \leq IS < 3{,}0$	$1{,}75 \leq GS < 3{,}5$
Below average	$0 \leq MS < 2{,}0$	$0 \leq IS < 1{,}5$	$0 \leq GS < 1{,}75$
Low	$MS < 0$	$IS < 0$	$GS < 0$

Source: Compiled by the authors.

fairly high value. Nevertheless, analysis of data on the stability of banking systems shows that this criterion is achievable. Thus, in 2017, the international position "high" in terms of (*IS*) was occupied by Swaziland (6.4), Estonia (5.9), Argentina (5.6), Uganda (5.6), and Sweden (4.5); in 2018 — Seychelles (7.51), Ghana (5.57), Lesotho (5.06), Norway (5.06); in 2019 — Seychelles (6.15), Lesotho (6.11), Ghana (5.78), Rwanda (5.65), Uganda (5.61), Zambia (5.10), Norway (4 .74).

Taking into account the established values of the criteria, a full rating scale was formed in terms of indicators of the general, market and institutional efficiency of the macroprudential policy (*Table 2*).

To check the calculated criteria for adequacy, a graphical analysis of the average values of indicators reflecting the effectiveness of macroprudential policies of central banks (*MS, IS, GS*) or the period 1998–2019 was carried out (*Fig. 1*). The results of this analysis confirmed the adequacy of the quantitative values of the criteria presented in *Table 2*.

Using the developed indicators and criteria, the general (*GS*), market (*MS*), and institutional (*IS*) effectiveness of macroprudential policies of the central banks of the EU countries for the period 2017–2019 was calculated, and the analyzed countries were determined by international positions (*Table 3*).

An analysis of the effectiveness of macroprudential policies of the EU countries allows us to come to the following main conclusions.

First, the average values of indicators of the general, market and institutional effectiveness of the macroprudential policies of the EU countries were lower than the average values of similar indicators in the countries worldwide.

Second, during the analyzed period, Romania (2017) and Greece (2018–2019); achieved the best performance in terms of the general efficiency of macroprudential policies; in terms of market efficiency — Greece (2017–2019); for institutional efficiency — Estonia (2017–2018) and Denmark (2019).

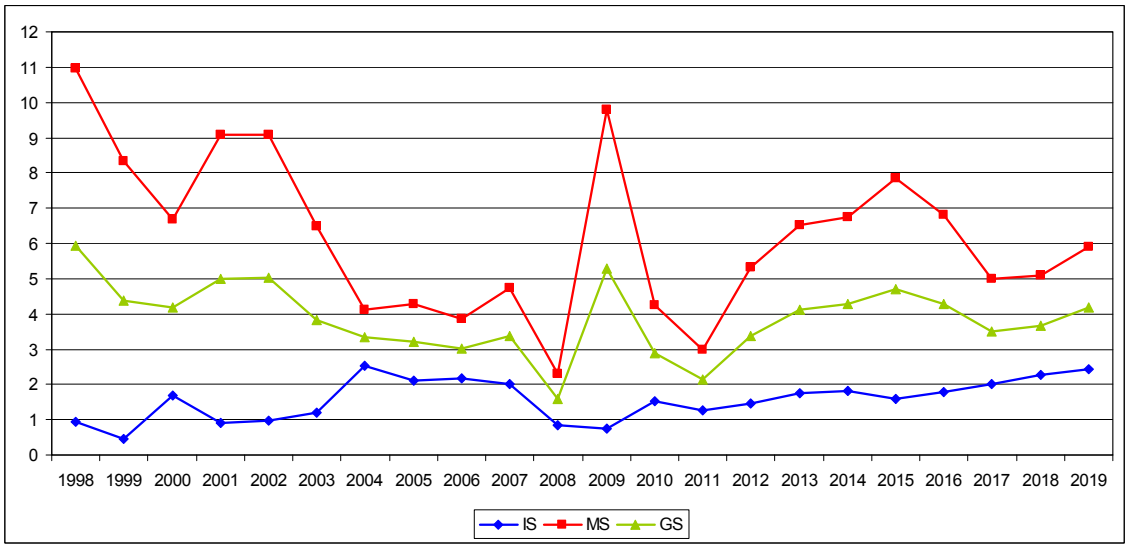

Fig. **Average Values of Indicators of Effectiveness of Macroprudential Policy of Central Banks for the Period 1998–2019, %**

Source: Authors' calculations based on the official statistics. URL: https://data.worldbank.org/; https://sdw.ecb.europa.eu/ (accessed on 12.12.2022).

Table 3

International Positions of EU Countries in 2019

International positions	Market efficiency (*MS*)	Institutional efficiency (*IS*)	General efficiency (*GS*)
High			
Above average		Cyprus, Denmark	
Average	Cyprus, Greece, Croatia, Ireland, Malta, Romania	Austria, Czech Republic, France, Croatia, Hungary, Ireland, Italy, Malta, Portugal, Sweden, Slovenia	Cyprus, Czech Republic, Denmark, Greece, Croatia, Ireland, Malta, Portugal
Below average	Austria, Bulgaria, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Ireland, Lithuania, Latvia, Poland, Portugal, Slovenia	Belgium, Germany, Estonia, Spain, Finland, Luxembourg, Netherlands, Poland, Slovakia	Austria, Belgium, Bulgaria, Germany, Estonia, Spain, Finland, France, Hungary, Italy, Lithuania, Luxembourg, Latvia, Poland, Romania, Sweden, Slovenia, Slovakia
Low	Belgium, UK, Hungary, Luxembourg, Netherlands, Sweden, Slovakia	Romania	UK, Netherlands

Source: Authors' calculations based on the official statistics. URL: https://data.worldbank.org/; URL: https://sdw.ecb.europa.eu/ (accessed on 12.12.2022).

Third, the UK (2017–2019), Lithuania (2017–2018), Luxembourg (2018), and the Netherlands (2019) were the source of general systemic risks).

Fourth, the source of systemic risks in financial markets was Austria (2017–2018), Belgium (2017–2019), Estonia (2017–2018), Spain (2017–2018), UK (2017–2019), Lithuania (2017–2018), Luxembourg (2017–2019), Sweden (2017–2019), Germany (2018), France (2018), Hungary (2018–2019), Netherlands (2019) Slovakia (2019).

Fifth, Greece (2017) and Romania (2019) acted as a source of systemic risks in the banking sector.

Sixth, the dynamics of the effectiveness of the macroprudential policy of the EU countries is multidirectional, which indicates a lack of coordination of this policy between countries.

Summing up the results of the analysis of the effectiveness of the macroprudential policy of the EU countries, it should be noted that, in general, this effectiveness is at an insufficiently high level, since most countries occupy the positions of "average" and "below average". The effectiveness of the macroprudential policy is characterized by multidirectional trends and contains threats to financial stability, mainly in relation to financial markets. This situation is explained by the policy of quantitative easing in order to stimulate economic growth; insufficient attention of central banks to the issues of regulating the stability of financial markets in comparison with the regulation of banking systems; lack of a methodology for developing, implementing and coordinating macroprudential policies that would allow effective government decisions in the area of financial regulation.

DISCUSSIONS

As a result of the study, new indicators and criteria for a comprehensive assessment of the effectiveness of the macroprudential policy were proposed. The value of the developed indicators and criteria lies in the fact that they can be used to conduct a comparative analysis of countries in terms of the general, market, and institutional efficiency of macroprudential policies and, on this basis, to identify the best world practices and sources of global risks in the form of countries with a low level of effectiveness.

These new indicators and benchmarks were developed on the assumption that the two macroprudential policy objectives are equal. In practice, the ratio of goals may be different depending on the chosen macroprudential policy regime. Since the development of macroprudential policy regimes and the assessment of the advantages and disadvantages of each of them were not included in the list of objectives of this study, we believe that research in this area is very relevant from the point of view of improving the effectiveness of state and international regulation of financial stability.

The study proposes to calculate the stability of financial systems for all participants in the sector of financial institutions and not just credit institutions. This increases the representativeness of the results of assessing the institutional effectiveness of the macroprudential policy. At the same time, financial activity is inherent in other sectors of the economy. Therefore, expanding the range of sectors of the economy to assess the effectiveness of macroprudential policies is a promising area for further research.

Another important point of the study is that the empirical analysis of the effectiveness of the countries' macroprudential policies was carried out using a simplified calculation formula (4). This is due to the fact that the publicly available official data of central banks, international financial organizations, and statistical agencies do not contain information about all the data used in formulas (1)–(3). In this regard, there is a need to improve the statistical base used in monitoring financial stability at the national and global levels of the world economy. In addition, this database must be updated regularly. Solving these problems will increase the level of scientific research in this area, as well as make practical conclusions more accurate.

CONCLUSIONS

As a result of the study, an integral indicator of a comprehensive assessment of the effectiveness of the macroprudential policy was developed, including private indicators in the form of market and institutional efficiency. Such an indicator of a comprehensive assessment of the effectiveness of the macroprudential policy has been developed for the first time. Its application makes it possible to form ratings of countries according to the general, market, and institutional efficiency of macroprudential policies, and to identify leading countries and countries that pose a threat to financial stability at the global level.

Criteria for a qualitative assessment of the general, market, and institutional efficiency of macroprudential policies have been formed, which makes it possible to determine the international positions of countries in terms

of these indicators. This is the first time such criteria have been proposed.

In general, the study is the first step in a comprehensive assessment of the effectiveness of macroprudential policies of central banks. This assessment is based on a number of assumptions that have arisen due to the lack of an evidence-based methodology and international standards for the formation and implementation of macroprudential policy. Therefore, there is a need for further research in this area. Their results will clarify and supplement the results of this study, as well as create a platform for making effective state and interstate decisions in the field of strategic management of financial stability.

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ORIGINAL PAPER

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The Impact of Former Top Managers Legal Scandals on Stock Prices of Companies

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ABSTRACT

The **main objective** of this article is to study the impact of a scandal with the Vice Chairman of the Founding Board — VCFB (former member of the Board of Directors — BoD) and the former General Manager of Asia Commercial Bank (ACB) on the daily returns of shares of 9 sectors of the Vietnam's stock market. The **event study method** is used for each industry with many different event windows. **Research results** show that the announcement of an arrest warrant is an entirely unexpected event for the stock market because no industry reacts significantly in the days before the event. The reaction of industries was strongest 5 days after the event for the Banking and Finance industries and 2 days after the event for non-financial industries. The **conclusion** of the study shows that although the information is directly related to one bank — ACB, its spillover effects have covered all nine industries including the financial and non-financial industries on the Vietnam stock market (VST). The nature of cross-ownership among commercial banks in Vietnam (CB Vietnam) explains that negative information only creates a spillover effect within the industry but does not have a competitive effect in this industry. Social networks amplify herd mentality and spillover effects, negatively impacting the financial and non-financial industries in the stock market.

Keywords: financial scandals; event study; stock returns; non-financial industries; spillover effect; cross-ownership

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INTRODUCTION

Topics investigating stock market reactions often focused on unexpected events directly related to the business such as changes in top managers [1], fraud or legal-related allegations [2], and inappropriate behavior by celebrities who represent the company's brand [3]. However, research on the legal scandals of former top managers affecting stock prices is still scant.

In addition, announcements on stock price reactions to unexpected events in countries with developed stock markets such as the United States (US) and Europe dominate [4–6] but publications on this topic in lower-rated stock markets are still limited. The VST has so far only approached the standards of an emerging market, so the results of this study will contribute to understanding the reaction of stock prices to unexpected events in this stock market.

Furthermore, the scope of events used in previous studies is often quite narrow, focusing only on the stock price response of a single company [7] or a particular industry [5]. This may be because the event selected in previous studies was predicted to have only a narrow impact. However, there are events that, although directly related to one company, can have an impact on the stock market, so understanding the cross-sectoral impact of these events is very important.

The news that the VCFB of ACB was arrested in the late afternoon of August 20, 2012, caused the VNIndex on August 21, 2012, of the VST to drop 4.67%, the largest drop in a year since the end of 2008 [8], has shown that the influence of this event is quite wide. Therefore, this article will study the impact of this event on the stock prices of 9 different sectors on the VST.

LITERATURE REVIEW AND RESEARCH HYPOTHESIS

Literature Review

Studies that measure the impact of an event on an investor's wealth are often based on assumptions about efficient markets and unforeseen events [4, 9].

Efficient Market Theory: Stock market efficiency implies that stock prices already reflect all available information in the market. If this is true, then any

new information regarding a company disclosed to investors will quickly be incorporated into the stock price. In terms of market signals, [10, 11] the efficiency is classified as weak-form, semi-strong-form, and strong-form. Fama [11] has more extensive tests for each level of market efficiency than [10]. The weak-form test is not only intended to test the predictive power of return in the past but is also extended to test the predictive power of return. The semi-strong-form test should be extended to the study of stock price reactions to events more generally than testing price adjustments to public announcements only. Strong-form testing should focus on personal information rather than finding out what information is not available in the market.

Social networks and ownership structures explain contagion to unforeseen events: Unforeseen events are events that are widely reported in the press but were not previously available to the market. Published unforeseen events about an individual are often classified into financial relevance [2] and personal behavioral information [3]. It is the element of surprise that makes the event's impact on stock prices stronger [12].

Wilson's social network theory [13] explains the contagion of unforeseen events to other firms (in the same industry and across industries) in the stock market. Contagion for unforeseen events is generally divided into two types: signal contagion and pure contagion [14]. Signal contagion is the driving force behind the competitive effect within the industry. In other words, if an unforeseen disclosure is determined to be negative for one company, it will confer a positive (advantage) for the rest of the industry competitors. Unlike signal contagion, pure contagion is affected by more herd effects and often contagion across multiple industries.

Ownership structure: Cross-ownership is the phenomenon of mutual ownership of shares between companies. The simplest cross-ownership structure is the mutual holding of shares between two companies, the pair of companies A-B and B-A, between the three companies is called circular ownership of the form A-B-C-A [15]. The characteristic of cross-ownership is that the companies in this structure are linked together by horizontally cross-shareholding to consolidate and hold the power of the controlling shareholders [16]. In addition, [17] has shown that in countries with poor shareholder protection, ownership structures are often pyramidal. In this case, the power of controlling shareholders over the companies is often greater than their cash flow rights because they participate in the management or control of large companies with pyramidal ownership structures. The difference between cross-ownership and pyramidal ownership is that the voting rights in cross-ownership used to control a group are still distributed over the entire group, while pyramidal ownership is concentrated in a single company or few controlling shareholders [16].

Research Hypothesis

Previous empirical studies have shown that top manager legal scandal events can lead to a significant loss of market value of public companies, even though the impact of this event can be significant. Spread to companies in the same industry and interdisciplinary. This is especially true for events with an element of surprise [9].

Studying the relationship between a company's stock price performance and subsequent changes in the company's top management, [1] showed an inverse relationship between the probability changes of the BoD and the performance of the company's shares.

To investigate the extent and causes of market-imposed penalties on U.S. stock exchange-listed businesses accused of engaging in illegal conduct, [18] using all published allegations of corporate crime that appeared in the Wall Street Journal and The Dow Jones Interactive Data Base between January 1, 1982, and December 31, 1996. Murphy et al. [18] show that this negative information causes significant economic and statistical loss to shareholder wealth. The average value of property loss over the disclosure period was 1.64%. In particular, the loss to shareholders related to the fraud allegations is significantly greater than other damages. Similar to [18, 19] pointed out that fraudulent events or crimes are commonly identified as causing the most serious financial loss to businesses. Therefore, there is a need for a mechanism to eliminate ineffective managers and encourage managers to act in the interests of shareholders [1].

Perry and De Fontnouvelle [7] measured a company's reputational loss by investigating its

stock price response to a large operating loss announcement. Reputation damage occurs if the decline in the market value of the company is greater than the reported loss. The results show that events of external origin lead to a one-for-one drop in market value with operating losses, but found internally-originated frauds to cause more market value declines, twice the reported operating loss percentage. Therefore, [7] argues that only losses due to internal fraud have an impact on the company's reputation, while external losses have no meaningful impact on the company's reputation.

Gillett et al. [4] studied operational and reputational risk in the financial industry by analyzing events that caused operating losses for listed companies in Europe and the US between 1990 and 2004. The difference between the market value loss and the declared loss amount is reputation risk. In this way [4] separates reputational risk and operational risk. The results showed that on the day of the loss announcement, the abnormal profit was significantly negative with increased trading volume. The market reaction would be significantly worse if the operating loss announcements were due to fraud and the behavior also negatively affected the company's reputation. Gillett et al. [4] argue that the timing of uncertainty resolution is also of great significance, especially when the market perceives a change in the risk profile of a financial institution. Thus, overreactions to events of unknown magnitude represent a flaw in the semi-strong-form efficient market theory.

The overlapping ownership of joint stock CBVietnam is much more complicated than that of state-owned commercial banks. Among the joint-stock commercial banks, the ownership structure of ACB has the leading level of complexity. As of May 2012, ACB, directly and indirectly, owned 5 joint stock CBVietnam with an ownership rate of over 5% [15], including two banks, Eximbank (EIB) and Sacombank (STB) listed on VST. Therefore, an event related to ACB will negatively affect not only the bank itself but also the banks in which ACB holds a high percentage of ownership [20]. Therefore, the first hypothesis concerns the banking industry, which is:

H01: The announcement of a legal scandal by a bank's top manager has no effect on the loss of market value of the banking industry.

Examining the reaction of stock prices in the US stock market to 1995–1999 earnings adjustment announcements by companies in the financial and non-financial industries, [21] found that the average AR of these companies was –9% within 2 days of notice. These regulatory notices raise questions of competence and integrity, thus [21] emphasizes that such events have the potential to increase risk and uncertainty about the future prospects of companies.

Cummins et al. [12] studied operating loss events with a minimum loss value of $ 10 million in the banking and insurance industries in the US. Statistics by [12] show that there are at least 20 events per year for the banking industry and 10 events per year for the insurance industry between 1990 and 2002 where the loss value for each event is at least 10 million USD. The results of [12] emphasize that operating losses carry adverse future cash-flow effects that are indicated when market value losses from events significantly exceed reported operating losses. Events related to "clients, products, and business practices" are an important source of loss for both banks and insurance companies. In it, banks suffer more serious losses than insurance companies for events related to internal fraud and external fraud. In addition, studies from the event window demonstrate a significant pre-event information leakage for the banking sector but not for the insurance sector. This is one of the reasons why the stock price reaction of insurance companies is stronger than that of banks.

Biell and Muller [5] examine the market reaction to operating loss announcements exceeding $ 1 million in the financial services sector in Europe from December 1972 to May 2009. The results show that the magnitude and speed of the market response are different from negative events originating from investment banking and commercial banks. The market is more responsive to commercial bank loss announcements and the most reactive to losses in the investment banking sector. Events involving insider fraud cause the market to react much earlier and faster than other types of events.

Fiordelisi et al. [2] studied the performance loss disclosures affecting the reputation of banks (both commercial and investment banks) in Europe and the US from 1994 to 2008. Focusing on operating losses of $ 1 million or more, [2] found "fraud", "trading and sales", and "payment and settlement" as losses that significantly impacted reputation. Among them, frauds cause the greatest damage to reputation. By region, events in Europe caused more damage than in North America.

By mid-2012, ACB owned Eximbank (20%); through Saigon-A-Chau Financial Investment Joint Stock Company which owns 5% of Sacombank (STB), through ACB Securities Company which owns three other joint stock commercial banks including Vietbank (10%), Dai A (10.8%), Kien Long (6.1%) [15]. It can be seen that ACB has used subsidiaries that are businesses in the financial industry to cross-own other banks. Therefore, the second hypothesis proposed in the study is:

H02: The announcement of a legal scandal by a top manager of a bank has no effect on the loss of market value of companies in the financial industry.

Jory et al. [6] have investigated major scandals (both financial and non-financial) involving CEOs affecting companies listed on US stock exchanges from 1993 to 2011. By comparing the performance of scandal-hit companies with other firms, [6] shows that investors react negatively to scandal-hit companies. Using unadjusted data, [6] estimated the total value of losses suffered by shareholders due to these scandals to be about 152 billion USD. Large companies are often scandal-prone companies, and companies with significant cash flows are less likely to get bogged down in scandals and they are often able to quickly remove the negative impact.

Before his arrest in August 2012, the VCFB of ACB (a former member of the BoD of ACB before) was known as a multi-disciplinary businessman as he and his family owned many businesses operating in many different industries such as tourism, finance, and entertainment [22]. Therefore, the third hypothesis proposed by the study is:

H03: Legal scandal notification by a bank's top manager has no effect on the loss of market value of companies in non-financial industries.

Using an event study approach to compare the spillover effects of the three largest rogue traders in European investment banks in 1995, 2008 and 2011 on banks and the continent's largest undisclosed insurer, [9] shows a significant negative impact on market value loss for all three banks. In addition, [9] indicates that the bankruptcy of the announced company causes a negative impact on the undisclosed companies through the contagion effect. But the competitive impact of insider fraud events in investment banking on other banks and insurers is significantly stronger than the contagion effect. In other words, [9] argues that the discovery of internal fraud (scandal) by this investment bank has a significant positive impact on other banks and insurance companies. The fourth hypothesis proposed is:

H04: The effect of the top manager's legal scandal on the market value loss of the banking industry and other industries is similar in magnitude and duration.

METHOD

The objective of this study is to assess the impact of the legal events of former senior leaders related to ACB in 2012 on the banking, financial and non-financial sectors of the VST. To achieve the research objective, the article uses the event research method to test the hypotheses that have been put forward in the theoretical basis.

Determine the event date ($T = 0$): This study examines the stock market's reaction to unexpected news regarding a former senior executive of ACB in August 2012. On the evening of August 20, 2012, the investigative agency of Vietnam's Ministry of Public Security arrested the VCFB of ACB (former member of the BoD of ACB) for "illegal business" according to Article 159. Vietnam's Criminal Code, and the General Director of ACB was summoned by the police for questioning [23].[1] On August 23, 2012, the General Director of ACB resigned and was arrested on the same day for intentionally violating the State's regulations on economic management, causing serious consequences according to article

[1] Vietnam arrests banking tycoon, bank shares fall. Reuters. Aug. 21, 2012. URL: https://mobile.reuters.com/article/amp/idUKL4E 8JL1N 320120821 (accessed on 10.01.2023).

165-Vietnam's Penal Code.,[23] Since the arrest information regarding the two former senior leaders of ACB is quite close and both are published at the end of the day (stock market trading time has expired), this article uses the date of August 21, 2012, as the event date to analyze the market's reaction to this information.

The event study method is often used to measure the response of events to stock returns [24, 25]. There are three reasons why the fact-finding approach is ideal for studying the influence of former bank executives' legal involvement on the market share. First, a company's future earnings are reflected in current stock earnings [26] Second, stock prices adjust to event announcements [24, 25]. Third, stock prices reflect an unbiased estimate of future earnings suggesting that the stock market is inefficient [11]. Information about a former senior leader of ACB related to the law is unprecedented, so this is unexpected news for the market. The surprise of the event will be reflected in the AR and the CAR from the date of the event. The larger the value of the significant AR on the event date and the larger the significant cumulative abnormal return, the greater will be the impact of this event on stock returns. The calculation of AR and CAR when using the event research method is as follows:

Abnormal return: The market model proposed by [27] is used to calculate the extraordinary return of each industry for a particular event. A market model is used for each industry and its parameters are obtained using estimated daily data of 250 trading sessions (equivalent to 1 year) prior to the event date. The difference between the observed return and the predicted return generated by the market model is the AR or prediction error.

$$AR_{i,t} = R_{i,t} - (\widehat{\alpha_{i,t}} + \widehat{\beta_{i,t}} R_{m,t}), \quad (1)$$

where on the right side of equation (1): $AR_{i,t}$ is the average excess profit price over t days of industry i; the left side of equation (1) is the excess return in the market model; $R_{i,t}$ is the return observable on day t of sector i, $R_{i,t}$ is calculated as log ($P_{i,t} / R_{i,t-1}$). This study uses 9 different industries on the VST in 2012; $R_{m,t}$ is the return of the general index of VST on day t, $R_{m,t}$ is calculated as log ($P_{m,t} / R_{m,t-1}$). VNIndex's daily closing price is used as a general market index.–

- $\widehat{\alpha_{i,t}}$ is the intercept of industry i;
- $\widehat{\beta_{i,t}}$ is the systematic risk of the market;
- Coefficient $\hat{\alpha}$; and $\hat{\beta}$ obtained from the market model regression by ordinary least squares method.

The t-test for abnormal returns (AR) is calculated by formula (2)

$$t - stat_{AR} = \frac{AR_t}{\widehat{SD(AR_t)}}, \quad (2)$$

where $\widehat{SD(AR_t)} = \left(\frac{\sum_{t=1}^{T} \left(AR_t - \overline{AR} \right)^2}{T-1} \right)^{1/2}$ (3)

$T = 0$ is the event date

$$\overline{AR} = \frac{1}{T} \sum_{t=1}^{T} AR_t . \quad (4)$$

CAR in the period from day m to n is calculated as formula (5)

$$CAR_{m,n} = \left(\frac{1}{n} \right) \sum_{t=m}^{n} AR_{i,t} . \quad (5)$$

The t-test for cumulative AR is calculated by formula (6)

$$t - stat_{AR} = \frac{CAR_{m,n}}{\widehat{SD(CAR_{m,n})}}. \quad (6)$$

If ARs and CARs are statistically significant, the fact is that ACB's former top managers have an effect on stock returns.

Event windows: The study used many different event windows, but all ranged from 10 days before the event to 10 days after the event.

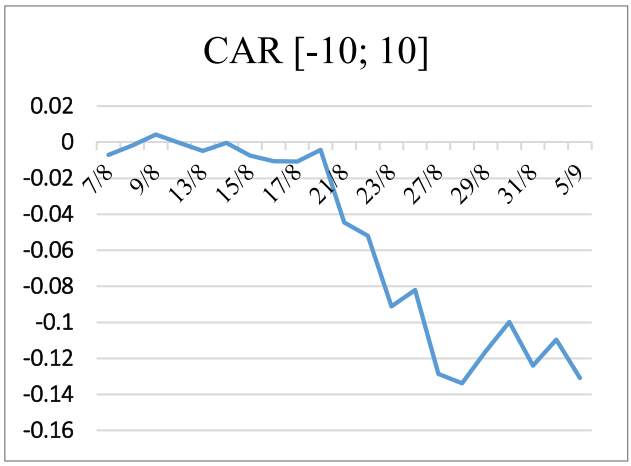
Research data: Due to the high proportion of the Banking industry in Vietnam's stock market [28], this

[2] Former general director of ACB Ly Xuan Hai arrested. Tuoitre. 2012. URL: https://tuoitre.vn/bat-nguyen-tong-giam-doc-nh-acb-ly-xuan-hai-508131.htm (In Vietnamese) (accessed on 10.01.2023).

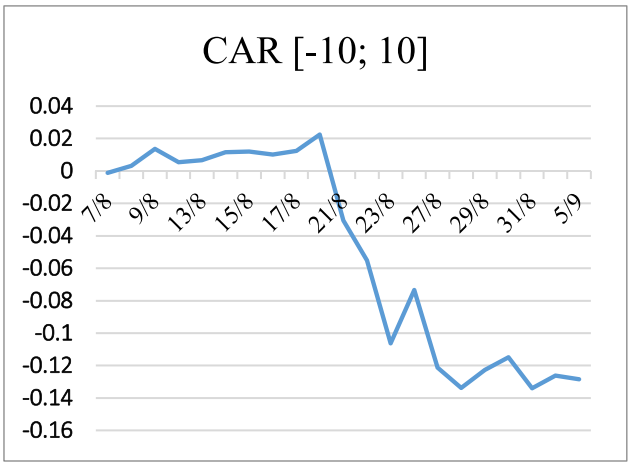
[3] Vietnam arrests ex-CEO of troubled ACB bank — report. Reuters. Aug. 24, 2012. URL: https://www.reuters.com/article/vietnam-bank-arrest-idUSL4E 8JO0IU 20120824 (accessed on 10.01.2023).

RESULTS

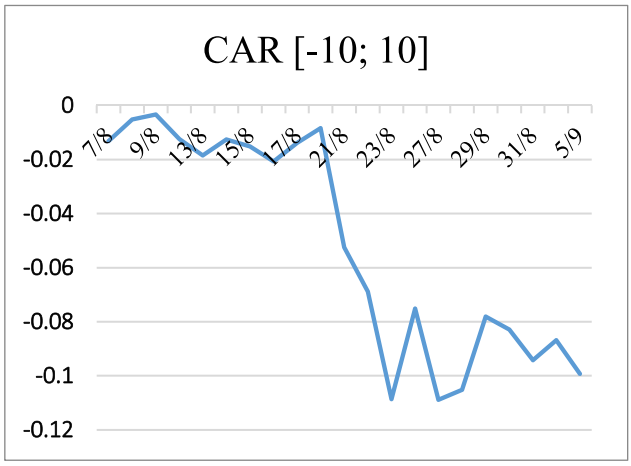
Finance (1)



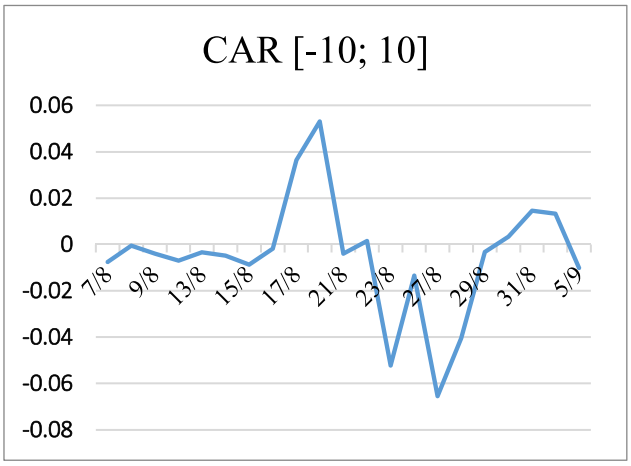
Banking (2)



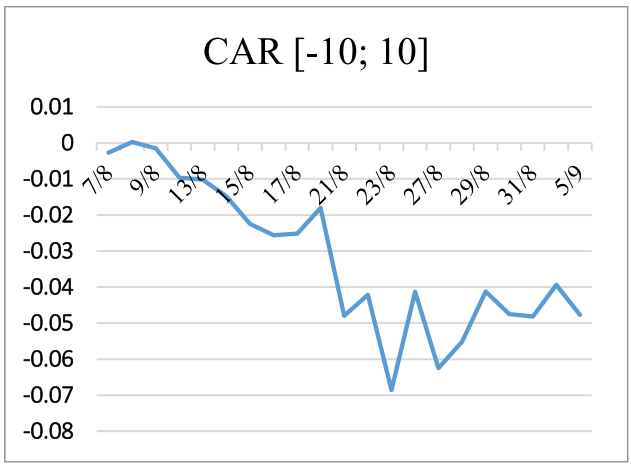
Industry (3)



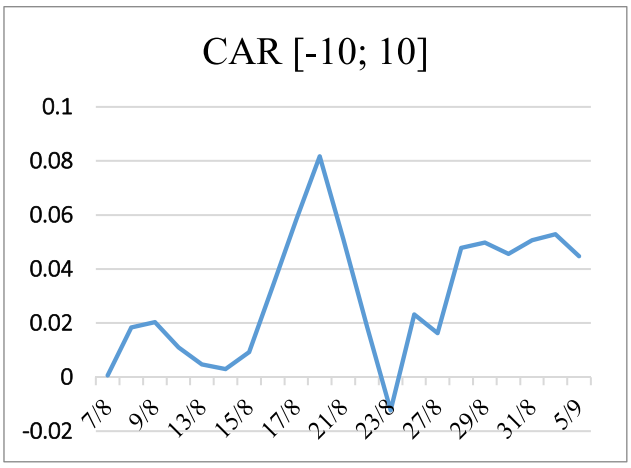
Oil & Gas (4)



Consumer Services (5)



Health Care (6)



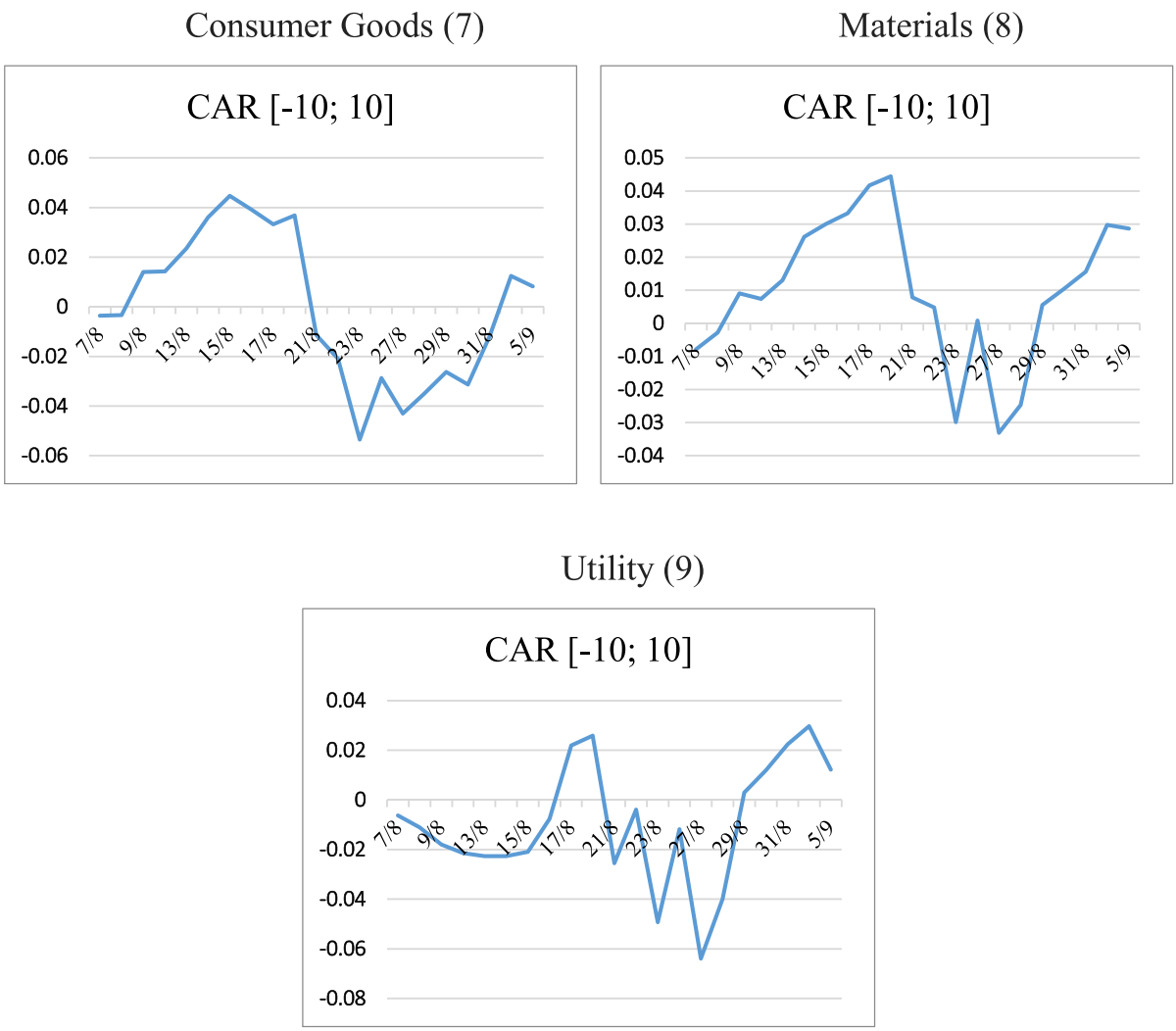


Fig. **Cumulative Abnormal Returns CAR [–10; 10] of 9 Industries in 2012**

Source: Authors' compilation and calculations.

industry is separated from the Finance industry. The Finance industry on Vietnam's stock market includes three sub- industries namely Financial Services, Insurance and Real Estate. This paper studies the market's reaction under nine industries (including Banking, Finance, Industry, Oil&Gas, Consumer Services, Health Care, Consumer Goods, Materials, and Utility). Industry index data source retrieved from FiinPro (URL: http://fiinpro.com/), and VNIndex is collected from Viet Capital Securities Company (URL: http://ra.vcsc.com.vn/Market/PriceHistory/-1?lang=en-US).

Figure shows the CAR from 10 days before the event to 10 days after the event for 9 different industry groups. There are 3 industries where CAR decreased by more than 10% including Finance (CAR [–10; 5]), Banking (CAR [–0; 5]) and Industry (CAR [–10; 4]); there are 3 industries where CAR decreased by 5–7% including Oil&Gas (CAR [–10; 4]), Utilities (CAR [–10; 4]) and Goods consumption (CAR [–10; 2]); and 2 industries with a decrease of less than 4% including Materials (CAR [–10; 4]) and Health Care (CAR [–10; 2]). Further analyzes of industry responses are presented and discussed shortly.

The results of *Table 1* show that at the event date, the AR of all 9 industries studied in this article are significantly negative. This shows that the arrest of the former top manager of ACB has had a widespread negative impact on the VST. To understand the reaction of stocks across sectors, it is important to investigate each industry in detail.

Table 1

Abnormal Return Results of Nine Industries

AR[*t*]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
–6	–0.004	0.001	–0.006	0.004	–0.001	–0.006	0.009	0.006	–0.001
–5	0.005	0.005	0.006	–0.002	–0.005	–0.002	0.013	0.013	0.000
–4	–0.007	0.001	–0.003	–0.004	–0.008	0.006	0.009	0.004	0.002
–3	–0.003	–0.002	–0.006	0.007	–0.003	0.024	–0.006	0.003	0.013
–2	0.000	0.002	0.007	0.038	0.000	0.025	–0.006	0.008	0.030
–1	0.006	0.010	0.005	0.017	0.007	0.023	0.004	0.003	0.004
0	**–0.040****	**–0.053*****	**–0.044*****	**–0.057*****	**–0.030*****	**–0.031*****	**–0.048*****	**–0.037*****	**–0.051*****
1	–0.007	–0.025	–0.016	0.005	0.006	–0.032***	–0.010	–0.003	0.022
2	**–0.039****	**–0.051*****	**–0.040****	**–0.054*****	**–0.026****	**–0.031*****	**–0.033****	**–0.035*****	**–0.045****
3	0.009	0.033	0.033	0.039	0.027	0.036	0.025	0.031	0.037
4	**–0.047*****	**–0.048*****	**–0.034****	**–0.052****	**–0.021***	–0.007	–0.014	**–0.034*****	**–0.052*****
5	–0.005	–0.013	0.004	0.025	0.007	0.031	0.008	0.008	0.024
6	0.018	0.011	0.027	0.037	0.014	0.002	0.009	0.030	0.043
7	0.016	0.008	–0.005	0.007	–0.006	–0.004	–0.005	0.005	0.009
8	–0.024	–0.019	–0.011	0.011	–0.001	0.005	0.019	0.005	0.010
9	0.014	0.008	0.007	–0.001	0.009	0.002	0.024	0.014	0.007
10	–0.021	–0.002	–0.012	–0.023	–0.008	–0.008	–0.004	–0.001	–0.017

Source: Authors' compilation and calculations.

Banking industry: The news that a former senior leader of ACB was arrested in August 2012 caused a sharp drop in the share price of the banking industry, which was reflected in the AR and CAR. The AR of the Banking industry on the event day was AR[0] = –5.3%, the steepest decline in the industry's review days. It turns out that, at the time of the event, although the position of VCFB of the bank was not specified in the Law on Credit Institutions of Vietnam, this leader was quite well-known in the banking industry and was a member of the BoD of ACB [15]. Therefore, the news of this former leader's arrest had a negative impact on the entire banking industry. Two days after the event, the bank's stock price continued to decline when the market received more information that the CEO of ACB resigned and was arrested immediately, the AR of this industry stock was AR [2] = –5.1%. In the 10 days after the event, there was another day of a significant decline in the banking industry's AR, which is AR [4] = –4.8%. *Table 2* shows that the CAR of the banking industry is all negative and statistically significant since the event date. In which, CAR at event windows with negative values above –10% are [–10; 5]; [–10; 10]; [0; 5]; [0; 8]. It shows that the CAR of the banking industry fell more sharply 5 days after the event than during the –/+10 days period after the event. This result demonstrates that to an unanticipated event, stock returns react most strongly in the first days after the event is announced, then the response declines in the following days. The fact that the stock reacts long after the event date, as demonstrated by AR and CAR, is statistically significant, indicating that the semi-strong form is violated. The event of ACB causing a drop in all listed banking stocks [29], causing both the AR and the CAR of the banking industry to be meaningfully negative, refuted the hypothesis. Hypothesis H01 demonstrates no competition effect for this event in the banking

Table 2

Cumulative Abnormal Return Results of Nine Industries at Event Windows

CAR [*t*1 – *t*2]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
[–6; 0]	–0.004	0.017	0.004	0.060	–0.008	0.071	0.023	0.037	0.047
[–5; 0]	0.001	0.016	0.010	0.056	–0.008	0.077	0.013	0.031	0.049
[–4; 0]	–0.004	0.011	0.004	0.058	–0.003	0.079	0.001	0.018	0.049
[–3; 0]	0.003	0.011	0.007	0.062	0.004	0.072	–0.008	0.014	0.047
[–2; 0]	0.006	0.012	0.012	0.055	0.008	0.048	–0.002	0.011	0.033
[–1; 0]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
[0; 2]	**–0.047***	**–0.076*****	**–0.056****	**–0.048***	**–0.021**	**–0.063*****	**–0.042****	**–0.038****	–0.024
[0; 3]	–0.037	**–0.043***	–0.023	–0.009	0.007	–0.028	–0.017	–0.007	0.014
[0; 4]	**–0.084****	**–0.091*****	**–0.057***	–0.062	–0.014	–0.035	–0.032	–0.041	–0.038
[0; 5]	**–0.089****	**–0.103*****	–0.053	–0.037	–0.007	–0.003	–0.023	–0.033	–0.014
[0; 6]	**–0.071***	**–0.092****	–0.026	0.001	0.007	–0.001	–0.015	–0.002	0.028
[0; 7]	–0.055	**–0.084****	–0.030	0.007	0.000	–0.005	–0.020	0.003	0.037
[0; 8]	–0.079	**–0.103****	–0.042	0.019	0.000	0.000	–0.001	0.008	0.048
[0; 9]	–0.065	**–0.096****	–0.034	0.017	0.009	0.002	0.024	0.022	0.055
[0; 10]	–0.086	**–0.098****	–0.047	–0.006	0.000	–0.006	0.020	0.021	0.038
[–10; 5]	**–0.1338***	**–0.1338****	–0.1052	–0.0405	–0.0552	0.0478	–0.0348	–0.0247	–0.0399
[–10; 10]	**–0.1308***	**–0.1285****	–0.0992	–0.0101	–0.0477	0.0446	0.0083	0.0287	0.0122
[–10; 9]	**–0.1096***	**–0.12.62****	–0.0869	–0.0132	–0.0394	0.0529	0.0124	0.0297	0.0297

Source: Authors' compilation and calculations.

industry. This can be explained by cross-ownership among banks in Vietnam during this time period. When banks cross-own each other, bad news from one bank affects the other banks. Cross-ownership between banks and social network theory explain the contagion of negative and persistent effects of one bank on the other banks.

Finance industry: Similar to the banking industry, the legal event related to former senior leaders of ACB also had a negative impact on the Finance industry. AR of the Finance industry that is statistically significant at 3 days includes $t = 0; 2; 4$. The difference in the reaction of the Finance industry compared to the Banking industry to this event is the comparison between the absolute value of the AR on day $t = 2; 4$. The absolute value of the AR of the Banking industry after the event date is negative but decreasing, but for the Finance industry, AR [4] decreases more than AR [2]. This result shows that the legal involvement of former top managers of ACB is officially announced, on the contrary, the Vice Chairman of the ACB Founding Council before his arrest was still the Chairman of the BoD of a number of businesses in the financial sector [22], but this information is only known by the market for a few days. Day after the event date. As a result, the uncertainty about the financial companies directly related to this leader caused the AR of Finance stocks on $t = 4$ to fall more sharply than on $t = 2$; and the CAR [–10; 10] of the Finance industry –13.08% is more negative than the CAR of the Banking industry –12.85%. Concerns about uncertainty and social networks diffused the negative impact of the event on the Finance industry. In addition, the CAR of the Finance industry is statistically significant in event windows including: [0; 2]; [0; 4]; [0; 5]; [0; 6]; [–10; 5]. The leader was both the VCFB of ACB before his arrest and also the Chairman of the Boards of three financial companies [22], but all three of these companies were not listed on the market. Therefore, the reaction of financial stocks to this event is mainly influenced by psychological factors in the context

of uncertainty. This result rejects hypothesis H02, it shows that this event not only negatively affects the banking industry but also spreads a negative impact to the whole financial industry. At the same time, it also shows that the market is not efficient in the semi-strong form.

Non-financial industries: The AR of all seven non-financial industries were significantly negative at the event date $t = 0; 2$. At the event date, the non-financial industry's AR ranged from –5.7% (Oil & Gas) to –3.0% (Consumer Services). At day $t = 2$, the AR of these industries ranged from –5.4% (Oil & Gas) to –2.6% (Consumer services). Only the Health Care had AR [1] = –3.2% which was statistically significant. At $t = 4$, except for the Health Care and Consumer Goods, the AR of the remaining 5 industries were all statistically significant, including Consumer services (–2.1%); Industry and Materials are both –3.4%; Oil&Gas and Utilities are both –5.2%. Statistically significant CAR of non-financial industries is mainly concentrated on the [0; 2] window day. Except for Consumer Services and Utilities which are not statistically significant at any event window, the remaining sectors with significant CAR include Health Care (CAR [0; 2]); Industry (CAR [0; 2]); [0; 4]); Oil&Gas (CAR [0; 2]); Consumer Goods (CAR [0; 2]) and Materials (CAR [0; 2]). This result shows that although the arrest of former top managers of ACB is directly related to ACB in the banking industry, it not only affects ACB (Phuong, 2021b), the banking industry but also affects non-financial industries. This result is explained by Finance and Banking (Phuong, 2021) which are two industries with a high proportion in Vietnam's stock market. Therefore, the decline of these two industries will significantly affect the herd mentality of investors in the whole market, thereby affecting the AR of the remaining industries. This result rejects hypothesis H03, in favor of the inter-industry contagion effect and herd mentality to explain the stock market inefficiencies.

Comparing the reactions of the banking and other industries: When comparing the response of the same event to the stock returns of the banking industry with the stock returns of the other eight industries, it was found that differences in impact levels and persistent responses across industries. In other words, the research results reject Hypothesis H04. In terms of impact, most of the statistically significant AR of the banking industry in the event windows are larger in absolute value than in other industries except Oil&Gas and Utilities. The reaction of the Oil&Gas and Utilities industries, as measured by AR, was even higher than the reaction of the Banking industry on some days. The absolute value of the Oil&Gas AR is higher than that of the banking industry at three days $t = 0; 2; 4$; The absolute value of Utilities AR is higher than that of Banking at day $t = 4$. This result shows that the Oil&Gas industry and the Utilities industry are quite sensitive to events related to legal factors. Regarding the persistent reaction, it has been proven that the negative impact of this event is persistent on the Banking industry as the CAR of 9 consecutive event windows starting from the event date and are all significant. In the remaining 8 industries, the Finance industry was affected the longest when the CAR of 4 event windows ([0; 2]; [0; 4]; [0; 5]; [0; 6]) are statistically significant; Industry has two event windows, [0; 2] and [0; 4]; four sectors (Oil&Gas, Health Care, Consumer Goods, Materials) with event window [0; 2].

CONCLUSION AND RECOMMENDATIONS

Conclusion

The purpose of this article is to investigate how the announcement of the arrest of the VCFB and the former CEO of ACB affects the stock returns of the Banking industry, Financial and non-financial on VST. An event study is a method used to study the reactions of nine different industries in the stock market. Event windows are established for a period of –/+ 10 days around the event date and return each industry is considered in response to these event windows. Research results show that the legal events of people related to ACB are completely unexpected for the entire stock market. It is represented by AR being insignificant for all industries before the event is announced.

Recommendations

Legal events related to ACB caused the Banking industry to decrease by –10.3%, the Finance sector by –8.9% for the event window [0; 5], and the non-Finance industry to decrease significantly at the event window [0; 2] from –3.8% (Materials) to

–6.3% (Health Care). The sharp decline in share returns of most industries for a banking event showed the industry's role in Vietnam's stock market and the rapid spread of negative sentiment from one industry to other industries. This fact raises the need for clear regulations on cross-ownership for credit institutions, monitoring, and disclosure mechanisms to limit the impact and similar events occurring in the future. In addition, it is necessary to remove the exclusion in compliance with the supervisory framework and expand the supervision rights of bank-owning shareholders. For example, management agencies of credit institutions need to promptly remind and take actions when banks offer high-level leadership positions that are not recognized by law (such as VCFB). Vietnam's stock market is still quite young so far, so in order for the stock market to be sustainable and to avoid temporary herd-psychological effects, the regulatory agency in charge of the stock market needs to hold regular meetings. The seminars aim to improve the knowledge and analytical skills of the majority of investors in the VST.

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Tax on Digital Services: Assessment of the Advantage of the Introduction in Russia

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ABSTRACT

The topic of digital services tax (DST), applied in a number of foreign jurisdictions, remains relevant, and there is an active discussion in the scientific community on the advisability of introducing such a tax in Russia. The purpose of the study is to characterize the directions of the impact of such a tax on economic growth for the justification of the expediency of its introduction in Russia. The hypothesis is that the introduction of indirect DST will not lead to the withdrawal of part of the property of foreign digital giants in favor of the Russian budget, since the tax burden will be completely transferred to Russian consumers of these services, which in turn will have a negative impact on the economic growth of the domestic economy. The study of the theoretical foundations of DST and the practice of its application in foreign countries has revealed its inconsistency with the principles of neutrality and non-discrimination of taxation, the complexity of tax administration. Using economic and mathematical tools, a model was developed for transferring the tax burden when introducing DST from a foreign company to Russian clients of the platform and end consumers in Russia. A simulation experiment using Airbnb as an example showed that if a digital tax of 3% is introduced in Russia, Airbnb's profit indicator is potentially expected to grow (which will be taxed in the Netherlands); decrease in profits of Russian Airbnb clients (Russian hotels); increase in Airbnb's end-customer costs. Presumably, tolerable scenario is that the full burden of the digital tax will be passed on to domestic taxpayers due to the indirect nature of the digital tax. As a result of the study, the hypothesis about the lack of economic feasibility of introducing indirect DST in Russia was confirmed.

Keywords: digital tax; shifting the tax burden; foreign digital giants; taxation in the digital economy; economic growth; consumers of digital services

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INTRODUCTION

The existing system of international taxation is based on the fundamental assumptions that (1) transactions between business entities and their clients are of a physical nature, for which (2) it is necessary to have a physical place of activity where income is generated and (3) which is subject to distribution for tax purposes between the country of source of income and the country of residence of the taxpayer. These assumptions do not hold up in a digital economy which is characterized by an unprecedented reliance on intangible assets [1].

Outdated "tax connection" and source of income rules that require a physical presence to conduct business activities are not effective tools in light of the spread of digital business models [2]. The non-adaptability of the rules to modern challenges leads to financial consequences, including the lower effective tax rate for digital giants and the shortfall in tax revenues in countries [3]. By the beginning of 2019, this led to the understanding that the value chain for such business models has undergone significant changes and its participants rightly attract the tax base to countries where TNCs carry out sales even in the absence of a physical presence [4].

The discussion of the problems of taxation of the digital economy and the search for a solution agreed upon by the countries took a long time. Only as part of work on Action 1 of the BEPS plan,[1] the OECD has devoted more than 5 years to them. Many governments are tired of waiting for such a uniform approach and have developed their own taxation

[1] OECD, Action 1 Final Report 2015 — Addressing the Tax Challenges of the Digital Economy (OECD 2015), International Organizations' Documentation IBFD. URL: https://www.oecd.org/ctp/addressing-the-tax-challenges-of-the-digital-economy-action-1–2015-final-report-9789264241046-en.htm (accessed on 20.03.2021).

rules. And it is turnover taxes which include: the equalization levy and the digital services tax (DST), that have become the most popular of these rules,[2] in particular, after the proposal for such rules by the European Commission (EC), put forward in 2018.[3]

The proposal was presented with a 3% tax on income generated by large TNCs from services in a situation where the "core value" is said to be "created through user participation". With the exception of the UK DST, all national DSTs have been developed on the EU model.

Foreign researchers G. Kofler and J. Sinnig [5], M. Devereux [6], I. Grinberg [7] addressed the question of the impact of DST on the economy. They pointed out that the introduction of DST could pose a threat to the economic growth of states.

In domestic science, the idea of introducing a digital tax in Russia was put forward by the Center for Strategic Research [8], as well as in the works of D.A. Mitin [9, 10]. The experts concluded that such an additional indirect tax is appropriately in the Russian tax system.

In none of the conducted scientific studies, calculations of the impact of such a tax on economic growth, incentives for production, investment and consumption were presented for public discussion.

The introduction of DST in Russia remains a topical debatable issue, therefore, the further logic of our study is to analyze the directions of the impact of such a tax on economic growth. The hypothesis of the study is that the introduction of DST, indirect in nature, will not lead to the withdrawal of part of the property of foreign digital giants — digital service providers in favor of the Russian budget, since the tax burden will be completely transferred to Russian consumers of these services, which in turn will have a negative impact on the economic growth of the domestic economy. The author's methodological approach includes the following areas:

1) transfer of the tax burden under DST;

2) the impact of DST on small and medium-sized businesses (SME) in Russia;

3) the impact of DST on the economic growth of the country;

4) the possibility of eliminating multiple taxation;

5) preliminary results of the practice of introducing DST in other countries.

The need for a qualitative assessment of DST in each of the proposed areas is due to the high degree of uncertainty of the consequences of its introduction due to the indirect nature of the tax.

THEORETICAL ASPECTS OF TAX ON DIGITAL SERVICES

The OECD's Final Report on Action 1 of the 2015 BEPS Plan reflected the following position — as the digital economy increasingly permeates the entire economy, over time it will be difficult, if not impossible, to separate it from the rest of the economy for tax purposes.[4] At the same time, the application of a digital tax only to MNCs that use certain types of digital business models can even cause further "ring-fencing" of a part of the digital economy within the digital economy itself.

Back at the 1998 conference in Ottawa on the taxation, a number of principles were declared to be followed by an appropriate tax policy, including the principle of neutrality.[5] This principle provides that taxation should be neutral irrespective of the form and methods of economic activity selected by the taxpayer. In the situation with the digital economy, it is the use of business models that differ in the form of doing business that becomes a factor that determines the need for new rules. Violation of the principle of neutrality can influence the distortion of the economic decisions of taxpayers and, as a result, can slow down economic growth. Thus, the Singaporean authorities criticize the approach of introducing independent taxation measures for

[2] Fundamentally, these rules do not differ, however, the rules in India are generally referred to as the equalization levy and the EU rules as digital services tax.

[3] European Commission, Proposal for a Council Directive on the common system of a digital services tax on revenues from the provision of certain digital services, COM (2018) 148 final, Brussels, March 21, 2018. URL: https:// ec.europa.eu/taxation_customs/sites/taxation/ files/proposal_common_system_digital_services_tax_21032018_en.pd (accessed on 12.10.2021).

[4] OECD, Action 1 Final Report 2015 — Addressing the Tax Challenges of the Digital Economy (OECD 2015), International Organizations' Documentation IBFD. URL: https://www.oecd.org/ctp/addressing-the-tax-challenges-of-the-digital-economy-action-1–2015-final-report-9789264241046-en.htm (accessed on 20.03.2021).

[5] OECD (1998) OECD Ministerial Conference Ottawa, Progress Report on the OECD Action Plan for Electronic Commerce. URL: https://www.oecd.org/ctp/consumption/1923256.pdf (accessed on 22.03.2021).

digital MNCs, emphasizing the importance of the principle of neutrality between traditional and digital business models.[6]

Discrimination occurs even at the level of digital business models themselves, as digital tax rules target certain types of such models. DST in UK only targets three highly digitalized business models: search engines, social media platforms and marketplaces. The question arises why these particular services, and not other services, such as, for example, music and video streaming were chosen for taxation [11]. If the justification for imposing a tax on digital services is a user-created value, then a similar approach should be applicable to all business models whose value chain includes a user participation factor, or even, according to some authors [12], in relation to all sectors of the economy. The reform of the rules in the field of the digital economy should be aimed at all digital business models that receive economic profit from remote access to data of a significant part of the population of the source country [13]. OECD in its developments seeks to prevent the "ring-fencing" of the digital economy.

To calculate the tax liability of an MNC, it would be necessary to identify the business activities that are covered by each digital tax in a given country, then separate the revenues generated from such activities, and then calculate the amounts of these revenues attributable to users in a particular jurisdiction. This approach can require significant work to determine the tax liability in each jurisdiction. There is a need to reduce the range of subjects of taxation, which would allow SME to be taken out of the digital tax area.

The object of taxation is the sale of digital services. The issues of determining the object of taxation on the basis of the principle of the occurrence of taxation on the location of service users are complex, i.e. the user acts as a kind of factor in the emergence of a tax connection with the source country — to determine the place of taxation for both B 2B and B 2C supplies [14]. However, there are exceptions to this rule in relation to certain services, such as the services of sites for renting real estate — the source of revenue should be determined by the location of the property. Since it is there that the user consumes the service [15].

The introduction of DST requires the establishment of rules to determine the location of the user. Identified by IP addresses can lead to erroneous information because users may connect to a VPN server located in other jurisdictions in order to access more favorable rates. The existing VAT on digital services in some countries has led to situations where taxpayers create barriers to determining their location. While technological solutions can establish the true location of a user even when using a VPN, in general, consideration will need to be given to what level of user identification will be sufficient.[7]

QUALITATIVE ASSESSMENT OF THE NEED TO INTRODUCE A DIGITAL TAX IN RUSSIA

The attractiveness of introducing a digital tax into the tax system of the Russia is due to the significant popularity of the implementation of this proposal both among developed European countries and in developing countries suffering from a lack of budgetary funds. However, neither at the EU level, nor at the level of individual countries, the digital tax rules have been assessed in order to identify risks for the tax system and consequences for the economy as a whole. The lack of a comprehensive assessment of the proposal for a digital tax, including the effects of shifting and redistributing the tax burden, inflationary effects, as well as the long-term consequences of a digital tax in the context of Russia's strategic goals, is also noted by other domestic researchers [16].

Turning to the budget indicators of countries that have introduced/are introducing DST, one cannot fail to notice that countries with a budget deficit (Belgium, Spain, France, Italy, Hungary, UK)[8] are more interested in such measures. Countries with significant budget surpluses are not currently

[6] SMU-TA Centre for Excellence in Taxation Conference — Speech by Ms Indranee Rajah, Senior Minister of State for Law and Finance. URL: https://www.iras.gov.sg/irashome/News-and-Events/Newsroom/Media-Releases-and-Speeches/Speeches/2017/SMU-TA-Centre-for-Excellence-in-Taxation-Conference—-Speech-by-Ms-Indranee-Rajah — Senior-Minister-of-State-for-Law-and-Finance/ (accessed on 21.10.2021).

[7] Sean Lowry, Congressional Research Service, Digital Services Taxes (DSTs): Policy and Economic Analysis. URL: https://crsreports.congress.gov/product/pdf/R/R 45532/1 (accessed on 12.10.2021).

[8] Eurostat. URL: https://ec.europa.eu/eurostat/web/national-accounts/data/main-tables (accessed on 12.10.2021).

considering introducing such a tax (e.g. Germany, Denmark, Bulgaria). Obviously, countries want to strengthen in this indicator and are looking for new sources of income. However, it should be borne in mind that budget revenues are not expected to be significant during DST start periods — projected revenues in countries where DST has been introduced / planned to be introduced do not exceed 0.1% of all tax revenues [17].

According to the authors, if it is recognized that it is expedient to introduce DST in a jurisdiction, it is necessary:

- to pay special attention to the minimum thresholds used to determine the circle of taxpayers in order to protect not so large-scale domestic business from its influence, it is recommended to set a threshold not in relation to the total amount of revenue, but in relation to the amount of revenue from digital services;
- provide mechanisms for the elimination of double taxation: it is necessary to provide for the deduction from the tax base for income tax of both the national DST and the DST paid abroad;
- establish rules that include approaches to determining the source of income and to identifying the location of users so that there is no uncertainty for taxpayers.

To resolve the issue of the advisability of introducing DST in Russia, it is necessary to analyze and evaluate the following points.

(1) How will the DST tax burden be distributed, and what consequences can this have?

It is important to take into account that, by its nature, DST is a tax levied on turnover and it has the nature of an indirect tax [18]. This means that it can have a significant adverse effect on increasing the overall effective tax burden, on shifting the balance of competition not in favor of small and medium-sized businesses.

It is the effect of a significant shift of the fiscal burden on consumers and a possible additional increase in the cost of services even above such a new burden that is typical for taxes levied on turnover [19]. The introduction of DST will affect not only the conduct of business by the giants of digital industries, but also domestic SMEs. In the work of Bergmann and Hansen [19], it is substantiated that the introduction of indirect taxes can lead to such an increase in prices that exceeds the initial tax increase.

(2) What impact will DST have on Russian SMEs?

In fact, the tax burden will be consistently shifted by digital service providers — the largest digital companies to customers of such services — SMEs and, ultimately, to end users. According to a study by German economists regarding the impact of DST on the German domestic market: the tax burden of DST will be partly, if not completely, shifted from digital platforms to German businesses, and ultimately to German consumers and investors [20].

The possibility of such an outcome is also supported by the statement by Amazon's Director of International Tax Policy that the company has notified more than 10,000 French companies selling goods through Amazon online stores of a 3% price increase for Amazon services when it was expected to introduce digital tax in France.[9] It was noted that the French DST will require companies to implement new complex transaction reporting systems.

(3) How will the introduction of DST affect the country's economic growth and innovation?

New digital companies are actively involved in the development of various sectors of the economy. The real economic benefits for companies using digital business models are created not only where these companies are located. Benefits are also created where services and innovations are consumed. The impact of DST may reduce the digital business activity of companies in countries, which will affect employment and tax revenues from companies using digital technologies (for example, SMEs). This will also affect tax revenues from personal income received in the digital industry and not only.[10]

(4) How will multiple taxation be eliminated?

The introduction of DST may lead to an increase in cases of multiple taxation of the same income. The reduction in the ability to offset DST with another

[9] Amazon, Facebook and Google hit back at tax on digital companies' sales, warn of trade wars. URL: https://www.abc.net.au/news/2019–09–03/french-tax-on-tech-giants-sales-could-spark-a-new-trade-war-and/11471756 (accessed on 15.10.2021).

[10] Report on France's Digital Services Tax Prepared in the Investigation under Section 301 of the Trade Act of 1974. URL: https://ustr.gov/sites/default/files/Report_On_France%27s_Digital_Services_Tax.pdf (accessed on 01.10.2021).

tax liability puts foreign companies providing digital services at a disadvantage compared to local companies that also provide similar services domestically, as the tax burden of foreign companies will be higher [21].

The introduction of such a new tax would allow it to go beyond the rules on distribution of tax powers established in tax treaties. So, according to the criteria of the OECD Model Convention on classifying taxes as taxes on income and the characteristics of a tax on digital services, the latter is much more reminiscent of a turnover tax than an income tax [18], which goes beyond the regulation of situations where double taxation agreements on the avoidance of double taxation [5]. As a consequence, this may increase the number of tax disputes regarding multiple taxation.

In order to reduce the degree of double taxation, it is necessary that the country of residence provides for appropriate measures. Therefore, in order to mitigate multiple taxation, it is necessary to provide for the deduction of the national DST from the tax base in the country of residence (for example, in the UK there is such a mechanism).[11] It is worth noting that not all countries that plan to introduce DST support this approach. The draft DST law in Italy does not provide for the elimination of double taxation [22].

(5) What evidence is there that DST has been introduced in other countries?

Some of the countries that have already introduced DST projected budget revenues from such a tax. Despite the fact that the predicted values are only 0.3–1.6% of tax revenues from income tax,[12] DST is an additional source of budget revenues.

However, after pressure from the United States, the above countries agreed to the temporary operation of the DST and its cancellation when the rules of the OECD Unified Approach are introduced.[13] This is an additional argument about the inexpediency of developing DST rules in Russia.

ECONOMIC AND MATHEMATICAL MODEL OF THE TRANSFER OF THE TAX BURDEN OF THE DIGITAL TAX ON CONSUMER

The authors propose using economic and mathematical tools to assess the degree of transfer of the tax burden when introducing DST from a foreign company — a provider of "digital" services to Russian clients of the platform and end users (*Table 1*). Assume that tax will be levied on the proceeds of a foreign company at a tax rate of 3%.

We will demonstrate the calculation experiment using the example of Airbnb (*Table 2*).

Transferring the burden to the client. We assume that the platform will have to decide on the share of the tax that will be passed on to the platform client (advertiser) by increasing the commission rate. In turn, an increase in the commission rate is likely to affect the number of sellers using the marketplace (i.e. an increase in the commission rate will make the marketplace less attractive and some sellers may decide to leave it and use other ways to market). As a rule, companies increase the commission rate by the amount of new tax liabilities, as well as the administrative burden caused by the introduction of such a tax, and at the same time slightly raise the price at this point, which is not so noticeable to customers. So we assume that this burden-shifting is 100%.

Shifting the burden to the end user. Platform customers will now pay higher fees than before. They will decide how much of this cost increase will be passed on to their own consumers by raising the price of the goods they sell and the services they provide. In turn, an increase in commodity prices will cause a volume effect, the magnitude of which will depend on the price elasticity of consumer demand.

Then the calculation of the shifting of the fiscal burden will look as follows.

I. Determine the change in the profit of a foreign digital platform when DST is introduced:

Let us calculate the gross revenue of a foreign company generated with the participation of Russian

[11] UK CT Deductibility of DST. URL: https://www.gov.uk/hmrc-internal-manuals/digital-services-tax/dst47100 (accessed on 10.10.2021).

[12] Compiled by the author based on data URL: https://www.bmf.gv.at/steuern/WFA_DiStG_Beg.pdf?6x1a08; https://www.gov.uk/government/publications/introduction-of-the-digital-services-tax/digital-services-tax; https://www.pwc.com/gx/en/tax/newsletters/tax-policy-bulletin/assets/pwc-italy-2019-budget-law-introduces-a-digital-service-tax.pdf (accessed on 12.10.2021).

[13] OECD/G20 Base Erosion and Profit Shifting Project. Statement on a Two-Pillar Solution to Address the Tax Challenges Arising from the Digitalisation of the Economy. 8 October 2021. OECD (2021). URL: https://www.oecd.org/tax/beps/brochure-two-pillar-solution-to-address-the-tax-challenges-arising-from-the-digitalisation-of-the-economy-october-2021.pdf (accessed on 19.10.2021).

Table 1

Economic and Mathematical Model of Transferring the Tax Burden to Platform Clients and End Consumers

1	2
Model Input	R_0 — gross revenue of the company before the introduction of the digital tax π — gross profit τ_d — digital tax rate c_0 — commission rate before digital tax c_1 — commission rate after digital tax introduction E_d – elasticity of demand E_s — supply elasticity ru — share of Russian platform users k_{eu} — share of the transfer of the tax burden to the final consumer (defined as $\frac{E_d}{E_{s+E_d}}+1$) k_{pc} — share of the transfer of the tax burden to the platform client δ — relative increase in revenue due to a 1% increase in commission
required values	R_1 — the company's gross revenue generated with the participation of Russian users R_2 — company's adjusted gross revenue generated with the participation of Russian users
Estimating the change in platform profits with the introduction of a digital tax (R_2)	The initial gross revenue of the company generated with the participation of Russian users (formula 1): $R_1 = R_0 \times ru$ (1) Company's Adjusted Gross Revenue, R_2 (formula 2): $R_2 = R_1 \times \left\{\left[1+(k_{eu}\times(c_1\times k_{pc}-c_0))\right]\times \times\left[1+(k_{eu}\times(c_1\times k_{pc}-c_0)\times E_d\right]+\delta\right\}$ (2)
Estimation of changes in the profit of the company's customers (P_{cl})	Decrease in gross profit indicator (formula 3): $P_{cl} = \frac{R_1}{c_0}\times(1-c_0)\times(1-0{,}1)- -\frac{R_1}{c_0}\times\left\{\left[1+(k_{eu}\times(c_1\times k_{pc}-c_0))\right]\times\left[1+(k_{eu}\times(c_1\times k_{pc}-c_0)\times E_d\right]\right\}\times \times(1-c_1)\times(1-0{,}1)$ (3)
Assessment of changes in costs at the end consumer (E_{cus})	Cost increase (formula 4): $E_{cus} = \frac{R_1}{c_0}\times\left\{\left[k_{eu}\times(c_1\times k_{pc}-c_0))\right]\times \times\left[1+(k_{eu}\times(c_1\times k_{pc}-c_0)\times E_d\right]\right\}$ (4)

Source: Compiled by the author.

users of its services using formula (1). In order to simplify calculations, we will define this indicator as the total revenue after the introduction of the tax, multiplied by the share of Russian users of the platform.[14] Then the gross revenue will be 306 million dollars:

$R_1 = R_0 \cdot ru = 3.4$ billion dollars $\times 0.09 = 0.306$ billion dollars.

The total revenue after the introduction of the digital tax due to the increase in the commission by 1% also grows by 6.25% in proportion to the increase in the commission, in addition, it will also be adjusted for changes in demand for platform services due to the rise in the cost of access to it.

Substitution of metrics in the formula (2):

$$R_2 = R_1 \times \left\{\left[1+(k_{eu}\times(c_1\times k_{pc}-c_0))\right]\times \times\left[1+(k_{eu}\times(c_1\times k_{pc}-c_0)\times E_d\right]+\delta\right\}, \text{we get}$$

$$R_2 = 0.306\times\left\{\left[1+(0.77\times(0.16\times 1-0.15)\right]\times \times\left[1+(0.77\times(0.16\times 1-0.15)\times(-0.52)\right]+0.0625\right\} = = 0.326 \text{ billion dollars.}$$

[14] Since such data is not publicly available for Airnbnb, it seems possible to rely on Booking.com data for which the share of Russian users is 9%. URL: https://www.similarweb.com/website/booking.com/#overview https://www.statista.com/statistics/1261943/booking-com-traffic-russia/ (accessed on 05.10.2021).

Then the increase in revenue will be:

326 million dollars — 306 million dollars = = 20 million dollars.

In this case, DST will be:

326 million dollars × 3% = 9.78 million dollars.

Gross profit from electronic services of the digital platform before the introduction of DST in relation to Russian users will be:

2.5 billion dollars × 0.09 = 225 million dollars.

Therefore, assuming that the costs of the digital platform do not increase, the change in the profit of the platform will be expressed as follows:

(225 million dollars × 1.0625 – 9.78 million dollars) — 225 million dollars = 4.3 million dollars.

Consequently, as a result of the introduction of DST in Russia, a potential increase in the profit indicator of a foreign organization — a provider of "digital" services by 1.91% is expected

$$(\frac{4.3 \text{ million dollars}}{225 \text{ million dollars}} \times 100\%).$$

II. Determine the change in the profit of Russian clients of a foreign company — a service provider (Russian hotels):

1. Gross revenue before the introduction of DST will be:

$$\frac{R_1}{c_0} = \frac{306 \text{ million dollars}}{15\%} = 2.04 \text{ billion dollars.}$$

Net income will be:

2.04 billion dollars x (1–0.15) = 1.73 billion dollars.

Gross profit will be:

1.73 billion dollars x (1–0.1) = 1.56 billion dollars.

2. Taking into account the above intermediate calculations ($\frac{R_1}{c_0} = 2.04$ billion dollars), gross revenue after the introduction of DST, calculated by formula (3), will be:

$$P_{cl} = \frac{R_1}{c_0} \times (1 - c_0) \times (1 - 0.1) -$$
$$- \frac{R_1}{c_0} \times \left\{ \left[1 + (k_{eu} \times (c_1 \times k_{pc} - c_0)) \right] \times \right.$$
$$\left. \times \left[1 + (k_{eu} \times (c_1 \times k_{pc} - c_0) \times E_d \right] \right\} \times$$
$$\times (1 - c_1) \times (1 - 0.1) =$$
$$= \frac{306}{0.15} \times (1 - 0.15) \times (1 - 0.1) -$$
$$- \frac{306}{0.15} \times \left\{ \left[1 + (0.77 \cdot (0.16 \times 1 - 0.15)) \right] \times \right.$$
$$\left. \times \left[1 + (0.77 \times (0.16 \times 1 - 0.15) \times (-0.52) \right] \right\} \times$$
$$\times (1 - 0.16) \times (1 - 0.1) = 12.1.$$

The decrease in gross profit will be:

12,1 million dollars.

Calculations show that as a result of the introduction of DST in Russia, the profit of Russian

Table 2

Initial Data for Testing the Economic and Mathematical Model on the Example of Airbnb

$R_0 = 3.4$ billion dollars – the company's gross revenue before the introduction of the digital tax

$\pi = 2.5$ billion dollars – gross profit

$\tau_d = 0.03$ – digital tax rate

$c_0 = 0.15$ – commission rate before digital tax

$c_1 = 0.16$ – commission rate after digital tax introduction

$E_d = -0.52$ – elasticity of demand*

$E_s = 1.75$ – supply elasticity**

$ru = 0.09$ – share of Russian platform users

$k_{eu} = 0.77$ – share of the transfer of the tax burden to the final consumer (defined as $\frac{E_d}{E_{s+E_d}} + 1$)

$k_{pc} = 1$ – share of the transfer of the tax burden to the platform client

$\delta = 0.0625$ – relative increase in revenue due to a 1% increase in commission.

Source: Compiled by the author.

* Inferring Tax Compliance from Pass-through: Evidence from Airbnb Tax Enforcement Agreements, Department of Economics Working Papers 2018, McMaster University. URL: https://socialsciences.mcmaster.ca/econ/rsrch/papers/archive/2018–06.pdf (accessed on 12.09.2021).

** Inferring Tax Compliance from Pass-through: Evidence from Airbnb Tax Enforcement Agreements, Department of Economics Working Papers 2018, McMaster University. URL: https://socialsciences.mcmaster.ca/econ/rsrch/papers/archive/2018–06.pdf (accessed on 12.09.2021).

clients of a foreign company — a service provider (Russian hotels) will decrease by 1.1%.

III. Let us determine the change in costs for the end consumer of a foreign company's digital services.

Substituting the values of indicators into formula (4), we obtain:

$$E_{cus} = \frac{R_1}{c_0} \times \left\{ \left[k_{eu} \times \left(c_1 \times k_{pc} - c_0 \right) \right] \times \right.$$

$$\left. \times \left[1 + \left(k_{eu} \times \left(c_1 \times k_{pc} - c_0 \right) \times E_d \right] \right] \right\} =$$

$$= 2.04 \text{ billion dollars} \times \left\{ \left[\left(0.77 \times \left(0.16 \times 1 - 0.15 \right) \right] \right] \times \right.$$

$$\left. \times \left[1 + \left(0.77 \times \left(0.16 \times 1 - 0.15 \right) \times \left(-0.52 \right) \right] \right] \right\} =$$

$$= 15.6 \text{ million dollars.}$$

Calculations show that with the introduction of DST in Russia in the amount of 3%, the costs of end users of the services of a foreign supplier will increase by $ 15.6 million.

CONCLUSIONS

The calculations show that with the introduction of DST, the final changes in the costs of all participants in the consumption of digital services will be greater in amount than DST levied. This is due to the fact that foreign digital platforms in response to the introduction of the tax may increase the commission, which exceeds the amount of the tax. The fiscal burden of DST will eventually be shifted to the final consumers of services, as is usually the case with indirect taxes, as well as to the company's customers — SMEs. A foreign company — a provider of "digital" services will receive additional profit.

Since digital marketplace services are largely consumed by SMEs that operate low-margin businesses and often have limited ability to pass the tax burden on to consumers, it is these companies that may suffer the most, risking their profitability and solvency.

Therefore, there is a risk that DST will further shift the balance of competition between large and small firms in favor of the former.

The qualitative assessment of DST indicates that its introduction did not meet the objectives of the tax policy of the Russian Federation, since it contradicts the objectives of stimulating the development and support of SME.[15] The introduction of DST can backfire on economic growth through the indirect nature of the tax. We believe that the introduction of an indirect digital tax in Russia is not economically feasible.

[15] The main directions of the budget, tax and customs tariff policy for 2022 and for the planning period of 2023 and 2024. Ministry of Finance of the Russian Federation, 2021. URL: https://minfin.gov.ru/common/upload/library/2021/09/main/ONBNiTTP_2022–2024.pdf (accessed on 20.02.2022).

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ORIGINAL PAPER

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Assessment of Interregional Inequality of Tax Revenues

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ABSTRACT

Efficiency of economic activity of 85 regions of the Russian Federation is analyzed in this article. The **purpose** of the research is assessment the interregional inequality of the Russian regions. The analysis was based on the total tax revenues collected within all the Russian regions. The research was based on **methods** of analysis and synthesis, analogy and generalization, comparison and comparison, induction and deduction, economic-mathematical and statistical methods of estimation of income inequality. For its implementation, coefficients and indices were used: Lorentz, Ginny, Robin Hood, Theil, Atkinson, and Herfindahl-Hirschman. Part of the analysis was performed in the analytical module of the information system "Taxes of the Russian Federation". Based on the Russian Federation subjects' economic activity model, it is concluded that the total tax revenues collected on regions reflect the effectiveness of its functioning. A more accurate picture is described with the quotient of the tax revenues' division by the labor resources engaged in their creation. Based on the methods used and data provided by the Federal Tax Service of the Russian Federation and Rosstat, was made of the uniformity of tax revenue collection among 85 subjects of the Russian Federation in the period from 2015 to 2020, all applied coefficients and indices were calculated. Using the share of employed population and tax revenues, the Lorenz curves and size diagrams (box plot) for the ratio of these shares (*r*) in the period under consideration are constructed and the emissions (outlier) in the distribution of tax revenues are determined. The dynamics of tax revenues and their variation are estimated. The obtained values of inequality indicators and indices showed that the distribution of tax revenues among 85 regions of the Russian Federation is uneven. Simultaneously, this situation is evident throughout the period under review. The subjects whose tax income values can be attributed to outliers have been identified. It is **concluded** that the problem of uneven development of regions of the country is traced through centuries. A way out of this situation is to use differentiated financial and tax policies in relation to different regions of the country.

Keywords: income differentiation; Lorentz curve; Gini coefficient; Theil index; tax revenues; employed population

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INTRODUCTION

Today, research and monitoring of the economic condition' regions of our country is a very urgent problem. The economic development of the federal subjects is influenced by numerous internal and external factors. The main ones are: decline in economic growth as a result of the impact of the COVID-19 pandemic, complication of the geopolitical situation and the imposition of numerous sanctions. In this regard, it is necessary to closely monitor the level of economic development of the regions of Russia and identify factors that can stimulate or hinder their economic development.

In our country there are different opinions about the future of the Russian economy. For example, G. B. Kleiner points to significant economic problems such as: "Low growth rate, insufficient innovation activity, reduced purchasing power of a large part of the population, etc." [1, p. 113]. The scientist assigns a very important role to the meso-level in the development of the country's economy, considering it "an indispensable tool for integration and coordination of economic processes and objects" [1, p. 112]. Problems of mesoeconomic level are connected with "discoordination of economic agents, and excessive differentiation of economic condition of regions and sectors of national economy" [1, p. 114]. Aspiration thesis "to equalize regions in terms of their socio-economic condition" are declared [1, p. 117]. Quantitative assessment of this thesis, based on data provided by the Federal Tax Service of the Russian Federation and Rosstat, will be the main purpose of the article.

A similar point of view in the late XIX century was expressed by the eminent Russian scientist and financier N. P. Yasnopol'skii. Research in the field of regional finance is devoted to his work "On the geographical distribution of state revenues and expenditures of Russia" [2]. The main idea of this article is the uneven burden for the different localities of Russia, the extreme burden of the agricultural center without appropriate compensation, as well as the concentration of government expenditures in the capitals and outskirts. N. P. Yasnopol'skii wrote: "I was trying to find out the different meaning that the same Russian financial system had for the different localities of our homeland" [2, p. 1].

In one of his speeches, the President of the Russian Federation, V. V. Putin, stated the need to support regions that have taken a course towards sustainable development: "The stimulating role of federal support should be strengthened and, I [V. V. Putin] emphasize, the financial autonomy of those regions that are properly concerned with economic development, conduct responsible budget policy, develop regional programs, modernize the social sphere. That is, it is necessary to give more space for leaders, for the initiative of those who are willing to work, do actively and works effectively".[1]

The presented facts, on the one hand, confirm the relevance of the research through the centuries, the problems of economic stratification of the regions of Russia, and on the other, partially describe the factors causing it, which can be attributed to: climatic, socio-demographic, regional and even administrative aspects. On this basis, the main purpose of the proposed work, as well as the subject and object of the research, are formed.

METHODS

In this regard, the purpose of the research is to assess the interregional inequality of the regions of the Russian Federation, based on the analysis of tax revenues collected within their borders. 85 regions of the Russian Federation were the object of research, and the subject is socio-economic processes changes in their territories.

[1] Russian Prime Minister V. V. Putin held a meeting on the improvement of inter-budgetary relations. URL: http://bujet.ru/article/112142.php (accessed on 03.08.2022).

Methodological basis of research was the general scientific methods of cognition: analysis and synthesis, analogy and generalization, compare and contrast, induction and deduction. Economic-mathematical and statistical methods were chosen as special methods of cognition. Statistical methods of data processing are research private science methods based on the application of coefficients and indices measure of income inequality, such as: Lorenz and Gini coefficients, Robin Hood, Theil, Atkinson and Herfindahl-Hirschman indices.

Next, the concept of economic inequality and the methods used to measure it will be considered. For two centuries there has been a constant interest on the part of the scientific community in the research of issues related to economic inequality. At the same time, economists are primarily interested in wealth inequality and income inequality [3, p. 89; 4, p. 5]. As early as 1905, the American mathematician and economist Max Otto Lorenz shows a degree of personal income inequality and constructs a graph called the Lorenz curve. Note that socio-economic inequality refers to the unequal distribution of income, wealth, opportunities, etc. between different social groups.

This economic direction is very relevant to date. It is devoted to numerous works of domestic [5, p. 72; 6, p. 46] and foreign authors [7, p. 5; 8, p. 555]. The application of coefficients and indices is discussed further. The Lorenz coefficient for studying economic inequality is applied in the works [9, c. 141; 10, c. 101; 11]. The Gini coefficient is used to study income inequality in articles [12, p. 75; 13]. The Robin Hood index is considered in the source [14, p. 80] as an effective tool for smoothing regional economic inequalities, and in the work [15, p. 134] it is applied to the analysis of the level of social inequality in the regions.

Interregional inequality in Russia based on the Theil index assessed in the paper [16, p. 20]. The analysis of regional inequality in the Russian Federation is given in the papers [17, p. 481; 18, p. 82], and in the source [19, p. 202] similar research was conducted for a developing Latin American country like Brazil. The indexes described may be applicable not only to the economy but also to other subject areas [20, p. 74].

Note that there are works whose authors are critical to the use of quantitative indicators of income inequality. Thus, the article [21, p. 91] states: "...that at present statistical measures of inequality do not give unambiguous results".

As shown above, a lot of indicators exist for measure inequality, each of which has certain advantages and disadvantages. Therefore, when analyzing the inequality of a resource, it is logical to use different quantitative indicators, comparing the results of calculations. As a rule, quantitative measures of inequality describe the distribution of a selected resource among a set of objects that make up a certain social commonality, and to some extent imply a comparison with a case of equitable distribution. 85 regions of our State will act as a set of objects in this research.

RESULTS

The data for the research was freely provided socio-economic information distributed by the Federal Tax Service of the Russian Federation and Rosstat. Tax revenue data (TR) is obtained from the tax reporting form No. 1–NOM "Accrual and revenues of taxes and fees in the consolidated budget of the Russian Federation for foreign economic activities".[2] The number of employed population (EP) is presented in collections of Rosstat "Regions of Russia. Socio-economic indicators".[3] The basic formation used in calculations is consolidated into the database of the information system

[2] Otchet po forme 1-NOM po sostoyaniyu na 01.01.2021. Report on Form 1 as of 01.01.2021. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022).

[3] Federalnaya sluzhba gosudarstvennoi statistiki RF. Federal State Statistics Service RF. URL: https://rosstat.gov.ru/folder/210/document/13204 (accessed on 11.08.2022).

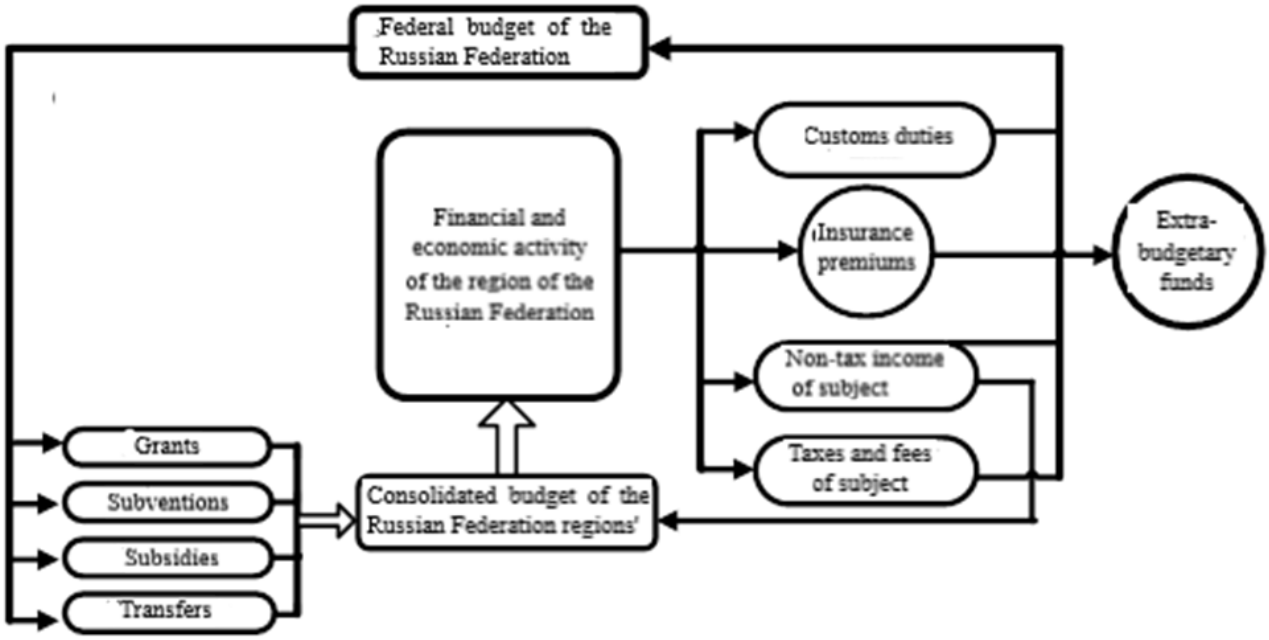

Fig. 1. **Model of Economic Functioning of the Russian Federation's Regions**

Source: Model was created by the authors [23, p. 125].

"Taxes of the Russian Federation" [22]. Some calculations were also made using the analytical module of the information system.

Further assessment of inequality economic activity of regions of the Russian Federation will be based on the thesis that the value of TR reflects the effectiveness of their functioning. On the basis of the proposed thesis, it is possible to successfully intersubjective comparison. The authors of the article developed a conceptual model of economic activity of any of the regions of our country (*Fig. 1*). It follows from the model that the economic and financial activity of any province, region or republic is: tax revenues, insurance premiums and customs payments. Funds received are allocated to budgets at all levels, as well as come to extrabudgetary funds. These funds are outputs of the system. Inputs of the system are payments from the federal budget to the income of the consolidated budget of subject of the federation and payments from the federal budget, such as: grants, subsidies, subventions and transfers.

In the proposed work, the quantitative analysis is based on data on the total tax revenues of the regions of the Russian Federation (in other words, tax revenues from regions) to the state budget and the employed population. Tasks of monitoring and research of problems of elimination of inequality in tax revenues from regions of the Russian Federation, as well as development of methods and techniques of its measurement are still very relevant.

The indicators to measure interregional inequality, which use information on the total distribution of tax revenues, i.e. those calculated for all units or their groups, will be considered below. The calculations used data on tax revenues of regions of the Russian Federation and the number of employed population of the Russian Federation for the period 2015–2020. Note that Rosstat provides data on the employed population with a delay of two years, which is one of the basic indicators used in the calculations.

The measurement of inequality of tax revenues gets started with the Gini coefficient k_G, perhaps the traditional most common indicator of inequality. This indicator, as any other, has both advantages and disadvantages [24, p. 71; 25, p. 35]. Coefficient values range

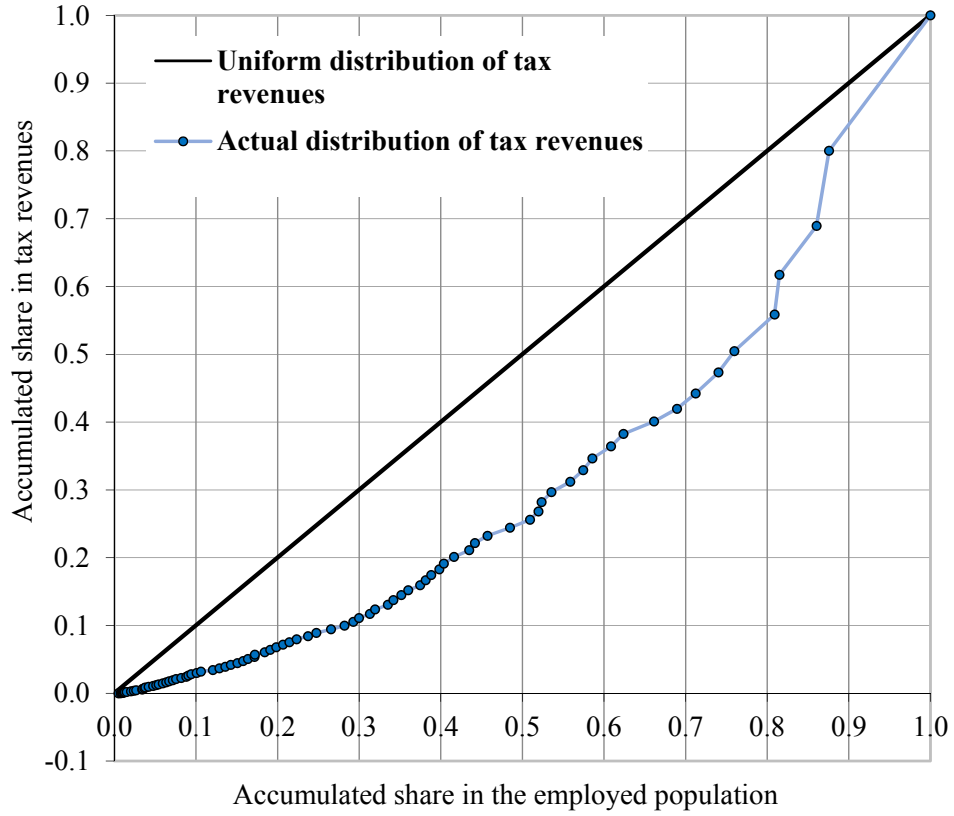

Fig. 2. **Lorentz Curve of Distribution Tax Revenues of the Russian Federation's Regions in 2020**

Source: Calculations of the authors according to the data of the Federal Tax Service of the Russian Federation and Rosstat. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022); URL: https://rosstat.gov.ru/folder/210/document/13204 https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022).

from 0 to 1, approaching to one with increasing number of observations. The maximum value of k_G equal $(N-1)/N$. The Gini coefficient is understandable and can be visually represented by the Lorenz curve. *Fig. 2* presents distribution of tax revenues from 85 regions of the Russian Federation in 2020. It can be seen that the Lorenz curve deviates very significantly from the straight line reflecting the uniform distribution of tax revenues of the regions of Russia. Note that the Lorenz coefficient was 0.307, the Gini coefficient — 0.340.

The Lorenz curve provides another quantitative measure of income inequality — Robin Hood index k_R. This indicator has other names, for example, Hoover index, Pietra index. The index k_R is equal to the share of the total TR of all regions of the Russian Federation, which must be redistributed to achieve uniform tax revenue (Hoover index values are in the range $0 \le k_R < 1$). Graphically, this indicator can be represented as the longest vertical segment (*Fig. 2*), connecting points on the Lorentz curve to the uniform distribution line, and the value of the Robin Hood index — as the length of this segment. Note that in 2020 the value $k_R = 0,270$.

When constructing the Lorentz curve, it is possible to determine another indicator of inequality of tax revenues in the regions. This is the Lorenz coefficient:

$$k_L = 0,5 \cdot \sum_i \left| d_i^{tr} - d_i^{ep} \right|, \quad (1)$$

where d_i^{tr} — tax revenue share of the *i*-region; d_i^{ep} — share of employed population of the *i*-region.

Possible Lorenz coefficient values belong to the interval [0–1].

The next class of indicators to assess the inequality of tax revenues of the regions of the Russian Federation can be obtained from the ratio of individual quantiles distribution. The most popular of this class of indicators is the decile coefficient k_d, which is the ratio of the lowest value of tax income among 10% (ninth decile d_9) regions [$min(d_9)$ with the highest TR to the highest income among the 10% lowest income regions ($max(d_1)$)].

To assess the inequality of tax revenues from regions of the Russian Federation we use another indicator — Herfindahl-Hirschman index. This is one of the few economic indicators that is used to assess the degree of market concentration, the share of companies or industries when comparing volume of their products. Here, this indicator k_H will reflect the shares of tax revenues from regions of the Russian Federation. The following formula was used to calculate the Herfindahl-Hirschman index:

$$I_{HH} = \sum_i d_i^2, \quad (2)$$

where d_i — tax revenue share of *i*-region.

Herfindahl-Hirschman values range from 1/*n* to 1, where *n* — is the number of regions of the Russian Federation $n = 85$ in this research).

As a measure of income inequality in society, indicators are also used that can be considered as a special case of a generalized entropy index. These include the Theil index k_T. In this paper, this indicator was calculated by the formula:

$$I_T = \sum_i d_i \ln(nd_i), \quad (3)$$

d_i — tax revenue share of the *i*-region;

n — number of regions of the Russian Federation.

The Theil index formula k_T shows, that in the case of an even income distribution, the index value will be $I_T = 0$, and is the smallest value, and the highest value — $I_T = ln(n)$. Since the highest value of the Theil index is unlimited, one can consider the Atkinson index k_A, which is in fact a normalized Theil index:

$$I_A = 1 - exp(-I_T). \quad (4)$$

Thus, in the analysis of the dynamics of inequality of tax revenues in 2015–2020, the following indicators were used: Gini index I_G, Robin Hood index I_R, Lorenz coefficient k_L, decile coefficient k_d, Herfindahl-Hirschman index I_{HH}, Theil I_T and Atkinson I_A. Add to this list such common statistical indicators of tax revenues: average $\bar{x}$, median *Me*, standard deviation σ and coefficient of variation $V = \sigma/\bar{x}$. Note that the Herfindahl-Hirschman index and the coefficient of variation are related as follows:

$$I_{HH} = \frac{V^2 + 1}{n}. \quad (5)$$

Consider the results of the quantitative analysis of tax revenues, the comparison of actual data with the uniform distribution, including the use of these indicators. It has already been noted above that for visual comparison of the actual distribution of tax revenues and the uniform distribution it is convenient to use the Lorentz curve. However, when such a comparison has to be considered in the dynamics, the Lorentz curve is not very useful. When constructing the Lorentz curve, the share of tax revenues of the *i*-region d_i^{TR} and the share of employed population of the *i*-region d_i^{EP} are used. Let's use these indicators and find the ratio of the share of tax revenues and the share of employed population of the *i*-region: $r_i = d_i^{TR} / d_i^{EP}$. Note that in uniform distribution of income for all subjects the value $r_i = 1$. *Fig. 3* visually shows the box-and-whiskers diagram for the resulting indicator.

It can be seen that for some subjects (4 to 7 depending on the year under consideration) the values of *r* can be attributed to "outliers" (these values are marked with dots). *Fig. 3* also shows the box-and-whiskers diagram, but without

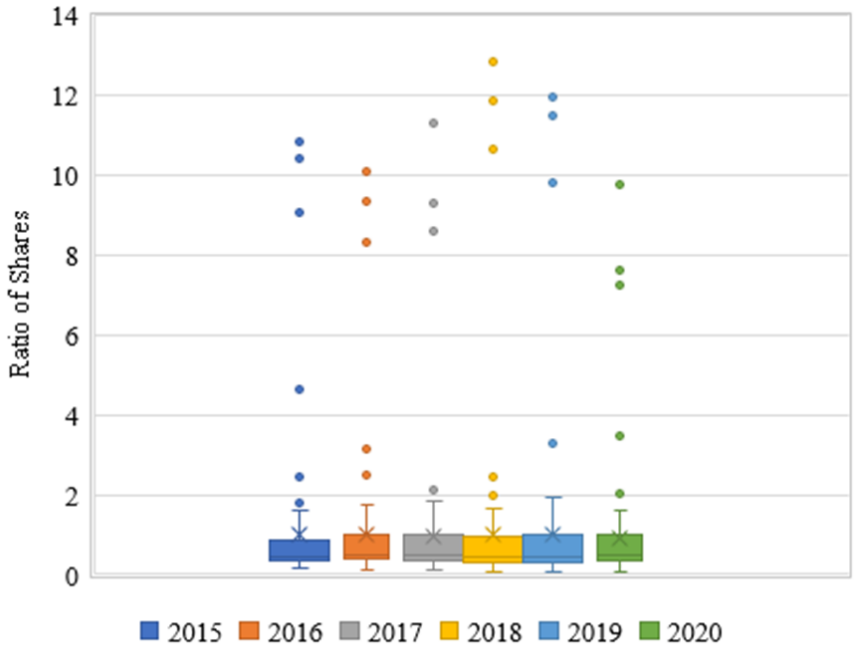

Fig. 3. **Box-and-Whiskers Diagram for the Ratio of *r* Shares in 2015–2020**

Source: Calculations of the authors according to the data of the Federal Tax Service of the Russian Federation and Rosstat. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022); URL: https://rosstat.gov.ru/folder/210/document/13204 https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022).

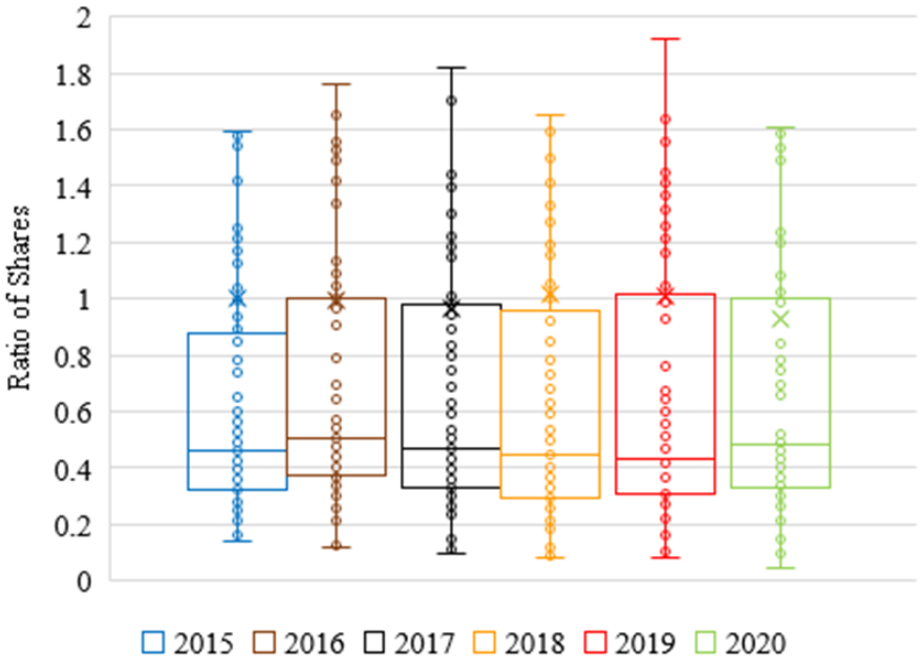

Fig. 4. **Box-and-Whiskers Diagram for the Ratio of *r* Shares Without Outliers**

Source: Calculations of the authors according to the data of the Federal Tax Service of the Russian Federation and Rosstat. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022); URL: https://rosstat.gov.ru/folder/210/document/13204 https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022).

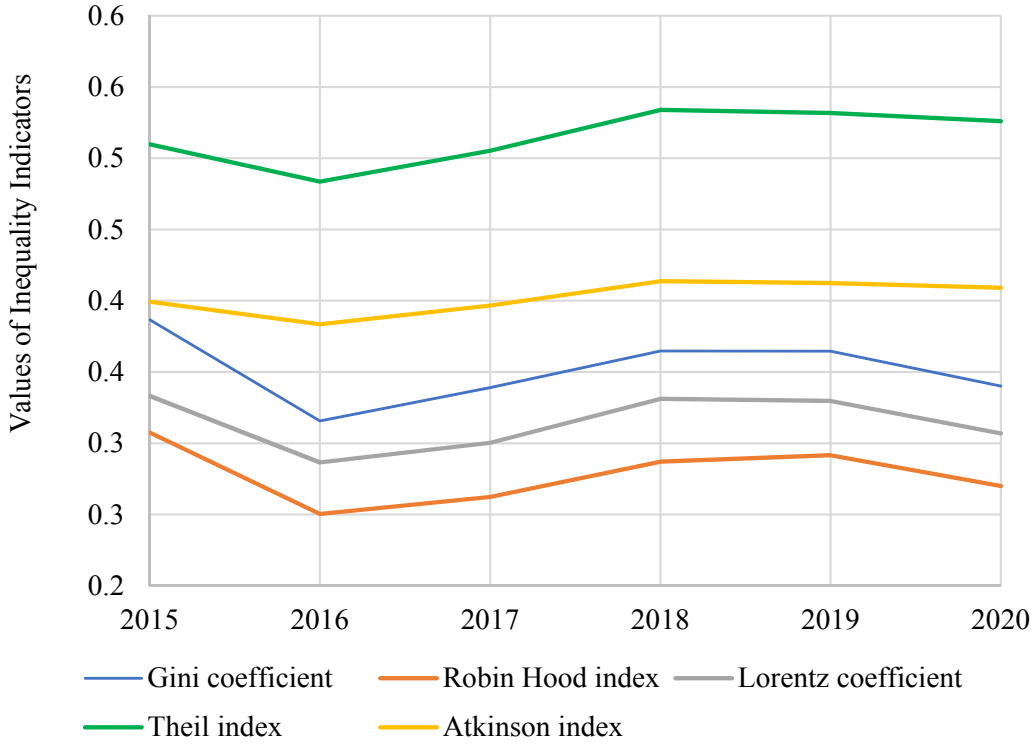

Fig. 5. **Dynamics of Inequality in Tax Revenues of the Russian Federation's Regions**

Source: Calculations of the authors according to the data of the Federal Tax Service of the Russian Federation and Rosstat. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022); URL: https://rosstat.gov.ru/folder/210/document/13204 https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022).

outliers and with the distribution of entities by the ratio of shares of tax revenues and employed population. Note that the average value of the sign *r* (on the graphs they are marked with a marker "x") is slightly different from one, except for 2020 ($\bar{r} = 0.93$), this year the positive dynamics of tax revenues from regions of the Russian Federation was disrupted, the total tax revenue in 2020 compared to the previous year decreased by almost 8%.

Fig. 3 shows that income distribution has a strong right asymmetry (asymmetry coefficient values $As = 4.43 - 4.80$). Median values of sign *r* (on "boxes" marked with horizontal segments) are much lower than average.

Diagrams *Fig. 4* show that the structure of tax revenues in the Russian Federation in the period 2015–2020 has not changed: the number of regions with tax income above the equal varies between 16–21, below the equal — respectively 64–69. At the same time, there is no trend of an increase in the number of regions with income above equal.

Fig. 5 presents a change some indicators of tax revenue inequality between 2015 and 2020.

Time series graphs of the five indicators show that they all provide roughly the same qualitative picture of changes in tax income inequality. It can be concluded that the structure of tax revenues from regions of the Russian Federation during the time period under consideration has not changed, there is no any general trend in dynamics of indicators of inequality. The values of the indicators presented in *Fig. 5*, one order and the graph of their change can be placed in one figure. However, there are indicators whose values are very different from those presented in *Fig. 5*. For example, Herfindahl-Hirschman index, decile differentiation coefficient, variation coefficient.

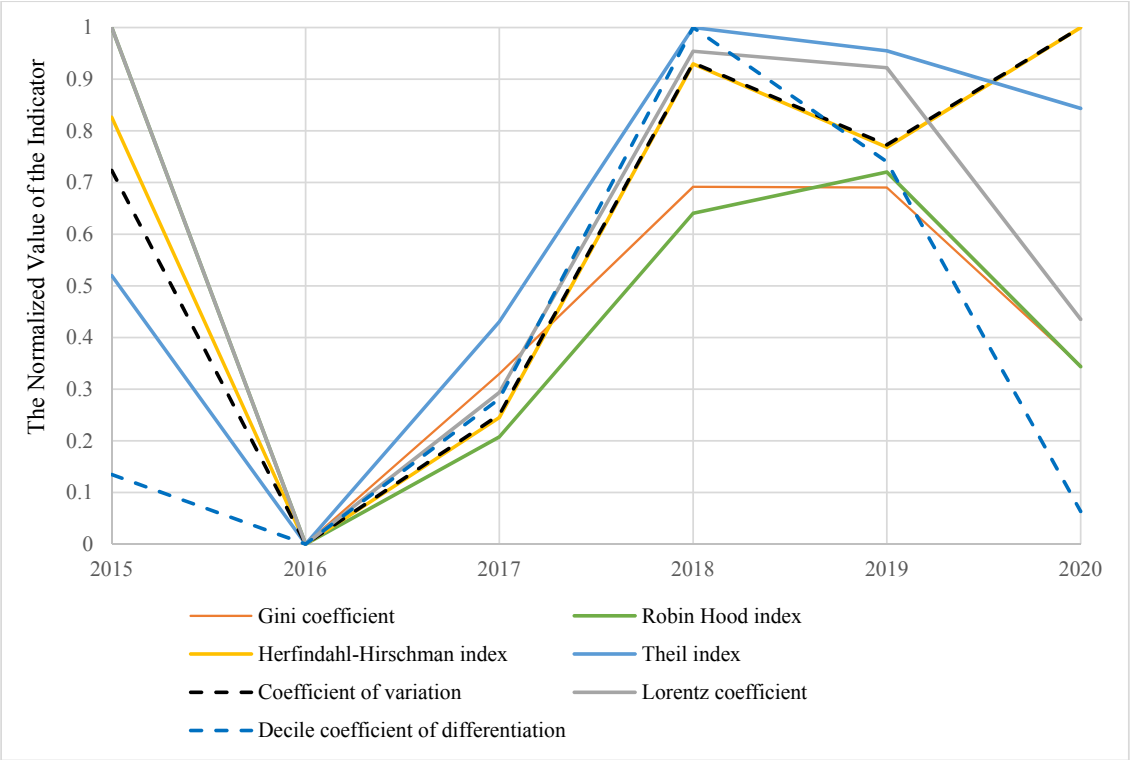

Fig. 6. **Dynamics of Inequality in Tax Revenues of the Russian Federation Region by Standard Indicators**

Source: Calculations of the authors according to the data of the Federal Tax Service of the Russian Federation and Rosstat. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022); URL: https://rosstat.gov.ru/folder/210/document/13204 https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022).

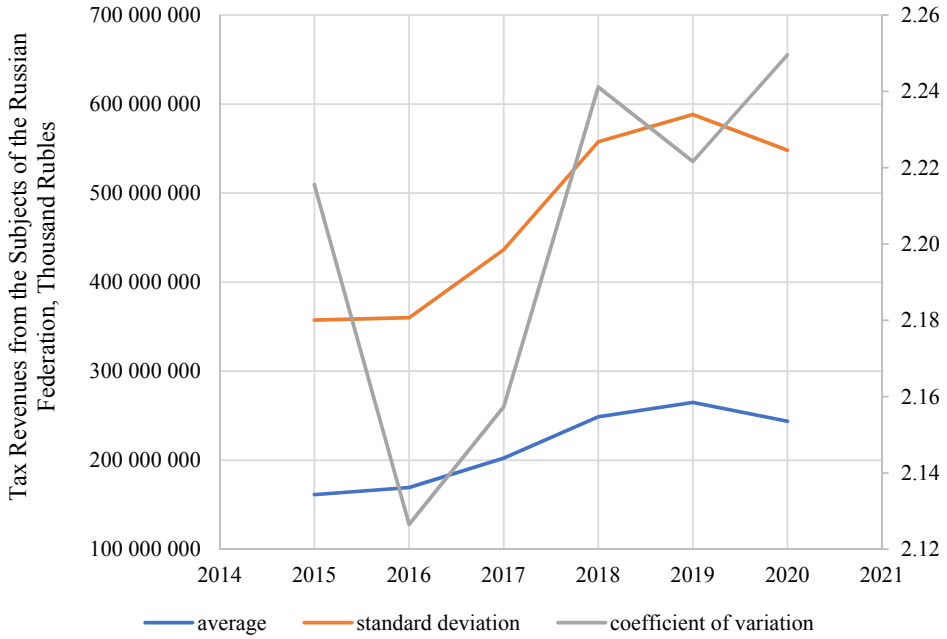

Fig. 7. **Dynamics of Tax Revenues and their Variation**

Source: Calculations of the authors according to the data of the Federal Tax Service of the Russian Federation and Rosstat. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022); URL: https://rosstat.gov.ru/folder/210/document/13204 https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022).

Table

Inequality's Indicators Tax Revenues Receipts in the Regions of Russia in 2015–2020

Indicators of Inequality	2015	2016	2017	2018	2019	2020
Gini Coefficient	0.387	0.316	0.339	0.365	0.365	0.340
Robin Hood Index	0.307	0.250	0.262	0.287	0.292	0.270
Lorentz Coefficient	0.333	0.287	0.300	0.331	0.330	0.307
Herfindahl-Hirschman Index	0.070	0.064	0.066	0.070	0.069	0.071
Theil Index	0.510	0.484	0.505	0.534	0.532	0.526
Atkinson Index	0.399	0.383	0.397	0.414	0.412	0.409

Source: Calculations of the authors according to the data of the Federal Tax Service of the Russian Federation and Rosstat. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022); URL: https://rosstat.gov.ru/folder/210/document/13204 https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/6092076/ (accessed on 11.08.2022).

For ease of comparison, measures of tax income inequality can lead to a single standard:

$$\dot{k}_t = \frac{k_t - \min(k_t)}{\max(k_t) - \min(k_t)}, \qquad (6)$$

where k_t — actual value; $\dot{k}_t$ — normalized value.

Normalized values of tax income inequality are shown in *Fig. 6*.

From *Fig. 6* it follows that various normalized indicators roughly of the same reflect the dynamics of inequality of tax revenues. The exception is the Herfindahl-Hirschman index and the coefficient of variation, we will remind that they are related by functional dependence (5). In 2020, these indicators point to an increase in income inequality, while the rest — are for a decrease. Consider the dynamics of the coefficient of variation. *Fig. 7* reflects changes in tax revenue statistics: average $\bar{x}$, standard deviation σ and coefficient of variation $V = \sigma/\bar{x}$.

Since the coefficient of variation is determined by the ratio of the standard deviation σ and average $\bar{x}$ of income, its change will depend on the growth rate of the numerator and the denominator. It is evident that in 2020 there was a significant decrease in tax revenues, but their variation also decreased. The decline σ was slower rate (standard deviation of income increased by 93% and income increased by 92%), leading to an increase in income inequality by coefficient of variation.

CONCLUSIONS

The article considers the actual problem of inequality distribution of regional tax revenues on the territory of Russia. Based on the developed model of economic functioning of the region of the Russian Federation, the thesis that the total tax revenues of any region of the country, attributed to the number of people employed in their creation, reflect the effectiveness of its functioning, is proposed and confirmed. Structure and dynamics of tax revenues in the period from 2015 to 2020 are reviewed.

It is concluded that the distribution of tax revenues by regions of the Russian Federation is significantly different from the uniform (*Fig. 2*). However, the difference between the actual and equal distribution of tax revenues is observed throughout the period under review.

The *Table* shows the values of the different indicators of income inequality.

In the conclusion we want to quote N.P. Yasnopol'skii, which shows in his work [2] the impossibility of using single tax and financial approaches to the regions of our vast homeland: "Now the time has passed for faith in the seemingly immutable rules of economic life that apply to all times and places. On the contrary, even economic science, rather than practice, has now become almost a commonality — recognition of the need to apply to the conditions of place and time" [2, p. 7].

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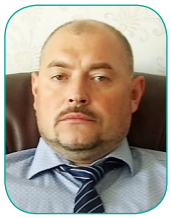

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Role of Digitalisation in Rural Banking Sector in Madurai, India

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ABSTRACT

The Indian banking sector has reached greater heights in recent days because of adopting and involving in the Digitalisation of banking. Though India is moving forward with digitalisation process, our nation faces several setbacks and opposition, which has to be crossed specifically in the rural banking system. The current research work has attempted to examine these challenges and setbacks which are found commonly in rural banking digitalisation. This paper **aims** in analysing the impacts and influences of Digitalisation in rural banks of Madurai city, Tamil Nadu. Moreover, the study is surveying multiple influencing factors like literacy rate, education qualification, income quality, gender equality and socio-economic position. Finally, some suggestions and conceptions to increase the maximum reach of knowledge and importance regarding the Digitalisation of banks in rural regions are suggested to the government and banking sectors. Regional based loan schemes and mechanisms and procedures must be encouraged by banks. Income assessment, repayable capacity in the rural areas of Madurai has to be initiated. The study focuses on research-based on quantitative tools. The Study aims in explaining the various positive outcomes of bank digitalisation via digital banking and financial inclusion here in India. The present study provides the awareness of the digital world and the advantages of adopting them in rural India for various banking services. The paper concludes that there is a need for digital establishments and digital banking in most rural areas all over India.

Keywords: digitalization; banking sector; rural banks; statistical analysis; influence factors; financial literacy; India

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INTRODUCTION

In general, Digitalisation is considered the active involvement of new digital and trending technologies in the business context to increase the revenue and more possible opportunities for ongoing projects. In other words, it is the procedure of shifting a business to the next level, i.e. digital company. In general, the term digitalisation refers to the integration of available trending latest techniques and business activities to improvise them even more effectively [1]. For example, if a bank is rendering its services online and a customer can make transactions and other bank-related activities online, it is called "Digital banking". Digitalisation refers to the conception of "digital transformation of the economy and the social status of a nation" [2]. Nowadays, Digitalisation in several sectors and business has become more intense and trending in the present decade. Digitalisation made a strong impact in addition to the recent innovations in business and trends. Therefore, the organisations and firms need to update to current digital strategies and stay focused on the factors and ideas that provide more profits in their respective business.

Today Digitalisation has set foot in all the fields [3]. Since the beginning of the 21st century, several digital techniques such as mobiles, the internet, internet banking, artificial intelligence, IoT have been developed. They have become an important aspect of every human's day-to-day lifestyle [4]. The following *Figure 1* will explain the current trend in banking technologies after the implementation of Digitalisation in India.

Challenges and Issues Faced by Digital Banking in Rural Regions of India

- No proper financial literacy and digital literacy
- No trust and vulnerability towards the digital system
- Non-acceptance of Digitalisation of the banking system
- Inadequate knowledge about Digitalisation and their advantages
- The natural setup of the rural regions, their mindsets and economic situations.

Suggestions and Strategies to Encourage Digitalisation in Rural Regions of India

- It enhances the infrastructure.
- Introducing low-cost smartphones to access banks online.
- They are providing basic knowledge about the cashless economy.
- Revamping of rural economy and gaining their trust towards Digitalisation
- Boosting and enhancing policies
- They are creating awareness of encouraging the use of banking applications through smartphones.

Major Contribution

The major contribution of the study is described below,

- To investigate the role of Digitalisation and the new trends available in the Indian banking sector of south India-Tamil Nadu.
- To critically analyse the services prevalent in rural regions of Tamil Nadu.
- To figure out the gender impact found in rural digital banking services of Tamil Nadu.
- To evaluate the major issues and difficulties faced by the customers in digital banking from rural regions of Tamil Nadu.
- To observe the improvement of ruralisation and their quality of services in public and private digital banks of Tamil Nadu.

Paper Organisation

The following sections disclose the details about the paperwork, Section 1 briefing about the banking sector and their performance after the involvement and implementation of Digitalisation in rural regions of Tamil Nadu. Later the importance and purpose are being mentioned. Finally, the major benefactions of the work are mentioned. Section 2 illustrates a survey made on existing literature and concepts based on the roles and responsibilities of the banking sector and the Digitalisation of banks. Section 3 describes the methodology section. Here is how the paperwork will be executed, and the major components in the paper are focused. The conceptual framework is made here. Section 4 has discussed the major analysis and discussions of the work. Section 5 provides the findings of the research work. Section 6 discusses the conclusion and future work of the research.

LITERATURE REVIEW

Digitalisation can be defined as converting the present data into a digital form by adapting to new technology. This kind of acquisition is quite essential for the banking sector. By espousing Digitalisation, banks will be able to bestow strengthened customer services. With the help of current technological trends, people have been supported with round the clock access to their respective banks through either online banking or mobile applications. With this method, handling a massive amount of liquid cash has become much easier and simpler. One of the major benefits of Digitalisation is that customers are opting for cashless transactions. Folk need not necessarily vary liquid cash anymore to make transactions at any time and place [5]. The world currently sees a rapid swift happening towards the digital shift in a globalised modern economy. The present paper focuses on the impacts of Digitalisation, which has occurred in the socio-economic situation of Romanian specificities. The research work implies that the understanding of Digitalisation is much needed and are quite causing some influence in several aspects [6].

The inequalities found majorly in socio-economic bereaves lead lives with low income to have a healthy life. Their well-being and economic status are widely dependent on the mainstream financial setup. Amartya Sen, an economist and a Noble laureate, has proclaimed that "Health and inclusion are key precepts of a well-functioning society under the 'capability approach".

Here the capability approach denotes the human improvement and development that can provide considerable independence to the economic transactions, normative utilities of choices and happiness and societal inclusion. The current paper aims to study the effect of Digitalisation based on financial inclusion on banks belonging to the public sector present in India. The paperwork suggests a few registered improvements to be encouraged and motivated [7].

Information and communication technologies are providing novel chances and confrontations for the developing country's economic betterment. The current study focuses on socio-economic development seen in the background of the Indian economy. Since India is considered as one of the largest economies, found globally [8]. The banking sector is regarded as the backbone of every nation's economy. If banks adopt Digitalisation, then the whole system can be exposed to technology and have an increased impact all over the nation's economy [9]. Banks are also promoting these techniques because today, most customers prefer to do their transactions online rather than waiting in queues. The banking services have also developed with many styles like transactions using Unified Payments Interface (UPI), Plastic money (Credit Cards, Debit Cards and Smart Cards), Point of Sale, electronic fund transfer and clearing services, online trading accounts, telephone banking, Internet Banking, Immediate Payment Service (IMPS), Mobile Banking are some of the recent products offered by the bank. The digital banking system will help to reduce robbery and the risk of involving liquid cash. The present study concentrates on the emergence of Digitalisation in banking sectors for a better Indian economy and nation [10]. There is a massive change happening worldwide in the area of digital technology in the human lifestyle. This is termed the "digital transformation".

Today, Digitalisation is happening in all fields with emerging technology, and it has become a notable trend [11]. The current paper aims in explaining the various positive outcomes of bank digitalisation via digital banking and financial inclusion here in India [12]. The Indian government has adapted itself to the Digitalisation of the country to make India a Digital India. In this process, the entire banking system of the whole nation has transformed and empowered with the Digitalisation of emerging technology. The government schemes and policies encourage the new Digitalisation in banks and their system infrastructures [13].

The present study provides the awareness of the digital world and the advantages of adopting them in rural India for various banking services [14]. Digitalisation is the process of upgrading the current business status to a more advanced and digital form

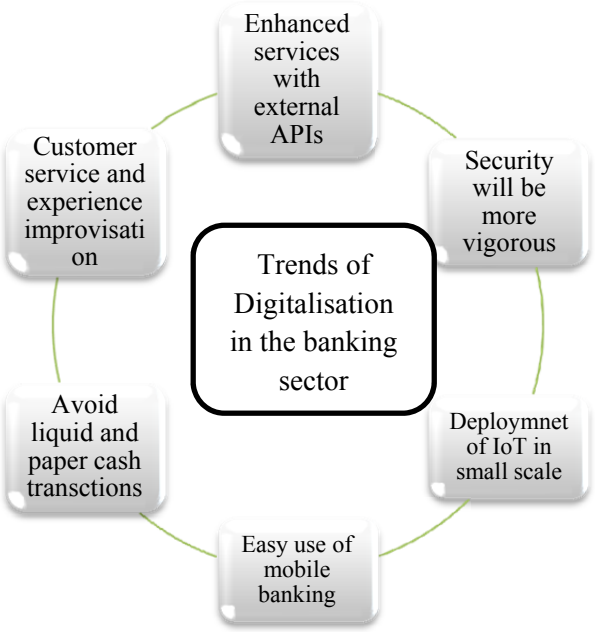

Fig. 1. **Various Digitalisation Trends Available in the Banking Sector**

Source: Authors' compilation.

to increase revenue and more value-producing chances. For these major positive reasons, the implementation and encouragement of Digitalisation in all sectors, mainly in banking, have gained a centre of attraction and embracement [15]. The process of Digitalisation is engaging in an active and major role in framing the Indian banking scenario. Since smartphones with an internet connection speed of 3G and 4G are available, it is making banking digitalisation even more easy and accessible. The current research paper is working on the needs and necessities of banking sector digitalisation [16].

Internet banking has become the trending topic of banking services and connections in recent times. The paper also aims in investigating the various trends of the Digitalisation of the banking system [17]. The financial system is indeed engaging in a significant role in the growth and enhancement of the nation's economy. The modern world out there has filled fully with emerging and developing techniques of the internet in the area of banking and other sectors, respectively [18]. The banking sector and Digitalisation have become integral features in our life, and without these, the world would be nothing. All the banks are involved and investing in digital initiatives to provide more enhanced

customer output. Digitalisation will increase more customisation and connect the customers easily. The paper aims to discuss the various advantages and disadvantages of the Digitalisation of the banking sector in India [19].

Research Gaps

- According to the RBI, the Indian banking sector is capable enough and deliberately efficient. The economic and financial situation in India is faraway upper level to many other nations in the world. The studies conducted on market, credit and liquidity risk recommends that banks in India are quite flexible, strong and have resisted well with worldwide deflation rigorously.
- India's loan services done in digital form stood at nearly US$ 75 billion during the financial year 2018. However, it is estimated to reach 1 trillion US$ by the end of the 2023 financial year as suitability analysis is yet to perform.
- The rural digital banking services in certain rural parts of India has not been implemented effectively and efficiently, suggested by certain studies.
- Several factors are affecting the reach and usage of banking services such as Digital infrastructure, rural dividend's, Education qualification, literacy rate, poverty and need for banking services should be studied effectively.

METHODS

This research is mainly concerned with analysing the impact of Digitalisation in rural regions of Madurai city in the state of Tamil Nadu. Digitalisation has brought some major changes in the banking sector, with many innovations and enhancements yet to come. With the help of Digitalisation, a vibrant future can be imagined. The national, state and international banks have attained some enormous benefits because of adapting to new technologies. The conception of online banking has reduced the trouble of standing in queues and resulted in yearning for a lot of revenue. These days, Digitalisation in banking is a hot topic to pick for discussions; current research is sticking to the empirical and quantitative analysis methods. Since the data gathered is from secondary sources. The respondents seemed to have bank accounts in either public banks or private banks. Further study is carried out using statistical analysis; a conceptual framework and Hypothesis are also framed accordingly. Since the study focuses on research-based on quantitative tools, the study is exploratory and conclusive.

Data Collection

Since the research is performed by using secondary data, which were gathered from existing sources like published papers, journals and articles from Dec 2020 — June 2021. The sample size was about 200 respondents belonging to the rural regions of Madurai, Tamil Nadu, southern India. For more reliability, the statistical analysis is also done in the research with the help of a statistical tool called IBM SPSS.

Conceptual Framework

With the support of a conceptual framework, the reach of Digitalisation of the banking sector and the use of digital banking systems is being analysed for rural regions. To be more specific, the analysis is carried out in the southern area of India. The city of Madurai was selected for carrying out the research. The following *Figure 2* will show the respective conceptual framework of the proposed work.

The conceptual framework describes in detail the proposed research work. The focus of the work is to concentrate on the adopted level of digital banking in rural regions. To identify the status of Digitalisation, Economic development, socio-economic development of the nation, and particular persons. The framework considers the facts like economic and socio-economic development as the dependent variable; the moderating variables are like types of services, the extent of usage of that services in rural regions are considered. The independent variable is the rural banks and their respective services. Keeping all these factors in consideration, the Hypothesis is framed accordingly.

Hypothesis

$H_1$1: Digital banking services are prevalent in the rural areas of Tamil Nadu, Madurai.

$H_1$0: Digital banking services are not prevalent in the rural areas of Tamil Nadu, Madurai.

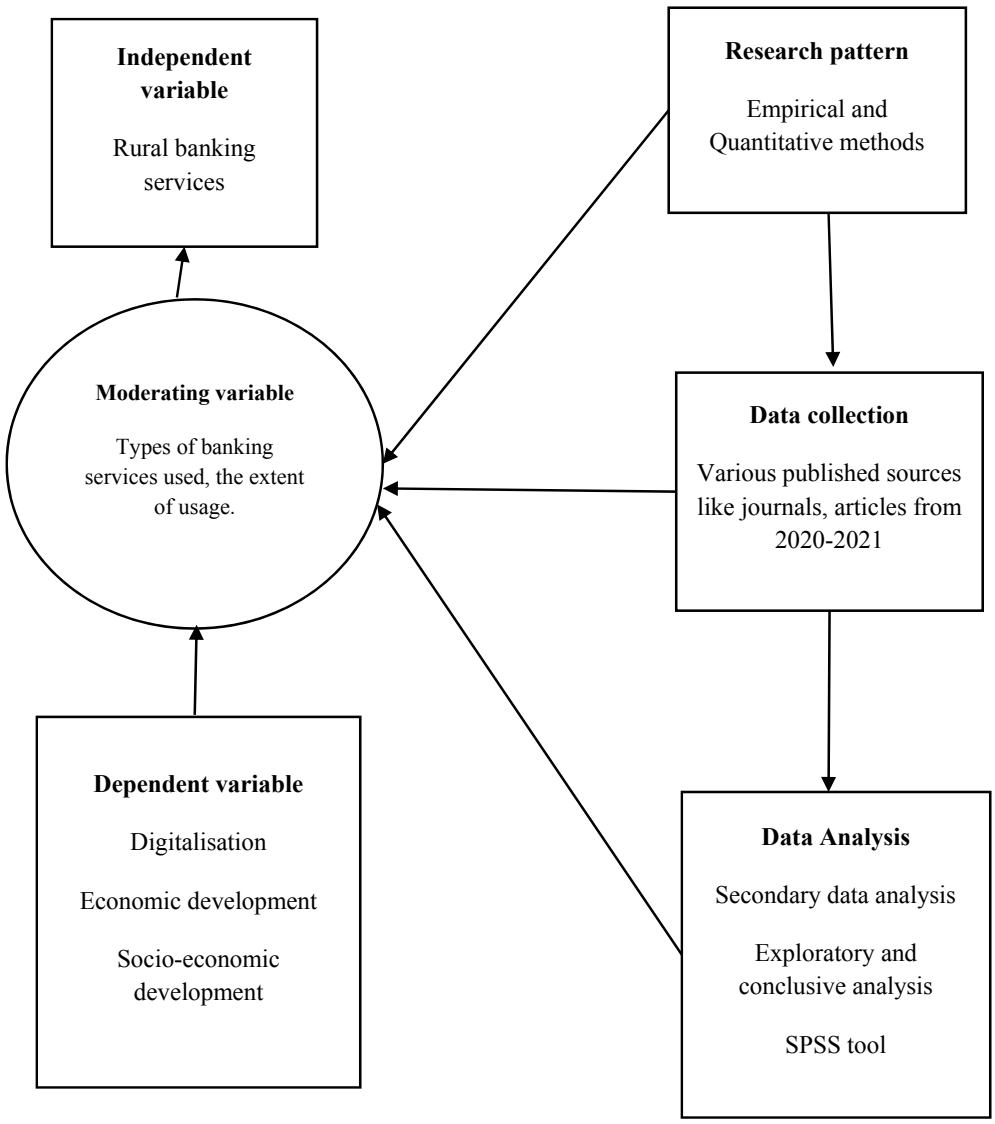

Fig. 2. **Conceptual Framework**

Source: Authors' compilation.

$H_2$1: The perception of digital banking to increase the standard of the economy in the rural regions of Madurai, Tamil Nadu is noteworthy.

$H_2$0: The perception of digital banking to increase the standard of the economy in the rural regions of Madurai, Tamil Nadu is not noteworthy.

Demography Profile

The analysis is further carried out with the secondary data gathered online in Madurai, Tamil Nadu, with 200 respondents. The following table will provide the details about their demographic analysis and their percentage, respectively.

Table 1 furnishes the demographic profile for rural banks (public and private) customers, which are considered the most important variables in this research work. Since this research work is a secondary data basis analysis, the data were collected from existing and published studies, journals, papers and articles. The survey had 200 respondents, out of which the male (102) was more dominant than female (98) customers. The age group was classified as 18–25, 26–35, 36–45, 46–60 and 61& above respectively with customers count of 35, 63, 57, 32, 1st 13. This shows that people in middle age have more accounts. Next is the Literacy rate of customers grouped and their total customers as SSLC — 24 customers, HSC/diploma — 20 customers, Bachelor degree — 138 customers, and customers with a master's degree are 18. Followed by the profession

Table 1

Demographic Analysis

Data demography		Percentage
Gender		
Male	102	51
Female	98	49
Age		
18–25	35	17
26–35	63	31
36–45	57	29
46–60	32	16
61 and above	13	7
Literacy rate		
SSLC	24	12
HSC/diploma	20	10
Bachelor degree	138	69
Master degree	18	9
Profession		
Student	98	49
Own business	38	19
Employed	32	16
Unemployed	8	4
Housewife	24	12
Marital status		
Married	102	51
Single	80	40
Separated	3	2
Widowed	5	7

Source: Authors' compilation.

of the customers grouped as students — 98 customers, having own business — 38 customers, Employed in various organisations — 32 customers, Unemployed 8 customers, Housewife — 24 customers respectively. The next field is recording their marital status with married — 102 customers, Singles — 80 customers, and Separated –3 customers and widowed —% customers.

Since the respondents have accounts with private and public banks, the study is also carried out in that way; from the details gathered, it was found that 5 major public and private sector bank customers were found in the responses. Therefore, they are grouped according to their banks, respectively, along with the analysis made regarding the digital banking system.

Public Banks

The following is tables and graphs representing the list of Public sector banks and their research-based analysis, respectively [21].

Table 2 describes the various government bank customers of the research study. It was found that a major part of consumers in the rural region of Madurai had their bank accounts in government banks. 102 respondents had government bank accounts. The following is the 5-point Likert scale analysis done on public banks of rural regions in Madurai, Tamil Nadu.

Table 3 furnishes the details of the analysis made with the 5-point Likert scale. These contained various information about online banking. The respondents for public banks were 102 in total, so the percentage and statistical analysis calculations were also made accordingly. The first question was regarding the time of having their accounts with their respective public banks. The responses were received as follows: 0–12 months — 15 respondents, 1–5 years — 19 respondents, 6–10 years — 25 respondents, 10–15 years — 26 respondents, and 15 years and more –17 respondents. Followed by analysing the awareness of the online banking system: Very much — 17 respondents, Much — 28 respondents, average — 24 respondents, Little — 19 respondents, and very little — 14 respondents in total. The next question was analysing the Familiarity with available banking services shown in figure 6 like managing accounts — 20 respondents, Fund transfer services — 54 respondents, Investment options — 5 respondents, Applying for new cheque book — 10 respondents and using for online bills payment — 13 respondents. Next, the user perspective about the online banking system in rural regions was analysed: Strongly agree — 17 respondents, agree — 38 respondents, Neutral — 34 respondents, Disagree — 10 respondents, and strongly disagree — 3 respondents. Finally, the Preference over traditional banking with digital banking was analysed: Strongly agree — 10 respondents, Agree — 32 respondents, neutral — 20 respondents, Disagree — 22 respondents, Strongly disagree — 18 respondents.

Table 2

List of Public Banks of 102 Respondents

No.	Public banks	Total users	Percentage
1	State bank of India	38	37
2	Canara bank	24	23
3	Indian overseas bank	22	21
4	Indian bank	12	12
5	IDBI bank	6	7
	Total	102	100

Source: Authors' compilation.

Private banks

The following is tables and graphs representing the list of Private sector banks and their research-based analysis, respectively [22].

Table 4 describes the various Private bank customers of the research study. It was found that only a few respondents were consumers in the rural region of Madurai had their bank accounts in private banks. On the other hand, 98 respondents had private bank accounts. The following is the 5-point Likert scale analysis done on public banks of rural regions in Madurai, Tamil Nadu.

Table 5 furnishes the details of analysis made with the 5-point Likert scale for private banks. These contained various information about online banking. The respondents for private banks were 98 in total, so the percentage and statistical analysis calculation was also made accordingly. The first question was regarding the time of having their accounts with their respective private banks. The responses were received from: 0–12 months — 12 respondents, 1–5 years — 25 respondents, 6–10 years — 31 respondents, 10–15 years — 14 respondents, and 15 years and more — 16 respondents. Followed by analysing the awareness of the online banking system: Very much — 16 respondents, Much — 15 respondents, average — 37 respondents, Little — 18 respondents and very little — 12 respondents in total. The next question was analysing the Familiarity with available banking services: Managing accounts — 13 respondents, Fund transfer services — 28 respondents, Investment options — 17 respondents, Applying for

Table 3

5-Point Likert Scale Analysis for Public Banks

Likert scale values	Responses	Percentage
Period of using public banks		
0–12 months	15	15
1–5 years	19	18.5
6–10 years	25	24.5
10–15 years	26	26
15 and more years	17	17
Awareness of online banking		
Very much	17	17
Much	28	28
average	24	24
little	19	18.5
Very little	14	13.5
Familiarity with banking services online		
Managing accounts	20	19.5
Fund transfers	54	52.5
Investment options	5	5
New cheque book request	10	10
Online bills payment	13	13
User perspective of online banking		
Strongly agree	17	17
Agree	38	36.5
Neutral	34	33.5
Dis agree	10	10
Strongly disagree	3	3
Preference over traditional banking for digital banking		
Strongly agree	10	10
Agree	32	31
Neutral	20	19.5
Dis agree	22	21.5
Strongly disagree	18	18

Source: Authors' compilation.

Table 4

List of Private Banks of 98 Respondents

S.no	Private banks	Total users	Percentage
1	Axis bank	15	15
2	HDFC bank	17	17
3	ICICI bank	14	14
4	City union bank	35	35
5	Karur Vysya bank	17	17
	Total	98	100

Source: Authors' compilation.

new cheque book — 15 respondents and using for online bills payment — 25 respondents. Next, the user perspective about the online banking system in rural regions was analysed: Strongly agree — 26 respondents, Agree — 27 respondents, Neutral — 26 respondents, Disagree — 10 respondents, and strongly disagree — 9 respondents. Finally, the Preference over traditional banking with digital banking was analysed: Strongly agree — 24 respondents, Agree — 23 respondents, neutral — 19 respondents, Disagree — 20 respondents, Strongly disagree — 12 respondents.

RESEARCH ANALYSIS AND RESULTS

To study the level of penetration of online banking in rural regions of Madurai, Tamil Nadu with the data acquired, the following statistical tests are carried out with the help of a statistical tool SPSS tool. Furthermore, to find the reliability of digital banking with public and private sector banks, the Chi-square test and correlation tests are done from the respective data separately.

Reliability Tests for Public Banks

Cross Tabulations – Chi-Square Test

Firstly, the chi-square test is carried out for public banks with a level of awareness of online banking in the rural region of Madurai, Tamil Nadu.

Above *Table 6* represents the chi-square output for the public banks with an awareness level of online banking with the respondents 102. The significant value is 0.159, which shows a good level of significance found between those two variables.

Table 5

5-Point Likert Scale Analysis for Private Banks

Likert scale values	Responses	Percentage
Period of using Private banks		
0–12 months	12	12.5
1–5 years	25	25.5
6–10 years	31	31
10–15 years	14	14.5
15 and more years	16	16.5
Awareness of online banking		
Very much	16	16.5
Much	15	15
average	37	38
little	18	18
Very little	12	12.5
Familiarity with banking services online		
Managing accounts	13	13
Fund transfers	28	29
Investment options	17	17.5
New cheque book request	15	15
Online bills payment	25	25.5
User perspective of online banking		
Strongly agree	26	26
Agree	27	28
Neutral	26	26
Dis agree	10	10
Strongly disagree	9	10
Preference over traditional banking for digital banking		
Strongly agree	24	24.5
Agree	23	23.5
Neutral	19	20
Dis agree	20	20
Strongly disagree	12	12

Source: Authors' compilation.

Table 6

Chi-square Test for Public Banks with the Level of Awareness of Online Banking

Parameter	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.218a	20	.159
Likelihood Ratio	18.579	20	.549
N of Valid Cases	102		

Source: Authors' compilation.

Table 7

Chi-Square Test for Public Banks with the Level of Familiarity of Online Banking

Parameter	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	67.930[a]	20	.132
Likelihood Ratio	27.689	20	.117
N of Valid Cases	102		

Source: Authors' compilation.

Table 8

Chi-Square Test for Public Banks with the Level of User Perspective on Online Banking

Parameter	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	66.701[a]	20	.161
Likelihood Ratio	25.766	20	.174
N of Valid Cases	102		

Source: Authors' compilation.

Table 9

Chi-Square Test for Public Banks with the Level of Preference over Traditional Banking with on Online Banking

Parameter	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.856[a]	20	.149
Likelihood Ratio	21.861	20	.348
N of Valid Cases	102		

Source: Authors' compilation.

Table 10

Correlation of Awareness of Online Banking with Familiarity of Online Services for Public Banks

Parameter		Online banking awareness	Online banking services
online banking awareness	Pearson Correlation	1	.360**
	Sig. (2-tailed)		.106
	N	102	102
online banking services	Pearson Correlation	.360**	1
	Sig. (2-tailed)	.106	
	N	102	102

Source: Authors' compilation.

The above *Table 7* is representing the chi-square output for the public banks with the Familiarity level of online banking with the respondents of 102. The significant value is 0.132, which shows that there is a good level of significance found between those two variables

The above *Table 8* represents the chi-square output for the public banks with User perspective level of online banking with the respondents of 102. The significant value is 0.161, which shows that there is a good level of significance found between those two variables

The above *Table 9* is representing the chi-square output for the public banks with Preference over traditional banking level with online banking with the respondents of 102. The significant value is 0.149, which shows that there is a good level of significance found between those two variables.

Cross Tabulations – Correlation

The next test performed in the available statistical tool is finding the correlation about the awareness of online banking with Familiarity, User perspective and Preference over traditional banking with online banking for public banks having respondents of 102 in rural regions of Madurai.

Table 10 represents the correlation outcomes of awareness of online banking comparing with the Familiarity of online services of Digital banking in Public Banks. The result shows a significant value of 0.360, which is a good level of significance, found in online banking of Public Banks.

Table 11 represents the correlation outcomes of online banking awareness comparing with the user's perspective on Digital banking in Public Banks. The result shows a significant value of 0.192, which is a good level of significance, found in online banking of Public Banks.

Table 12 represents the correlation outcomes of awareness of online banking compared with the Preference over traditional banking with Digital banking in Public Banks. The result shows a significant value of 0.119, which is a good level of significance, found in online banking of Public Banks.

Reliability Tests for Private Banks

Cross Tabulations – Chi-Square Test

Firstly, the chi-square test is carried out for Private Banks with a Level of awareness of online banking in the rural region of Madurai, Tamil Nadu.

The above *Table 13* represents the chi-square output for the Private Banks with an awareness level of online banking with the respondents 98. The significant value is 0.355, which shows a High level of significance found between those two variables.

The above *Table 14* represents the chi-square output for the Private Banks with the Familiarity level of various online banking services with the respondents of 98. The significant value is 0.300, which shows that there is a High level of significance found between those two variables.

The above *Table 15* represents the chi-square output for the Private Banks with the user perspective of online banking with the respondents of 98. The significant value is 0.195, which shows that there is a Moderate level of significance found between those two variables.

The above *Table 16* represents the chi-square output for the Private Banks with the Preference of online banking over traditional banking with

Table 11

Correlation of Awareness of Online Banking with User Perspective of Online Services for Public Banks

Parameter		Online banking awareness	Online banking user
online banking awareness	Pearson Correlation	1	.192
	Sig. (2-tailed)		.359
	N	102	102
online banking user	Pearson Correlation	.192	1
	Sig. (2-tailed)	.359	
	N	102	102

Source: Authors' compilation.

Table 12

Correlation of Awareness of Online Banking with Preference over Traditional Banking with of Online Services for Public Banks

Parameter		Online banking awareness	Traditional banking vs digital banking
Online banking awareness	Pearson Correlation	1	.119
	Sig. (2-tailed)		.234
	N	102	102
Banking vs digital Banking	Pearson Correlation	.119	1
	Sig. (2-tailed)	.234	
	N	102	102

Source: Authors' compilation.

Table 13

Chi-Square Test for Private Banks with the Level of Awareness of Online Banking

Parameter	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.745[a]	20	.355
Likelihood Ratio	15.820	20	.728
N of Valid Cases	98		

Source: Authors' compilation.

Table 14

Chi-Square Test for Private Banks with Familiarity Level of Various Services of Online Banking

Parameter	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.778[a]	20	.300
Likelihood Ratio	16.978	20	.654
N of Valid Cases	98		

Source: Authors' compilation.

Table 15

Chi-Square Test for Private Banks with User Perspective of Online Banking

Parameter	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.650[a]	20	.195
Likelihood Ratio	18.095	20	.581
N of Valid Cases	98		

Source: Authors' compilation.

Table 16

Chi-Square Test for Private Banks with Preference of Online Banking Over Traditional Banking

Parameter	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	25.334[a]	20	.189
Likelihood Ratio	17.806	20	.600
N of Valid Cases	98		

Source: Authors' compilation.

Table 17

Correlation of Awareness of Online Banking with Familiarity of Online Services for Private Banks

Parameter		Awareness of online banking	Familiarity with online banking services
Awareness of online banking	Pearson Correlation	1	.158
	Sig. (2-tailed)		.569
	N	98	98
Familiarity with online Banking services	Pearson Correlation	.158	1
	Sig. (2-tailed)	.569	
	N	98	98

Source: Authors' compilation.

Table 18

Correlation of Awareness of Online Banking with Perspective of User of Online Services for Private Banks

Parameter		Awareness of online banking	User perspective on online banking
Awareness of online banking	Pearson Correlation	1	.185
	Sig. (2-tailed)		.068
	N	98	98
User perspective on online banking	Pearson Correlation	.185	1
	Sig. (2-tailed)	.068	
	N	98	98

Source: Authors' compilation.

Table 19

Correlation of Awareness of Online Banking with Preference for Private Banks over Traditional Banking

Parameter		Awareness of online banking	Preference over traditional banking and digital banking
awareness of online banking	Pearson Correlation	1	0.247
	Sig. (2-tailed)		.645
	N	98	98
preference over traditional banking and digital banking	Pearson Correlation	0.247	1
	Sig. (2-tailed)	.645	
	N	98	98

Source: Authors' compilation.

the respondents of 98. The significant value is 0.189, which shows that there is a Moderate level of significance found between those two variables.

Cross Tabulations – Correlation

The next test performed in the available statistical tool is finding the correlation about the awareness of online banking with Familiarity, User perspective and Preference over traditional banking with online banking for Private Banks, having respondents of 98 in rural regions of Madurai.

Table 17 represents the correlation outcomes of awareness of online banking compared with Familiarity of online services of Digital banking in Private Banks. The result shows a significant value of 0.158, which is a satisfactory level of significance, found in online banking of Private Banks.

Table 18 represents the correlation outcomes of online banking awareness compared with users' perspective for online services of Digital banking in Private Banks. The result shows a significant value of 0.185, which is a satisfactory level of significance, found in online banking of Private Banks.

Table 19 represents the correlation outcomes of awareness of online banking comparing with Preference users of online services of Digital banking with traditional banking in Private Banks. The result shows a significant value of 0.247, which is a satisfactory level of significance, found in online banking of Private Banks.

FINDINGS AND DISCUSSIONS

The sample of the study confines the rural regions of various parts of Madurai city, Tamil Nadu. Secondary data was collected from multiple published sources like papers, journals, articles published from 2020–2021. The data analysis and statistical analysis was done with the help of the SPSS tool. An empirical

model would be suggested to increase the reach and more usage of digital banking in rural regions of Madurai city, Tamil Nadu. Suitable suggestions, recommendations and appropriate conclusions would be provided for the research work.

The reach out of positive impacts of digitisation in rural banks is very low in the regions of Madurai. The male members of the family have more awareness when compared to female members of the family. Therefore, the government must focus on providing more awareness schemes and programs in rural regions. Problems of poverty, Social inequality, income, and literacy rate influence the reach and extent of digital banking adoption in the rural areas of Madurai and India overall. Smartphones are a must for improving Digitalisation in rural banks. The research work suggests the banks provide loans for nominal smartphones for rural regions. Regionally based loan schemes and mechanisms and procedures must be encouraged by banks. Income assessment, repayable capacity in the rural areas of Madurai has to be initiated.

CONCLUSION AND SUGGESTIONS

The research work and analysis is clearly showing that the rural regions in many parts of India are still not having clear knowledge about the impacts and advantages of digital banking. This is mainly because of the lack of knowledge, literacy rate, and inequality found abundantly in income distribution. People who are aware of digital banking, are very minimum in count. To overcome this situation, the study suggests some ideas such as the level of awareness is very poor in rural regions of Madurai, so that some government policies can consider. Next, the male users are predominant in all families, so to attain female customers, women based programs are needed and encouraged. Since the income level is also having an impact on families of rural regions, new methods should be considered. Lastly, it was found that there is a need for digital establishments and digital banking in most rural areas all over India. So that, the awareness of banking-related applications increasing and that are accessible on smartphones.

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Credit Rationing Equilibrium Achievement in the Conditions of Digitalization

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ABSTRACT

The author clarified the degree of achievement of the credit market equilibrium in the conditions of information asymmetry and active digitalization of processes in activity of credit market participants. The **subject** of research is the economic and technological conditions for achieving credit rationing equilibrium. The **purpose** of the research is to highlight the nature of the impact of digitalization on the degree of achieving equilibrium in the credit market in the context of digitalization. The author focuses on the new conditions of functioning of the credit market, when the current digitalization allows to significantly complement the credit profile of borrowers, and new participants appear in the credit market. The **objective** of research is assessment of compliance of theoretical postulates on achieving the credit rationing equilibrium in the context of digitalization of processes associated with the lending. The authors' **hypothesis** is that the credit market has the potential to increase the return on a loan per currency unit of borrowers' loans, and the current estimates of the of defaults borrowers' probability, interest rates are "biased". As the main methods, the author used systematic and logical methods, which made it possible to consider the credit market equilibrium in terms of the economic relationships between its participants and the achieved economic indicators. As a **result** of the analysis of theoretical concept of credit rationing equilibrium, taking into account the identified qualitative changes, that take place in the credit market in the context of digitalization. The author **concludes** that is the potential increase the rate of return on credit operations. Extending the borrower credit data with alternative, non-credit sources, as expected, allows to get more accurate creditworthiness assessment. The **results** of the research to some extent serve as a rationale for possible decisions of central banks to expand the traditional sources of borrowers' credit histories, reconfigure the existing information exchange architecture in the credit market.

Keywords: information asymmetry; credit market; digitalization of the economy; credit rationing equilibrium; credit supply and demand; moral hazard; adverse selection risk; credit history bureaus (CHBs); enriched data; credit histories

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INTRODUCTION

Development of modern information technologies and their active implementation in the credit market provides new insights into the existing problem of information asymmetry. If before professional creditors in the person of the same credit and microfinance organizations were guided by credit histories of borrowers when assessing credit risks, then in the conditions of active digitalization, penetrating into all spheres of life, both the part of information exchange participants and the types of analysis are increasing, which, in fact, can "enrich", qualitatively complement available credit information. In these conditions, the national monetary regulators responsible for ensuring financial stability in the financial market were actively involved in the work on the effects of digitalization.[1]

Discussion of information asymmetry in the credit market has been going on for a long time. Interest in credit rationing was driven by the need for central banks to take into account autonomous credit restrictions (credit rationing) by banks in implementing the transmission mechanism of monetary policy [1]. In addition, a number of papers studied the issues of credit rationing in terms of achieving macroeconomic equilibrium under conditions of rational expectations [2, 3], the need for the development of infrastructure institutions of the credit market, which carry out information exchange of credit information [4], regulation of interest rates and risk neutrality of borrowers [5–7].

Beginning in the 80s of the 20th centuries in the scientific works of B. Bernanke and M. Gertler [8], A. Blinder and J. Stiglitz [9], B. Greenwald and J. Stiglitz [10] highlight issues of endogenous money supply, assess the role of credit in the business cycle and features of the transmission mechanism of monetary policy. It is questioned in imperfect information theory, that interest rates emerging in the capital market fully reflect the impact of financial variables on aggregate demand.

The problem of information asymmetry is an ongoing problem for creditors. Crediting is characterized by information asymmetry *"ex ante"*, since creditors need to determine and assess the risk profile of potential borrowers in advance before approving a loan, and *"ex post"*, as they need to monitor the solvency (state) of borrowers once the loan is granted [11].

There are two types of risks associated with incomplete/inaccurate information in the lending process. First of all, it's a *risk of moral hazard*[2] and *risk of adverse selection*.[3] In the aspect of the credit process, these risks can be formed most as at the initial stage of the credit placement, when the loaned value is granted for temporary use, and at the subsequent stage of the borrower's use of the loaned value. Depending on what "volume" credit information has creditor in relation to the borrower, how adequate are the econometric credit scoring models used, accurate in forecasting the borrower's behavior in relation to credit debt servicing, as well as what costs payable for *ex-post monitoring* the status of clients, will be determined the final amount of the credit interest rate. In an information asymmetry where credit risks to different borrowers can be either overestimated or underestimated, interest rates become *"biased"*. Part of fair borrowers "unfairly" faces higher rates, and unfair borrowers receive the credit funds they need.

It is known that reduction of negative effects from asymmetry of information is achieved through the development of financial intermediation. The classic institution of financial intermediation involved in the distribution of the total risk

[1] On the development strategy of the credit histories bureau' services market. 2017. URL: https://www.cbr.ru/Content/Document/File/50684/Consultation_Paper_171024.pdf (accessed on 08.04.2022).

[2] Moral hazard — unfair execution risk by the borrower of their obligation under the credit contract.

[3] Adverse selection risk — risk of the loan to the least reliable borrower.

premium is the banks themselves, which attract the free money and transform it into credit and investment. As noted in several research studies on the effects of exchange of information in the credit market [12–16], the asymmetry of information associated with the risk of adverse selection and risk of moral hazard can be significantly reduced by establishing a system of exchange of credit information between creditors. And scientists identify quite economic prerequisites for such an exchange. It is noted that even banks that have an information monopoly on their customers[4] and extract high *information rent*, may face the problem of *incentive effect* from borrowers to support business efficiency. Borrowers understand that the source of interest rate-based information rent is entrepreneurial and/or personal income. Accordingly, the higher the lending rate, the more of its income borrowers will give to owners of loan capital, thereby limiting the growth of their wealth. A modern view on this problem is presented in the work of the Central Bank of the Russian Federation [17].

Banks are therefore economically motivated to exchange credit information. In the process of such exchange of information rent, that generating income *(P)* is distributed among all creditors, motivating the latter to find and improve their competitive advantage. In the end, *all other things being equal*, the active exchange of credit information will help to reduce the unpredictable amount of risks and, consequently, will reduce the average interest rate in the credit system. In other words, more accurate assessment of the creditworthiness of customers, their possible defaults will allow more adequate adjustment of interest rates for the respective groups of borrowers.

Separately, we note that at present, questions remain open for discussion on how complete the information exchange between creditors in a market economic system should be. It is quite possible that a "partial" rather than a full exchange of information can be economically more profitable for some creditors and borrowers, debt issuers and investors [13]. This is especially relevant for economic systems with a high concentration of bank capital. In our opinion, in this case it is the State that is able and should lay the foundations for the development of "rules", rules for information exchange, ensuring competitive access to critical information to a wide range of financial market participants, to be used in the decision-making process to extend credit.

The scientific works of J. Stiglitz and A. Weiss [18] show in a systematic way how the balance in the credit market can be formed under conditions of asymmetry of information (*credit rationing equilibrium*). According to scholars, the interest rate fluctuation is determined not only by the level of competition in the credit market, but also to some extent by the (not) uniformity distribution of information about borrowers among lenders themselves. It follows that, all other things being equal, the increase in profitability of credit operations is determined by changes in the quality of borrowers. As the interest rate on the credit grows, the share of "quality" borrowers who could service their credit debts in full and on time will gradually decrease. Conscientious borrowers faced with higher interest rates will refuse credit. They will be replaced by less reliable borrowers who allow delay payments on the part of existing debt and/or can use the loan funds not for designated purpose. Consequently, a further increase in interest rates will increase the number of high-risk borrowers (*adverse selection effect*).

The response of banks to the presence of asymmetry of information in the credit market is credit rationing. Moreover, credit rationing can be at least two types. Thus, the first type of rationing relates to the situation where, at a given interest rate, the lender limits the amount of the credit to the individual borrower. The second type of rationing occurs when

[4] If it is treated as the ultimate hypothetical version.

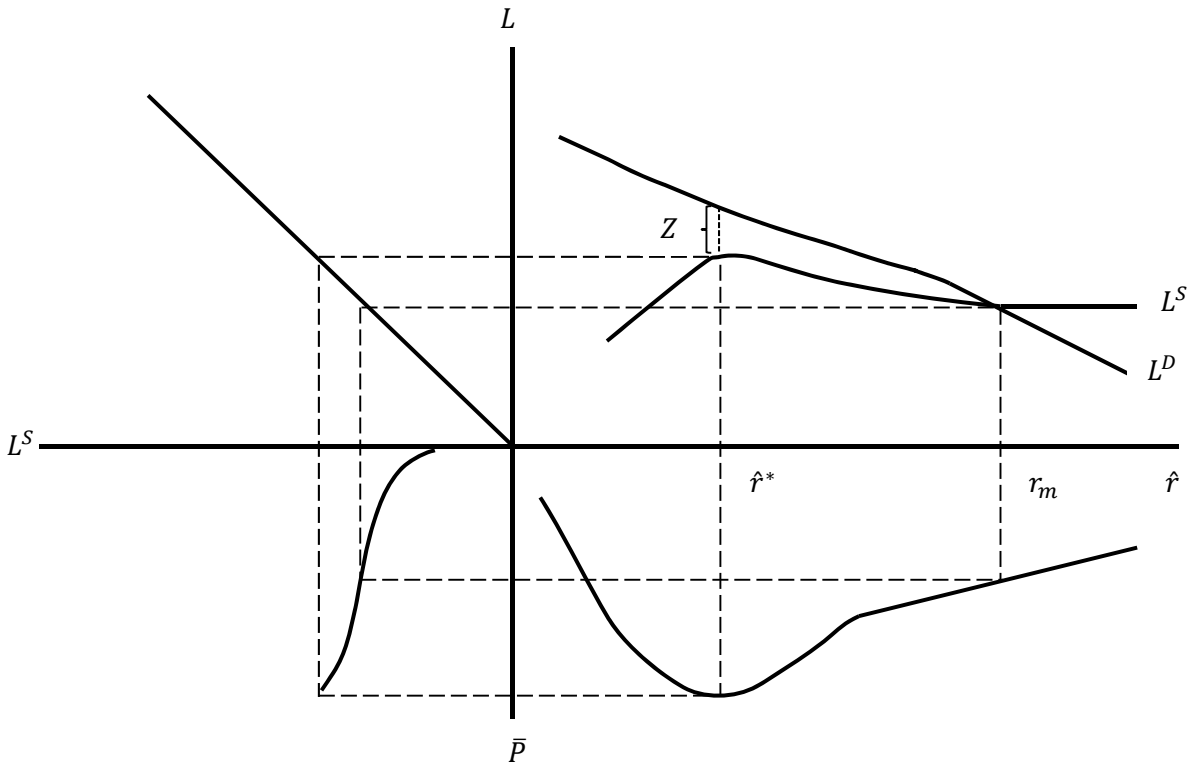

Fig. 1. **The Market Equilibrium in the Credit Market with Information Asymmetry**

Source: [18].

Note: L^S – supply of loan; L – loans (supply/demand); $\bar{P}$ – average expected return (credit body and interest) per currency of loan; $\hat{r}$ – loan interest rate; L^D – demand for loan; $\hat{r}^*$ – the optimal interest rate; r_m – the interest rate at which the demand for loan equals the supply for loan; Z – the excess (unsatisfied) demand for loan.

borrowers do not differ in the parameters assessed, but creditors do not satisfy all applications [19]. These measures of banks are very logical, as the interest rate and the volume of mortgaged property have a direct impact on the quality of the credit portfolio.

Credit rationing in the credit market may generate an excess (unsatisfied) demand for credit $\left(Z = L^S - L^D\right)$. Nevertheless, this credit market condition is described as the balance of credit rationing (*Fig. 1*).

Emphasize that currently there are different versions in the description of market equilibrium in the credit market under conditions of asymmetry of information. One of the first works can be considered by J. Stiglitz and A. Weiss [18], D. De Meza and D. Webb [20], W. English [21]. This study will be based on the basic model J. Stiglitz and A. Weiss and its analytical description presented in the paper D. De Meza and D. Webb. The feature of the basic model is the consideration as borrowers of entrepreneurs who plan to take a credit to cover the deficiency amount *(B)* in the implementation of projects. The initial assumptions are that entrepreneurs and banks are risk-neutral and all business projects have the same return *(R)* and differ only in the level of risk. The risk of adverse selection and the *main source of information asymmetry* is that banks do not have complete information about the success of projects, while entrepreneurs are more aware. Each entrepreneur applies to the bank for a credit with one project (i). The probability of project success is equal (p_i), and each entrepreneurial project provides income $\left(R^s\right)$. In this case, some projects will fail with probability $(1-p_i)$ and will bring the same low income in size $\left(R^f\right)$.

The expected income of the entrepreneur is determined by the expression:

$$E\left(R_i\right) = p_i \cdot R^s + \left(1-p_i\right) \cdot R^f, \qquad (1)$$

and expected profit of the entrepreneur, taking into account the costs of repayment of principal and interest payments:

$$E(\pi_i) = E(R_i) - (1+r)\cdot B, \quad (2)$$

where r — credit interest rate, uniform for all borrowers (entrepreneurs).

If the project fails, the profit of the entrepreneur is zero:

$$R^f - (1+r)\cdot B = 0, \quad (3)$$

i.e. the income from the project is at best sufficient only to cover the cost of the base debt and interest.

Income from business projects is a source for repayment of loaned value to the bank and payment of interest. In other words, the bank receives a portion of the business income received, which covers the amount of credit provided (B) and provides interest rate $(r\cdot B)$, i.e. interest income. In an analytical form, the income that entrepreneurs give to banks is: $(1+r)B$. The probability of an entrepreneur applying for a loan to finance the project (i) is ρ_i.

When describing the expected income that entrepreneurs have to give to the bank, it should be noted that unsuccessful projects will lead to problematic debts with creditors, i.e. banks will not receive the planned increase in loan capital:

$$R^f < (1+r)\cdot B. \quad (4)$$

In the case of limiting, when projects bring no business income at all, $R^f = 0$.

Hence, the expected total repayments (loan body and interest) that the bank will receive from entrepreneurs, including taking into account the implementation of failed projects, is described by the function:

$$E(R_b) = (1+r)Bp_i\int_0^{\rho} g(\rho_i)d\rho_i + R^f(1-p_i)\int_0^{\rho} g(\rho_i)d\rho_i, \quad (5)$$

where $g(\rho_i)$ — density functionя (ρ_i) on entrepreneurs; ρ_i — the probability of entrepreneurs turning for a loan, which takes many possible values on a segment $[0, \rho]$ and is monotonously decreasing function at interest rate (r):

$$\rho = e^{(-a_1 r)}. \quad (6)$$

In the case of limiting, if the interest rate *(r)* was zero, then the probability of customers turning to the bank would be 100%.

The first term in formula (5) reflects a certain set of entrepreneurs who applied to the bank for a credit with probability (ρ_i), with successful projects, which provides a positive increase in the bank's loan capital. The second component of formula (5) shows that credit is sought by those entrepreneurs who are more aware that their projects will fail.

The ratio of aggregate repayments to loans granted $(\overline{P}_b)$ describes the degree of loan capital increase:

$$\overline{P}_b = \frac{E(R_b)}{B}. \quad (7)$$

According to the basic model, a single bank can achieve the highest average expected total repayments of its credit debt (curve in the lower right quadrant *Fig. 1* at the optimal rate ($\hat{r}^*$) and a certain ratio of the combination of conditionally "good" and "bad" borrowers). In other words, the bank calibrates the interest rate *(r)* so as to maximize the total cash flow in the form of loan payments, i.e. equality is ensured $dE(R_b)/dr = 0$:

$$\frac{dE(R_b)}{dr} = \underbrace{B\int_0^{\rho} p_i g(\rho_i)d\rho_i}_{\substack{\text{payments on}\\ \text{successful}\\ \text{projects}}} + \underbrace{\left(\frac{d\rho}{dr}\right)\left[(1+r)Bpg(\rho) + R^f(1-p)g(\rho)\right]}_{\substack{\text{reduced potential repayment}\\ \text{of credits (negative component)}}}. \quad (8)$$

As the interest rate rises, the right part of the term (8) will also increase: a set of clients with successful projects that could provide the bank with total value $(1+r)B$, will decline, good borrowers will be replaced by unfair. This allows banks to implement credit rationing.

If any creditor considers it necessary to raise the rate, for example, $r_2 > \hat{r}^*$, to attract borrowers serviced by other banks, it will lead, first of all, to the inflow of high-risk borrowers to it and, as a result, to reduce the aggregate credit payments.

At the same time, there is a certain rate in the credit market (r_m), at which the demand for credit can be fully satisfied $(Z=0)$. However, this rate is not equilibrium under conditions of information asymmetry in the credit market. By offering a lower interest rate ($\hat{r}^*$) than the rate (r_m), the creditor will attract more borrowers and provide a higher total debts ratio per currency of loaned funds $(\overline{P})$.

In our opinion, the above conclusions are also valid in the case of the analysis of borrowers — individuals. Despite credit market and institutions such as credit bureaus that reduce information asymmetry, adverse selection risks remain in modern infrastructure. Among the borrowers will always be citizens who have no credit history or do not have a long-term credit relationship with banks, on the basis of which it is possible to form the most accurate estimates on their creditworthiness. The distribution of such borrowers into credit rating categories does not yet guarantee the fact that all loan applications within one subgroup will be satisfied or that the interest rate will be strictly dependent on a subgroup of borrowers. It is the implementation of credit rationing that allows banks to form a loan portfolio that combines various groups of borrowers accessing credit on various terms.

RESULTS

In order to develop scientific research on the problems of asymmetry of information, we suggest taking into account *those qualitative changes that occur in the credit market in the context of digitalization, among which we can highlight*:

- arrival of analytical companies providing collection and processing of large amounts of information calculated credit ratings for users of credit histories (creditors);
- expansion of the functionality of existing infrastructure credit market institutions, including credit history bureaus;
- emergence of new participants' credit market (for example, *BigTech*- companies), offering their own loan programs;
- development of models and online information platforms for providing credit that exclude traditional banks in a certain part (P2P, P2B-lending);
- development of information exchange channels among users of credit information, including blockchain technologies.

Fig. 2 schematically presents new technologies, which are gradually introduced into business processes of formation of credit reports.

With digitalization and the accumulation of large amounts of household data, it is possible to supplement traditional (credit) information with alternative non-credit data (municipal services, telecommunications operators, payment platforms, etc.), *Fig. 3*.

In this aspect, the Central Bank of the Russian Federation analyses the legal and economic basis for "enriched data"[5] of credit histories with alternative data. In 2017, the Central Bank of the Russian Federation initiated a discussion on the possible addition of suppliers of credit histories (banks, microfinance organizations) data sources such as the Pension Fund of the Russian Federation (PFR); the Federal Tax Service (FTS); the Federal Bailiff Service (FBS); the Federal Service for State Registration, Cadaster and

[5] Data enrichment is a well-established term that describes qualitative addition of traditional credit information to other, non-credit information, which allows to increase the adequacy in the formation of assessment of creditworthiness of borrowers. This term is used by the Bank of Russia.

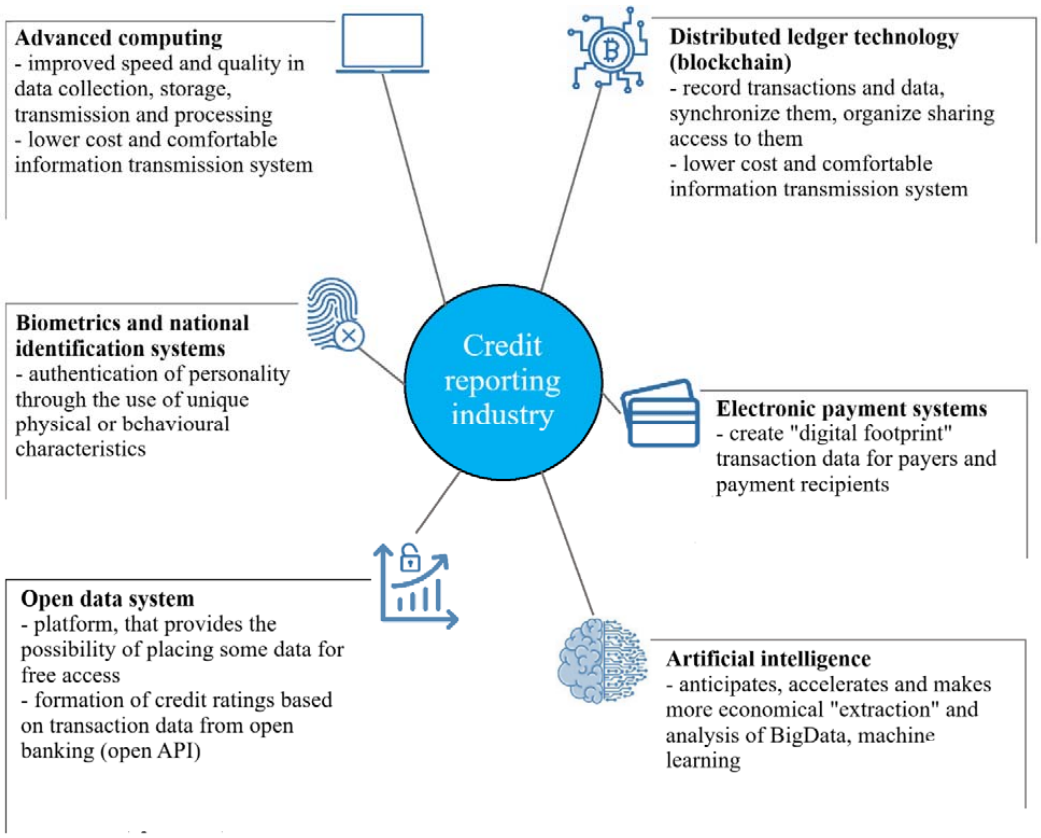

Fig. 2. **New Technologies Used in the Credit Reporting Industry**

Source: Compiled by author based on World Bank materials. URL: https://documents1.worldbank.org/curated/en/587611557814694439/pdf/Disruptive-Technologies-in-the-Credit-Information-Sharing-Industry-Developments-and-Implications.pdf (accessed on 08.05.2022).

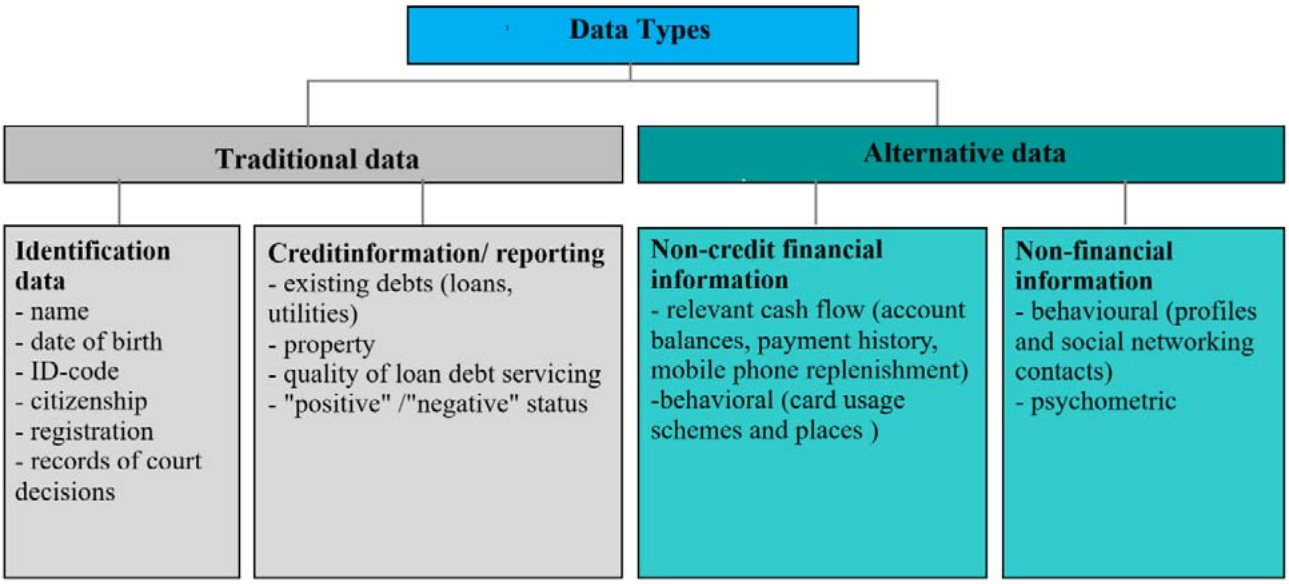

Fig. 3. **Types of Data for Current and Perspective Credit Reports**

Source: Compiled by author based on World Bank materials. URL: https://documents1.worldbank.org/curated/en/587611557814694439/pdf/Disruptive-Technologies-in-the-Credit-Information-Sharing-Industry-Developments-and-Implications.pdf (accessed on 08.05.2022).

Cartography (Rosreestr); the State Inspection for the Safety of Road Traffic (SISRT or GIBDD in Russian); the Federal Service for Supervision of Communications, Information Technology and Mass Communications (Roskomnadzor) [1, 23]. It is suggested that a broader range of borrower information may even lead to a reassessment of the importance of collateral as an indicator of creditworthiness [24].

Implementation of the Central Bank of the Russian Federation's intentions on "enriched data" of credit histories implies further development of the system of infrastructure institutions of the credit market: credit history bureaus (SHBs), rating agencies, analytics companies that aggregate *Big Data* and use *machine learning* technologies to calculate credit ratings. In the foreign scientific literature, the same institute SHBs is often referred to as an information broker [14], which provides accumulated information on borrowers to users of credit information. In this way, SHBs can reduce creditors' costs of finding the necessary information [25] and provide more equitable access to it.

In our opinion, possible organizational and managerial decisions at the state level on the complex development of the system of credit infrastructure institutions, supporting the development of new channels of organizational relations between users and aggregators of credit information (professional creditors, SHBs, analytical companies), application of modern technologies of *Big Data* collection and analysis, *machine learning*, expansion of traditional sources of credit information alternative (non-credit) makes a qualitative contribution to solving the problem of asymmetry of information in the condition of digitalization.

In terms of the credit market, the expected economic effect of the implementation of organizational and managerial decisions is expected to be the achievement in addition of potential aggregate payments per unit of loaned funds $\left(\overline{P}\right)$. Banks will be able to more accurately assign borrowers to appropriate credit rating subgroups and assess their creditworthiness. At the same time, it is expected to increase the availability of credit to potential borrowers — individuals by analyzing alternative (non-credit) data. This, in turn, will allow for a greater degree to satisfy (latent) demand for credit from customers without credit history and/or demotivated due to determining their high interest rates.

Theoretically, we consider that the definition of market equilibrium in a credit market with information asymmetry, as illustrated above (*Fig. 1*), is, all other things being equal, a limit state: Interest rates are "biased" relative to the optimal value ($\hat{r}^*$), and the average ratio of the expected aggregate repayments to the value of the credit provided has the potential to increase.

In practice, under conditions of digitalization, the infrastructure and information development of the credit market only contributes to the movement of the credit market to achieve equilibrium credit rationing. Let's analyze this remark in *Fig. 4* taking into account the assumptions made in the basic model J. Stiglitz and A. Weiss.

Under this assumption, the banking system operates close to the optimum average expected cumulative payments per currency of loaned funds $\left(\overline{P}^*\right)$. On the graph these states are marked in the lower right quadrant by points A and A^* respectively. At point A in the credit market, the weighted average interest rate on the credit is formed $\left(r_1\right)$, which provides the average expected aggregate repayments per unit of loaned funds $\left(\overline{P}_{b1}\right)$ under the current level of information asymmetry. In other words, in the market there is "bias" in assessments of the success of projects / creditworthiness of borrowers, which can be expressed in theory in absolute deviation of rates from its optimal value $\left(\vartheta_r\right)$:

$$\vartheta_r = r_1 - \hat{r}^*, \qquad \left(\vartheta_r > 0\right). \tag{9}$$

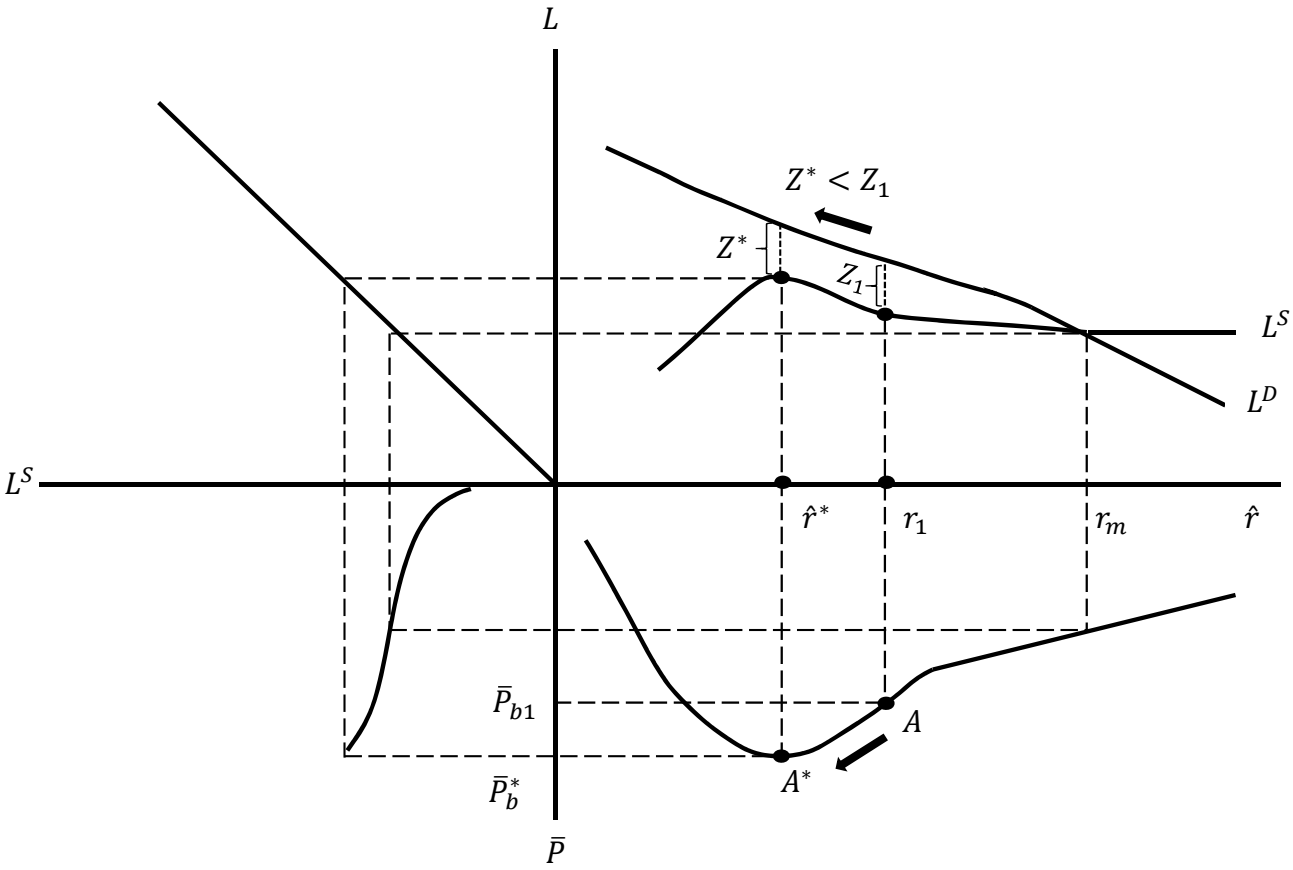

Fig. 4. **Market Equilibrium Achievement in the Credit Market with Information Asymmetry in the Context of Digitalization**

Source: Compiled by author based on [18].

Note: $\bar{P}, \bar{P}_1, \bar{P}^*$ – average expected cumulative payments per currency of borrowed funds; $\hat{r}^*, r_1$ – loan interest rate; Z_1, Z^* — the different levels of excess of (unsatisfied) demand for loan.

Accordingly, the individual bank does not reach the potential accumulation of loan capital increase of $\left(\vartheta_{\bar{P}_b}\right)$:

$$\vartheta_{\bar{P}_b} = \bar{P}_{b1}^* - \bar{P}_b, \ \left(\vartheta_{\bar{P}_b} > 0\right). \quad (10)$$

Due to the fact that banks do not have reliable and complete information on the basis of which it would be possible to achieve the minimization of defaults or their local minimums as for existing borrowers, and for clients without credit history and/or demotivated previous experience of applying to the bank, credit demand remains unsatisfied at the rate of $\left(Z_1\right)$. However, as noted above, the construction of an effective system of exchange of credit information with the development of institutions of the credit market infrastructure, as well as the use of modern technologies of collection and processing of Big Data, is will expect to provide more precise adjustment of the interest rate, to increase the average level of return of the banking system on credit operations. Degree of "bias" of interest rates will decrease. All other things being equal, as a result of more efficient exchange of information, qualitative level of its processing, the interest rate on the credit $\left(r_1\right)$ will decrease and only in the limit can reach the amount ($\hat{r}^*$), bringing the banking system to the optimal state $\left(\bar{P}^*\right)$. At the same time, we do not exclude that infrastructure and information changes will reduce the amount of unmet demand for credit: $Z^* < Z_1$.

Table

Estimation the Increase in Loan Funds as a Result of a Loan

Credit (traditional) sources						
Borrowers	**Default prob.** $(1-p_i)$	**Credit rating category**	**Principal** (B)	**Rate of interest** (r_1)	**Total value** $E(R_b)$	**Exp. return on loan** $(\bar{P}_b)$
Borrower 1	0	A	100	10	110	1.10
Borrower 2	0	A	100	10	110	1.10
Borrower 3	0.5	C	50	15	28.75	1.15
Totals			250	11.00*	248.75	0.995*
"Enriched" data about borrowers						
Borrower 1	0	A	100	10	110	1.10
Borrower 2	0.2	B	80	12	89.6	1.12
Borrower 3	0	A	100	10	110	1.10
Totals			280	10.57*	248.75	1.106*

Source: Compiled by the author.

Note: * The interest rate in the final line was calculated as a weighted average.

Alternative (non-credit) information in addition to information from credit reports is likely to lower price barriers for individuals who do not have a credit history and/or have a negative experience of applying to banking institutions for a credit. However, the opposite effect of reallocating existing borrowers to credit rating groups cannot be excluded. In addition, a certain share of the unsatisfied part of the demand for credit in today's digital economy may reasonably be satisfied through alternative banks "suppliers" of credit, for example, large technology companies (*BigTech*) with their own credit programs, as well as crowdlending online loan platforms.

Let us illustrate the above scientific findings with a small example. Suppose 3 borrowers apply to the bank for a credit of 100 currency units for a period of one year. Two of the borrowers have a credit history and the highest credit rating of 4 possible categories. The third borrower has no credit history, i.e. he is in some "gray" zone for the bank. Based on the hypothetical data presented in the *Table*, we will determine the increase in loan capital as a result of the provision of credit. In this case, consider two scenarios: a) the bank determines the amount and interest rate on the credit based only on credit (traditional) information, aggregated by CHBs in the Central Catalogue of Credit Histories; b) the bank determines the amount and interest rate on the credit on the basis of "enriched" credit information with alternative data, which become available in the digital environment.

The analysis of tabular data shows that in the digital environment, the available "enrichment" of traditional credit data by alternative sources allows to reduce the more unmet aggregate demand for credit:

a) $Z_1 = 300 - 250 = 50$; b) $Z_2 = 300 - 280 = 20$. In so doing, it is assumed, banks will be able to assess creditworthiness of borrowers with greater accuracy, including without credit history or having «short» credit history, which will eventually lead, all other things being equal, to a reduction in weighted average interest rates, defaults of borrowers and to increase in aggregate value payments in terms of loan debt servicing

CONCLUSION

In today's digital environment, it is possible to realize hidden reserves of growth of profitability of credit operations. To a certain extent, this is achieved through the development of financial intermediation, infrastructure institutions of the credit market and financial instruments. However, the State can make a significant contribution to solving the problem of information asymmetry in the credit market. In this respect, the supervisory authorities and, in particular, the monetary regulators have the regulatory potential both for the development of information exchange between users of credit information and for the development of functional institutions of the credit market.

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Combined Feature Selection Scheme for Banking Modeling

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ABSTRACT

Machine learning methods have been successful in various aspects of bank lending. Banks have accumulated huge amounts of data about borrowers over the years of application. On the one hand, this made it possible to predict borrower behavior more accurately, on the other, it gave rise to the problem a problem of data redundancy, which greatly complicates the model development. Methods of feature selection, which allows to improve the quality of models, are apply to solve this problem. Feature selection methods can be divided into three main types: filters, wrappers, and embedded methods. Filters are simple and time-efficient methods that may help discover one-dimensional relations. Wrappers and embedded methods are more effective in feature selection, because they account for multi-dimensional relationships, but these methods are resource-consuming and may fail to process large samples with many features. In this article, the authors propose a combined feature selection scheme (CFSS), in which the first stages of selection use coarse filters, and on the final — wrappers for high-quality selection. This architecture lets us increase the quality of selection and reduce the time necessary to process large multi-dimensional samples, which are used in the development of industrial models. Experiments conducted by authors for four types of bank modelling tasks (survey scoring, behavioral scoring, customer response to cross-selling, and delayed debt collection) have shown that the proposed method better than classical methods containing only filters or only wrappers.

Keywords: feature selection; machine learning; feature importance; filters; wrappers; embedded methods

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INTODUCTION

Machine learning methods have been successful in various aspects of bank lending. Huge amounts of data allow more accurate to predict the behavior of the borrower, while is causing the problem of data redundancy, which complicates the development of models and can lead to unsatisfactory results. To solve this problem, various methods of feature selection were proposed [1]. The basic concept of these methods is to reduce the dimension of the feature space by excluding redundant features.

The methods of feature selection proposed in the scientific literature are divided into three types: filter methods, wrapper methods and embedded methods [2].

Most of the proposed methods in the scientific literature are tested on open repositories that contain either few observations (a few dozen to several thousand), or few features (a few dozen) [3–5]. In practice, bank modeling uses samples, that are orders of magnitude more scientific databases, and include from several hundred thousand to several million observations and from several hundred to several thousand features. On such samples, the methods proposed in the studies either do not produce a declared result or work for a very long time. To solve these problems, we offer the method of Combined Feature Selection Scheme (CFSS), which is a hybrid multi-stage selection scheme, where filters are used in the first stages and wrappers in the subsequent stages. As filters we use methods for cleaning data, feature stability check, feature correlation with target variable, cross-covariance matrix [6] and VIF analysis [7], as wrappers — permutation method

based on a Random Forest [8] and evaluation of p-value features using the Backward Elimination method [9].

Our proposed method was tested on four samples for different banking tasks: prediction of the probability of a credit overdue at the time of application (Application PD), prediction of the probability of future credit overdue during life of the loan (Behavioral PD), evaluation of client response to advertising (CRM PTB) and estimate the transition probability of a credit overdue in a later month (Collection Allocation).

The results showed that the CFSS method works well on large high-dimensional samples. We have also demonstrated that the CFSS method achieves a higher generalization ability of the models through a flexible combination of filters and wrappers than the non-filter wrapper method. Additional experiments have shown that the CFSS method is ten times faster than classical feature sampling methods, which is an important advantage of the method in industrial applications.

REVIEW OF THE LITERATURE

Filters

The simplest feature selection methods include filters that allow the selection of features independently of the model being developed.

The selection of variables by the matrix of correlation (CFS) allows the assessment of subsets of features, based on the hypothesis that good subsets contain features that are not correlated with each other but strongly correlated with the target variable. The simplest way to highlight strongly correlated features is to build matrix of pair correlations features. This approach has been widely adopted in practice. The advantages of the method include simplicity of implementation and interpretation. Disadvantages of the method include sensitivity to data quality (emissions, errors, etc.), as well as inability to identify multi-factor relationships.

Principal Component method (PCA), proposed by Karl Pearson in 1901 [10] and still a popular method in applied problems, reduces dimension by computing the main component of the feature matrix and then reducing the dimension of the matrix through its singular decomposition [11]. Among the advantages of the method can be noted the simplicity of its implementation. The disadvantages of PCA include scale sensitivity, difficulty in selecting cut-off score for the main components, and the fact that PCA does not take into account the target variable, so that the main components may not be informative.

Despite these disadvantages, filters are actively used in practice and are still the subject of scientific research. Zhang and co-authors [12] use Welch's t-test to develop algorithms for early computer diagnosis of Alzheimer's disease

Roffo and Melzi [5] propose a method for selecting features based on the analysis of the graph, where the vertices of the graph are the investigated features, and the edges — are the strength of the connection between the features. The authors assume that the eigenvector will contain rank-by-importance features with the maximum main component in the adjacency matrix of the graph. If the coefficients of linear correlation between features are used as a link function, then the adjacency matrix of the graph becomes a standard correlation matrix.

Wrappers

Among wrapper methods, the most popular was the stepwise regression methods: Forward Selection method [13], Backward Elimination method [13] and Stepwise method [14].[1] Despite its simplicity and effectiveness, stepwise regression methods have been criticized in the scientific community [15].

In the scientific literature also, much attention is paid to metaheuristic optimi-

[1] SAS Institute Inc. (1989) SAS/STAT User's Guide, Version 6, Fourth Edition, Vol. 2, Cary, NC. URL: https://www.scirp.org/reference/ReferencesPapers.aspx? ReferenceID=1542754 (accessed on 07.02.2023).

zation algorithms for feature selection, which include: Particle Swarm Optimization (PSO) [16], Grey Wolf Optimization (GWO) [14], Genetic Algorithm (GA) [17, 18], Bee Swarm Optimization (BSO) [19] and etc. Shen and Zhang proposed an Improved Two-Step Gray Wolf Optimization (IGWO) [3], where at the first stage the authors propose to use the nested regularization method LASSO, on the second — Grey Wolf Optimization method (GWO). Basak and co-authors have proposed the Reinforced Swarm Optimization (RSO) [4] wrappers method, which is an improved Bee Swarm Optimization algorithm, where instead of BSO optimization the reinforcement learning approach is used. Feature selection methods based on metaheuristic algorithms are widely used to select a good approximation in various complex optimization problems, but they do not always provide the best solution because that the training of the final models can be done with other machine learning algorithms for which the selected features may not be optimal.

Among other effective wrappers there are permutation methods based on random forest [18, 20]. In permutation methods, evaluated features are not removed from the sample, i.e. the feature space remains unshifted. Important advantages of permutation methods based on random forest algorithms include the possibility of obtaining unbiased importance estimates using randomized trees (unlike the gradient boosting, where the trees are dependent and the evaluation is biased). The disadvantages of these methods include high computational complexity, which limits the applicability of these methods to large, high-dimensional samples. Celik and co-authors [8] tried to solve this problem by proposing the permutation method New Approach, which showed high efficiency in working speed on large samples. However, the authors have demonstrated that permutation methods do not work well on high-dimensional samples when the number of features is counted several thousand or more.

Embedded Methods

Regularization refers to the embedded methods group where feature selection becomes part of the model building process. In the logistic regression, which became the banking standard [21], the most common regularization methods are L1 (LASSO) [22] and L2 (Ridge) [23] (Tikhonov regularization [24]). The general concept of regularization is to add a penalty element to a functional error that punishes the model for excessive complexity. Regularization of L1 allows to nullify part of weight regression coefficients, and regularization of L2 limits their norm [25]. L1 regularization has a number of disadvantages and does not work well on high-dimensional data with few observations. Zou and Trevor [26] suggest circumventing these limitations with the Elastic Net approach — a combination of L1 and L2 methods.

COMBINED FEATURE SELECTION SCHEME

Pros and cons described in the scientific literature impose limitations on the applicability of the proposed methods of feature selection to practical business tasks. If you need fast methods with low computing requirements, filters will be the most optimal. For higher quality models, wrappers and embedded methods should be used, which may require more computing power. It is important to note that research results may not be reproduced in practice on large, high-dimensional data. These problems motivated us to develop a method of combined feature selection that includes 10 steps of data processing (*Fig. 1*).

Data Quality Analysis

Data quality — a generalized concept reflecting the degree of suitability of data to solve of certain task. Among methods of data quality analysis can be distinguished:

1) Exploratory Data Analysis (EDA) [27] — to identification basic properties of data, to

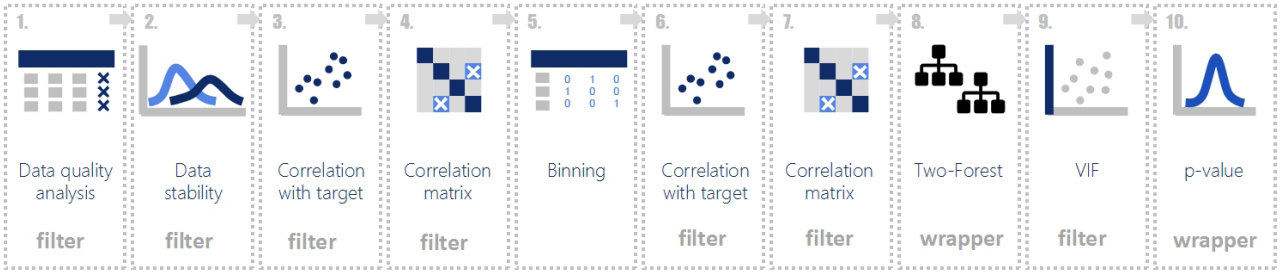

Fig. 1. **Combined feature selection scheme**

Source: Compiled by the authors.

find general patterns, analysis of distributions, emissions, etc.;

2) Analysis of omissions and incomplete data — is conducted using statistical indicators such as the number of non-empty observations, omissions, minimum and maximum values, median, modal value, standard deviation, quantili, etc.;

3) Analysis of anomalies — statistical and expert analysis of the reasons for the occurrence of observations beyond the acceptable range of the variable. The main working methods with anomalies are reduced to the construction of the distribution according to the observed variable and the subsequent definition of thresholds values in the "end" distribution. Alternative methods of working with anomalies are also used, such as monotonic transformation of variables (logarithmic, etc.), calculation of z-score, etc.[2]

Analysis of Data Stability and Continuity

Statistical algorithms depend on continuous and stable data. The reason for the instability in the data can be changes in the bank's business processes, legislation, customer behavior, data formats, etc.

Before evaluating stability, all string variables must be converted to numeric format using LabelEncoder[3] (omissions are replaced with unique numeric value). To estimate the stability of features it is necessary to calculate the divergence between distributions built on different time periods. To do this, stability is assessed for different periods:

1) *large periods:* the sample is divided into equal sub-samples with a large interval (for example, by half-years), after which on these sub-samples in pairs the distributions of features on the principle "each with each" (*Fig. 2a*);

2) *small periods:* the total sample is divided into equal small sub-samples (for example, monthly), after which the features by contiguous periods distributions are compared in pairs (*Fig. 2b*).

In the CFSS scheme, three values are calculated and averaged to calculate the divergence between sub-samples: S- statistics [28], population stability index (PSI) [29] and Kolmogorov-Smirnov statistics (KS) [30].

This method allows to detect both long-term changes features (instability over large periods) and frequent short-term changes (instability for small periods).

Correlation of Features with the Target Variable

Correlation analysis of features with target variable allows to select features that strongly influence target variable. At the same time, this method does not take into account complex dependencies between the features, so it can be attributed to "rude" filter methods that can be used for the primary selection of features.

Correlation analysis methods depend on the type of target variable and the type researched feature.[4]

[2] Understanding Statistics. Graham J.G. Upton, Ian T. Cook. Oxford University Press, 1996. URL: https://books.google.ru/books?id=vXzWG09_SzAC&printsec=frontcover&hl=ru#v=onepage&q&f=false (accessed on 30.01.2023).

[3] URL: scikit-learn.org/stable/modules/generated/sklearn.preprocessing.LabelEncoder.html (accessed on 30.01.2023).

[4] Aivazyan S.A., Mkhitaryan B.S. Applied statistics. Basics of econometrics. Textbook for universities. In 2 vol., 2nd edition. Vol. 1. Probability theory and applied statistics. Moscow: IUNITI-DANA; 2001. 656 p.

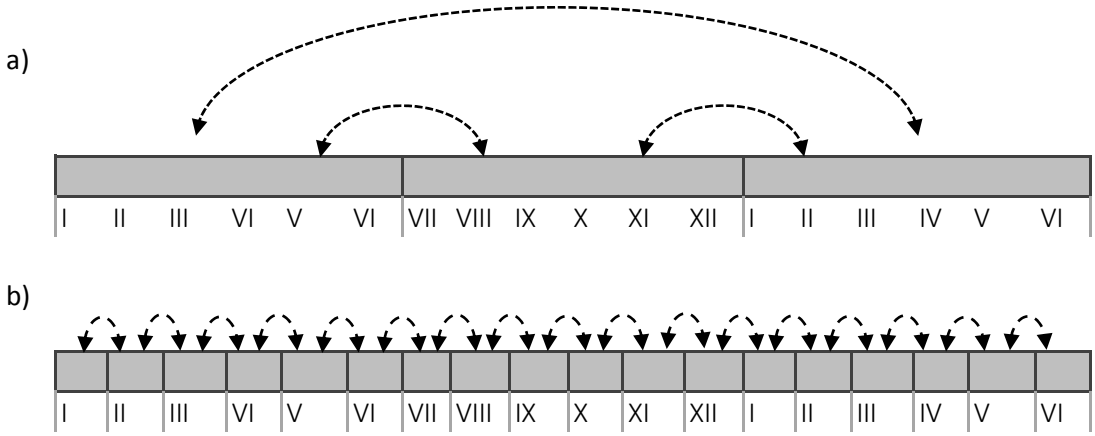

Fig. 2. **An Example of a Split into Periods to Estimate the Stability of Feature a) large Periods; b) Small Periods**

Source: Compiled by the authors.

Note: Months are indicated by Roman numerals.

Features, that do not pass test on correlation value with target variable, are excluded from further analysis. Significance thresholds are set as heuristic or experimentally selected.

In the combined CFSS scheme, features are checked for correlation with the target variable twice — before binarization of features and after (step 6, *Fig. 1*).

Matrix of Correlation

Highly correlated features can be detected using a correlation matrix (CFS), which has the form:

$$R_x = \begin{pmatrix} 1 & r_{x_1x_2} & \dots & r_{x_1x_n} \\ r_{x_2x_1} & 1 & \dots & r_{x_2x_n} \\ \dots & \dots & \dots & \dots \\ r_{x_nx_1} & r_{x_nx_2} & \dots & 1 \end{pmatrix}, \quad (1)$$

where $r_{x_ix_j}$ — correlation between i and j features.

Pearson correlation is calculated for continuous features and Spearman's correlation for categorical and binary features.

In the combined CFSS scheme, feature selection with the correlation matrix is performed twice — before and after feature binarization (step 7, *Fig. 1*). Threshold values for feature selection are set as heuristics and depend on the type of task. For our experiments we set the following thresholds: 90% for the stage "before binarization of features" (weak filtering) and 70% for the stage "after binarization of features" (strong filtering).

Dummy-Coding of Categorical Variables

After the feature selection by primary filters, it is necessary to convert the categorical features into binary variables for their possible use in regression algorithms. For logistic regression, the dummy-coding procedure [31] is used by full rank method when one of the categories is removed. Thus, after dummy-coding the categorical variable is $k - 1$ binary variable, where k — is the number of categories in the original feature.

After transformation of categorical feature for each new binary variable the number of observations of "positive" class will be calculated. All binary variables for which the number of observations of the "positive" class is less than the specified threshold of significance is combined into one category. For other types of target variables, the number of observations in the category is considered. Significance threshold is set as heuristic or experimentally selected. For our experiments, we set the threshold at 10.

Two-Forest Method

After primary feature filtering, CFSS uses wrapper methods that consider complex relationships between features. Random forest selection methods are the most accurate wrappers [18, 20]. To select a random forest method, need to evaluate the importance of each features using one of two approaches:

1. Importance by reducing heterogeneity:

1) for each tree in a random forest, the sum of the decreases in the heterogeneity of all branches associated with this variable is calculated;

2) the total amount of heterogeneity decreases is divided by the total number of trees;

3) steps (1) and (2) are repeated for all variables.

The desired importance of a feature — is the frequency with which a variable is used as a predictor of branching.

2. Importance based on reduced quality forecasting in case of random permutation:

1) Random forest model is trained;

2) an error is calculated on the test/OOB multiple;[5]

3) variable (or group of variables) is fixed and its values are randomly rearranged on test/OOB multiple;

4) calculates the difference between the error on the original multiple and the error on the multiple with the permutation.

The calculated error subtraction is the permutation importance of the variable.

The CFSS scheme uses an adapted New Approach [8] method, which we called Two-forest.[6] The general concept of the Two-forest method is evaluation the importance of features as quality forecasting at random permutation:

$$VI_j = P\left(Y \neq f\left(X_1,\ldots,X_j^*,\ldots,X_p\right)\right) - P\left(Y \neq f\left(X_1,\ldots,X_j,\ldots,X_p\right)\right). \quad (2)$$

1. Adapted Two-forest method works according to the following algorithm:

2. The training sample is representative of two equal parts.

3. Each sub-sample are training a random forest.[7]

4. Quality is assessed at sub-sample on which the model was not trained.

5. Each variable is randomly mixed and the result for each of the two models on the sub-samples is considered.

6. Calculates the subtraction between the baseline value obtained in step 3 and the new value.

7. The importance of the variable is calculated as the average of the importance value on two sub-samples.

The p-value value is calculated for the resulting value:

1) observations with negative values of importance are selected;

2) zero-value observations are selected;

3) negative values of importance are multiplied by (–1);

4) vectors obtained from steps (1)–(3) are concatenated;

5) a cumulative distribution is constructed for the resulting vector;

6) on the received distribution p-value is calculated.

8. Variables with p-value below a given threshold are selected. The following heuristics are possible:

1) divide the importance by the average value of the baseline, those variables whose change exceeds the specified threshold are selected;

2) sort the variables by importance values and select the first N variables (the number N

[5] OOB (Out-of-Bag) — quality assessment for each observation only for those trees of the ensemble that were not trained on this observation (i.e. using objects that were not part of the training sample for each base tree).

[6] Authors called the method "Two-forests" because in this approach learns two random forests at once.

[7] Different algorithms are used depending on the type of target variable: Random Forest Classifier — for the binary target variable; Random Forest Regressor — for continuous target variable.

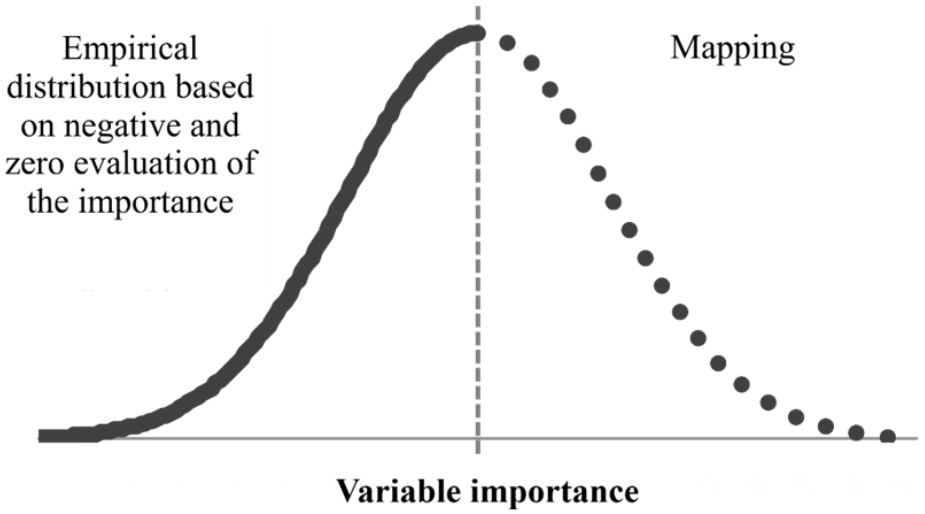

Fig. 3. **Example of Constructing an F Distribution Based on Irrelevant Features (i.e. with Negative or Zero Importance Evaluations)**

Source: Compiled by the authors.

is experimentally selected), the value p-value of the selected variables should be less than 10%.

VIF Analysis

Another approach to reduce multicollinearity between features is based on the estimation of indicator VIF (Variance Inflation Factor) [7]. To calculate this indicator, it is necessary to construct a linear regression for each explanatory factors (as a target variable) from all other features. Selection by VIF analysis is based on the following algorithm:

1. For each feature X_i is training linear regression, in which X_i is a function of all other features:

$$X_i = \beta_0 + \sum_{j=1}^{k} \beta_j X_j, \quad i \neq j, \tag{3}$$

where β_0 — is the member of regression;

k — total number of features (including analysed).

2. VIF coefficient for feature X_i is calculated:

$$VIF_i = \frac{1}{1 - R_i^2}, \tag{4}$$

where R_i^2 — coefficient determinant of regression based on step 1.

3. Evaluation of obtained VIF values is carried out, where a general empirical rule is applied: features with VIF > 10 refer to multicollinear [32]. A feature with a maximum VIF value is removed from the list of multicollinear features.

4. Steps 1–3 are iteratively repeated until the maximum value of VIF for the remaining features is less than or equal to 10.

Statistical Significance of Features

The final step in the CFSS scheme is to check the statistical significance of the features based on the likelihood ratio test.

The procedure estimate of statistical significance features by a test of the likelihood ratio boils down to the verification of the null hypothesis of the value of feature through the evaluation of the probability ratio statistics. For a model with a parameter vector β it is necessary to test the $H_0 : g(\beta) = 0$, hypothesis with sample data, where $g(\beta)$ — collection (vector) of some parameter functions. To test the null hypothesis, the likelihood functions of the full model (i.e. trained on all n features) are compared to the shortened model without the feature being tested (trained on n — 1 remaining features). To do this, we calculate the likelihood ratio test:

$$LR = 2 \cdot (L_l - L_s) = 2 \cdot \ln \frac{L_l}{L_s}, \tag{5}$$

where L_l — the value of logarithmic function likelihood of full model;

Table 1

Characteristics of Samples for Banking Modeling Tasks

DataSet	Period of train and test samples	Out-of-time period (OOT)	Observations, amount	Features, amount	Minority class Percentage (bad-rate), %
PTB (CRM)	01.11.2019–30.01.2020	01.02.2020–28.02.2020	545 963	1222	1.28
Behavioral PD (Scoring)			1 195 466	1087	13.88
Application PD (Scoring)			793 080	423	3.60
Allocation (Collection)	01.06.2018–30.04.2019	01.05.2019–30.06.2019	256 220	162	37.19

Source: Compiled by the authors.

L_s — the value of logarithmic function likelihood of shortened model.

LR statistics under the null hypothesis have chi-square distributions with q degrees of freedom — $\chi^2(q)$, where q — number of restrictions (number of excluded features). If the value of this statistic is greater than the critical value of the distribution at a given level of significance, then the excluded feature is considered relevant and the full model is preferred. Otherwise, the deleted variable is recognized insignificant.

The p-value threshold is set as a heuristic or experimentally selected. In the tested CFSS scheme, the value level p-value was set to 0.05.

EXPERIMENTAL EQUIPMENT

Data

Data from a large Russian bank were used for experiments. Comparison selection methods were performed on four datasets for banking binary classification tasks:

1. *CRM: PTB (probability to bay)* — model of estimation of client's response to cross-sell loan offer.
2. *Scoring: Application PD (CASH)* — a model for estimating the probability of default at the lending stage (cash loans for individuals).
3. *Scoring: Behavioral PD (CASH)* — a model for estimating the probability of default over the lifetime of a loan, using behavioral information about the client's previous credit payments. This model allows to assess the level of credit risk on the loan portfolio for reserve and capital formation in accordance with the requirements of international financial reporting (IFRS 9) and on the basis of domestic ratings (IRB, Basel II).
4. *Collection: Allocation* — a model for estimating the probability of overdue on a loan in the later month of the payment schedule.

Characteristics of samples are presented in *Table 1*.

Experiment

The second experiment was conducted to compare the classic selection methods popular in banking practice and the CFSS scheme using the Two-forest method. Comparison between three selection schemes:

1. *Gini Scheme* — in this scheme at step 8 (*Fig. 1*) instead of Two-forest method the selection of features using Gini estimates was

Table 2

Comparison of Three Feature Selection Schemes: Gini, Forward, CFSS

Scheme	Models	Features, amount	Gini			
			LogReg		LightGBM	
			Test	OOT	Test	OOT
Gini Scheme (GS)	PTB (CRM)	1222	0.4157	0.4312	0.4380	0.4480
	Behavioral PD (Scoring)	1087	0.6843	0.6400	0.6904	0.6493
	Application PD (Scoring)	423	0.4051	0.3980	0.4251	0.4179
	Allocation (Collection)	162	0.6048	0.6075	0.6499	0.6494
Forward Scheme (FS)	PTB (CRM)	1222	0.4259	**0.4369**	0.4302	0.4481
	Behavioral PD (Scoring)	1087	**0.6907**	**0.6466**	**0.7068**	**0.6705**
	Application PD (Scoring)	423	**0.4164**	**0.4067**	0.4356	0.4203
	Allocation (Collection)	162	**0.6143**	0.6041	0.6418	0.6436
CFSS	PTB (CRM)	1222	**0.4332**	0.4340	**0.4401**	**0.4527**
	Behavioral PD (Scoring)	1087	0.6881	0.6439	0.7050	0.6682
	Application PD (Scoring)	423	0.4093	0.4051	**0.4390**	**0.4290**
	Allocation (Collection)	162	0.6111	**0.6085**	**0.6500**	**0.6507**
	Δ Gini					
Difference: (CFSS – GS)	PTB (CRM)	1222	**0.0174**	**0.0028**	**0.0021**	**0.0047**
	Behavioral PD (Scoring)	1087	**0.0038**	**0.0040**	**0.0146**	**0.0189**
	Application PD (Scoring)	423	**0.0042**	**0.0071**	**0.0139**	**0.0111**
	Allocation (Collection)	162	**0.0062**	**0.0011**	**0.0001**	**0.0013**
Difference: (CFSS – FS)	PTB (CRM)	1222	**0.0073**	-0.0030	**0.0100**	**0.0046**
	Behavioral PD (Scoring)	1087	–0.0025	–0.0027	–0.0018	–0.0023
	Application PD (Scoring)	423	–0.0072	–0.0016	**0.0034**	**0.0087**
	Allocation (Collection)	162	–0.0032	**0.0044**	**0.0082**	**0.0071**

Source: Compiled by the authors.

applied (Gini > 5%) for single factor logistic regressions (all other stages of selection of the general scheme remained unchanged).

2. *Forward Scheme* — in this scheme in step 8, feature selection using the method of Forward Selection was applied.

3. *CFSS* — combined selection using the Two-forest method (*Fig. 1*).

The methods listed were estimated as part of a 10-stage combination selection scheme, in order not to compare the obviously weak Gini and Forward methods with a strong Two-forest method.

As part of the second experiment, the time of the Forward and Two-Forest methods was also estimated.

RESULTS

The objective of the experiment was to compare the CFSS scheme with industry standard methods. Combined selection schemes were compared (*Fig. 1*) with the addition of three different selection methods in step 8: Gini (banking standard), Forward (banking standard) and Two-Forest (CFSS — our approach).

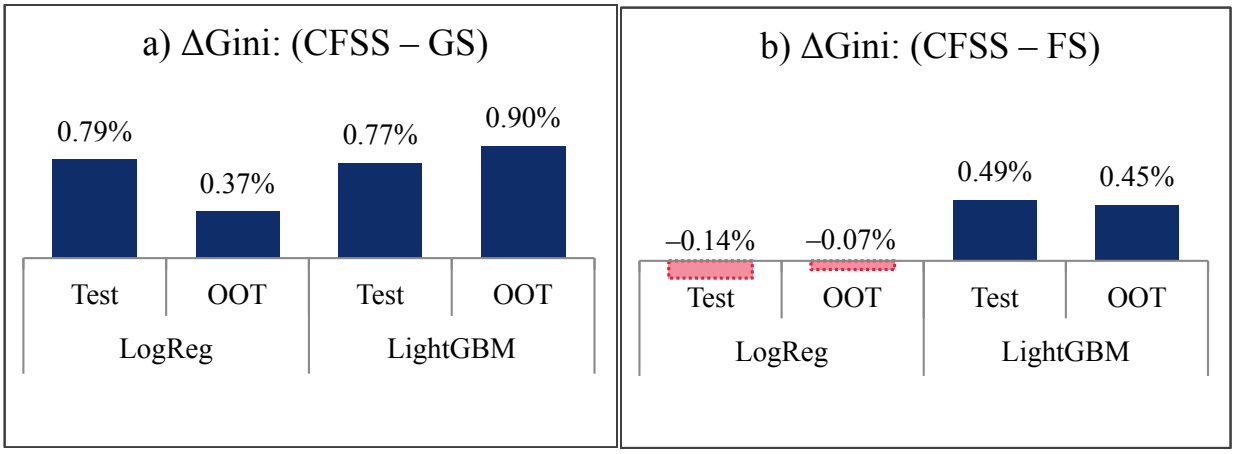

Fig. 4. **Comparison of Gini Scheme (GS), Forward Scheme (FS) and CFSS: a) Gini Difference between CFSS and GS Models; b) Gini Difference between CFSS and FS Models**

Source: Compiled by the authors.

Table 3

Selection Time of the Forward and Two-Forest Methods

Model	Observations, amount (Train)	Features, amount	Time (hh: mm: ss)		x-Times: Forward / 2Forest
			Forward	Two-Forest	
PTB (CRM)	303 220	1222	14:01:28	0:30:48	74x
Behavioral PD (Scoring)	588 385	1087	16:11:04	0:16:36	58x
Application PD (Scoring)	497 063	423	5:34:12	0:15:00	22x
Allocation (Collection)	172 250	162	3:06:40	0:05:50	32x

Source: Compiled by the authors.

The results of experiments (*Table 2*) showed that the Gini scheme lost on quality of Forward and CFSS schemes. On the other hand, the Forward scheme showed better results for logistic regression, and the CFSS scheme — for gradient boosting in LightGBM implementation. This result confirms the thesis that to choose the wrappers you need to consider the type of algorithm for the final model.

A comparison of the average quality difference of the studied models showed that the CFSS scheme lost slightly to the FS scheme (*Fig. 4*) in logistic regression, demonstrating the good stability of the CFSS scheme to the type of algorithm for training the final model. This may be due to the fact that scheme CFSS uses a linear Backward (p-value) method after the nonlinear Two-Forest method, which balances selection towards linear features.

A time comparison of Forward and Two-Forest methods showed that Two-Forest works ten times faster than the Forward method (*Table 3*). In this experiment, the during operation methods were compared only in step 8 of the overall scheme, as all other selection steps were the same.

CONCLUSION

In this article we proposed a scheme of combined CFSS feature selection, in which the first stages are performed feature cleaning and stability checking, the next steps are used correlation filters, allowing to eliminate highly correlated features among themselves, and in the final stages the wrapper methods are applied, which are fine-tuning the scheme and final selection. This selection scheme "from simple to complex" allows to balance the selection and to achieve good results in quality

and speed on large high-dimensional samples.

The results of our experiments showed that the CFSS scheme works well for different types of models (linear and non-linear) and different banking tasks (credit scoring, advertising campaigns, collect overdue debts, etc.) and exceeds the quality of the scheme, containing only filters or wrappers.

Inclusion of multiple wrapper methods in the combined selection scheme allows to control the correctness of each method on the previous selection steps.

Compared to regression approaches, the Two-Forest selection method shows better quality for non-linear models and comparable quality for linear. At the same time, the Two-Forest method scores ten times faster than the regression methods.

The combined feature selection scheme can be fully automated by integrating it into the overall pipeline development models in the bank. This allows the development of models in the mode "End-to-End", which speeds up the development process and reduces model risks.

It should be noted that the CFSS scheme used a set of fixed threshold metrics defined by an expert. Thus, the CFSS scheme is still metaheuristic when data specificities are not considered at some stages of selection. Heuristics data as well as CFSS methods can be further configured as hyperparameters of the model, which will take into account the specifics of the task and improve the quality of the final models. However, configuring hyperparameters will increase the time complexity of the CFSS scheme. Our future researches will be dedicated to these issues.

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ORIGINAL PAPER

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Impact of Foreign Direct Investment on Manufacturing Sector: Evidence from Indian Economy

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ABSTRACT

There is need for an additional source of finance in form of foreign direct investment (FDI) in the Indian manufacturing sector due to its long-term engagement between the investors and the host country. Further FDI in the manufacturing sector is gaining importance because of the benefits the manufacturing sector reaps as a result of technology spillover brought through FDI. Therefore the **objectiv**e of the study is to assess the impact of Foreign Direct Investment on the manufacturing sector output of the Indian economy for the period of 1991–2020. **Methods** such as bounds test, Autoregressive Distributed Lag Model (ARDL) and Granger causality are used to study the impact of FDI and the interaction of FDI and human capital as two different variables on the output of the manufacturing sector in the Indian economy. Also, the technology-enhancing effect of FDI is addressed in the current study. The **results** of the study reveal that the inflow of FDI leads to an increase in manufacturing sector output. Further, it **concludes** that the higher the level of education (human capital) and the greater the technology gap between host and home country, the more is the technology spillover, and hence more prominent is the impact of FDI on the output of the manufacturing sector.

Keywords: Foreign Direct Investment; manufacturing sector productivity; ARDL model; India; absorption capacity; human capital; spillover; technology gap

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INTRODUCTION

Foreign direct investment (FDI) refers to investment made by one country in another with the purpose of controlling ownership in the host country [1]. It is also considered as an amalgamation of capital, technology, marketing skills, and managerial know-how [2]. Further, FDI is that it not only bridges the gap between domestic investment and the required investment, but also enhances economic growth, employment opportunity, exports, and positive balance of payment, production, and competitive practices [3]. Therefore, this kind of investment is essential for the manufacturing sector to meet the demand for capital and enhance the productivity of workers.

The inflow of FDI acts as an agent in developing less developed economies by promoting industrialisation and eventually improving the production of the manufacturing sector through bringing required capital, improved knowledge, skills, and innovative technology [4–7] since the manufacturing sector is primarily concerned with the conversion of raw material into usable finished goods or intermediate products [8].

FDI creates technology spillover in the manufacturing sector. However, the amount of benefit depends on the absorption capacity, which, in turn, depends upon educated or skilled employees, or human capital [9, 10]. Also, FDI leads to technology diffusion from the home to the host country, improves skills, reduces prices, and creates a competitive national structure [11, 12].

India has become an attractive destination for FDI because of its large consumer base, availability of cheap labour, and low cost of production [12]. India is also producing 2.2% of global manufacturing output, which is equivalent to the output produced by the UK [13]. According to the Global Manufacturing Competitive [14], "India held the second position in terms of its manufacturing capabilities in the entire world". India is becoming a desired destination for manufacturing, for numerous companies, and others are willing to

move their manufacturing base to India, as the country ranks second in terms of excellence for quality after Japan.[1]

Thus, this paper is a modest attempt to study the impact of FDI on the manufacturing sector's output in India. The next section lays down the need for the study, followed by objectives in section 3. Section 4 focuses on a review of past studies and section 5 enumerates the methodology used in the study. Section 6 discusses the results obtained, followed by section 7, which contains the conclusion and policy implications.

NEED FOR THE STUDY

While there are numerous studies on FDI and manufacturing sector output/production links, little work has been done on the impact of FDI, and the linkage of FDI and human capital as two different variables on the output of the manufacturing sector. Besides, the technology-enhancing effect of FDI is still an unresolved issue, which the current study addresses. Thus, the study will be more useful, as a single country examination is able to analyse the detailed scenario of a developing economy like India to derive better policy implications.

OBJECTIVES

1. To determine the direct impact of FDI on manufacturing sector output in India.

2. To investigate the indirect effect of FDI through its interaction with human capital on the manufacturing sector output of India.

3. To study the impact of the technology gap on the manufacturing sector output of India.

REVIEW OF LITERATURE

Past studies related to the impact of FDI on the manufacturing sector and the technology spillover effect have shown mixed results. On one hand researchers state that an increased inflow of foreign investment is useful to meet the demand for required funds thus leading to economic growth and improved productivity of the host country [14–18]. Some other studies supported the positive impact of FDI on the manufacturing sector [3, 7–10, 19–23].

Studies by C. Azolibe [7], S. Samal and D. Raju [13], and L. Mounde [20], and indicated that FDI acts as a catalyst in manufacturing sector growth by providing the required finances, knowledge, expertise, and technology. In line with this, E. Ekienabor et al. [4], M. Sinha et al. [5], Fujimori et al. [12], T. Masron and M. Hassan [19], and B. Ni et al. [24] stated that FDI triggers technology spillover through the development of human capital, leading to increase in output of the manufacturing sector.

A major factor through which FDI impacts manufacturing sector production is the absorption capacity of a firm. One way to measure the absorption capacity is through the availability of a skilled and educated labour force. Skilled workers are also required for complex technological progress and technology changes, as well as to adapt to information changes in the organisation [13, 25, 26]. Some researchers explained that firms with skilled labour and better human capital can benefit from spillover [27, 28]. FDI is identified as a major source of technology spillover. However, the amount of technology spillover depends on the learning capacity of employees (human capital) [9, 10]. In connection with these results, T. Kalu-Ulu [2] stated that FDI, in addition to human capital among other factors, helps the economy to achieve growth through the transfer of technology, improved productivity, skills, employee training and development, and international production network. N. Aggrey [29] similarly found that human capital is the essence for all economies that want to increase manufacturing growth by improving technology and skills brought through FDI. Likewise, C. Jude [30] asserted that spillover occurs due to heterogeneity in domestic firms and that human capital plays a major role in absorption and transfer of knowledge.

On the other hand, some researchers suggest that the greater the technology gap between host and foreign firms, the greater the probability of technology transfer [19]. Technology transfer occurs when local firms adopt foreign firms'

[1] Global manufacturing competitiveness Index. Dellolite. 2010. URL: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-mfg-2010-global-manufacturing-competitiveness-index.pdf (accessed on 12.12.2022).

technology [7, 22]. C. Malikane & P. Chitambra [11] stated that FDI has a limited effect on the productivity of African countries due to the limited absorption of technology. Another study conducted by M. Azeroual [9] revealed FDI from France had a negative impact on the Moroccan manufacturing sector, whereas FDI coming from Spain had a positive influence on productivity. The reason for the negative impact of FDI originating from France was that all the inflow was directed towards medium and high technology sectors, thus reducing the technology gap. With minimal technology gap, there was very little scope for the transfer of technology.

However, some studies show the mixed impact of FDI. O. Timothy & A. Chigozie [31] stated that there is no short-run causality from FDI, human capital, and GDP towards manufacturing value-added, but since FDI impacts the performance of the manufacturing sector in the long run, it is required to maintain human capital to absorb the required skill brought through FDI. On the other hand, E. Akpan & G. Eweke [32] explained there is no long-run relationship between the variables; however, there was a bidirectional causal relationship between FDI and industrial development, and industrial development and GDP.

Other researchers are of the opinion that FDI negatively affects the production of the manufacturing sector in the host country [3, 23, 33]. These results were supported by A. Fujimori et al. [12], stating the negative productivity is due to the inability of domestic firms to fight international competition, thus driving domestic firms out of the market. Similarly, K. Marcin [28] found negative impact of foreign investment on manufacturing productivity; however, he stated that the magnitude of impact varies according to the absorptive capacity of the home country. This was further supported by N. Samantha & H. Liu [22] in their study on Sri Lanka's industrial sector.

RESEARCH METHODOLOGY

Data Collection and Definition of Variables Selected

The data chosen for the study is annual data for the period of 1991–2020 for the Indian economy. The data was collected after 1991, that is, after the liberalisation of the economy, which led to a tremendous inflow of foreign funds.

Manufacturing sector output/production is the dependent variable, while FDI, human capital, labour, capital, trade openness, and technology gap are the independent variables identified by theory; however, technology spillover, also referred to as absorption capacity, is measured by technology gap similar to [9, 11], and interactive variable (FDI*H) in line with [9, 34, 35]. Trade openness was identified as a control variable by [7, 9, 20, 22]. All the data was collected through secondary sources such as the Central Statistical Office, the Ministry of Statistics and Programme Implementation, the Government of India, the RBI Handbook of Statistics on the Indian Economy, and DIPP.

THEORETIC WORK

From the literature, the link between FDI and productivity has three branches. The first is the neoclassical growth model of R. Solow [36] and T. Swan [37]. In this model, production (Y) is a function of two variables, labour (L) and capital (K), where A measures the productivity component, Total Factor Productivity (TFP). TFP can be attained from various factors such as knowledge, technology spillover, human capital, and foreign investment [3, 8]. The equation as per the neoclassical growth model is given by:

$$Y = f(K, AL).$$

Later new growth theory suggests that, unlike land and capital, learning does not suffer from losses and emphasised on innovation and learning to drive returns.

Subsequently, the development of endogenous growth theory emphasised the importance of human capital to absorb knowledge and skills. This theory took into consideration the importance of FDI and human capital [6]. The endogenous model focuses on the impact of FDI on economic growth through spillover [8, 10, 22]. Also, from theory and literature, FDI has an impact on the host economy in various ways. The studies focused on the importance of human

capital and skilled labour to take advantage of technology spillover from FDI inflow. Thus, the human element interacting with FDI and the technology gap act as two technology spillover (absorption capacity) measures.

Thus, the production function is

$$Y_t = L_t^{a1} K_t^{a2} FDI_t^{a3} H_t^{a4} TG_t^{a5} FDI * H_t^{a6} TO_t^{a7}$$

where *Y* stands for manufacturing sector output, *L* is labour measured by the number of people employed, *K* is capital (measured using gross fixed capital formation), *FDI* is foreign direct investment inflow, *H* is human capital (measured by the population that has completed senior secondary education), TG refers to technology gap (measured by total value added) as it is used to measure the absorption capacity in order to determine the spillover, *FDI * H* is the interactive term to assess the indirect impact of *FDI* with human capital (spillover), and *TO* is trade openness (measured by the sum of imports and exports as a ratio of *GDP*), where *TO* is a control variable.

Log-Log transformation is used to smoothen the data and reduce the problem of heterogeneity.

$$lnY_t = a_0 + a_1 ln\, L_t + a_2 lnK_t + a_3 lnFDI_t + a_4 lnH_{t0} + \\ + a_5 lnTG_t + a_6 lnFDI * H_t + a_7 lnTO_t + et.$$

Model Specification

To estimate the impact of FDI, along with capital, labour, and human capital, on manufacturing sector production, we applied autoregressive distributed lag (ARDL) model proposed by M. Pearson et al. [38] rather than conventional cointegration techniques proposed by R. Engle and C. Granger [39] and S. Johansen [40] as ARDL model is that it has numerous advantages over these methods.

The estimated ARDL equation is given as

$$\ln Y_t = a_1 + \sum_{i=1}^{p} \lambda 1 \ln Y_{t-1} + \sum_{j=1}^{q} \lambda 2 \Delta \ln FDI_{t-1} +$$

$$+ \sum_{k=1}^{q} \lambda 3 \Delta \ln K_{t-1} + \sum_{l=1}^{q} \lambda 4 \Delta \ln L_{t-1} + \sum_{m=1}^{q} \lambda 5 \ln H_{t-1} +$$

$$+ \sum_{n=1}^{q} \lambda 6 \ln FDI * H_{t-1} + \sum_{o=1}^{q} \lambda 7 \ln TO_{t-1} + \sum_{p=1}^{q} \lambda 8 \ln \Delta TG$$
$$t\text{-}i +$$
$$+ \lambda ECT_{t-1} + e_t$$

where a is the drift, t is the time period measured quarterly, p and q are the lag of the dependent variable and independent variables, $\lambda_1,\ldots\lambda_7$ are long-run multipliers, e_t is the error term related to the normal distribution, λ is the speed of adjustment parameter, and ECT_{t-1} is the error correction term, the lagged value of the residual obtained from the cointegrating regression of the dependent variables on the repressors, containing long-run information from the long-run cointegration equation.

RESULTS AND DISCUSSION

Unit Root Test

We used the Phillips-Perron test [41] to assess the presence of unit root. As variables are integrated at the combination of I (1) and I (0), thus it is preferable to adopt the ARDL method. The results are summarised in *Table 1*.

Multicollinearity

Multicollinearity test results (*shown in Table 2*) show that capital (K) has a very high centered VIF, that is, a value of 13.98, as a result of which it had to be removed from the list of the independent variables for further analysis.

Cointegration and Causality

Bound test results (shown in *Table 3*) depict that the calculated F-statistics (7.4936) is higher than the upper critical bound (4.088), indicating the existence of cointegration among the variables at 5% level of significance. Further, the ARDL model was applied to determine short-as well as long-run coefficients, along with ECT. The appropriate lag length has been selected based on Akaike Information Criteria (AIC).

ARDL results (*summarised in Table 4*) show a higher value of Durbin-Watson than R-squared, indicating the absence of serial correlation. In the long run, human capital, labour, technology gap, and FDI*H have a significant and positive influence on manufacturing sector output, indicating the

Table 1

Phillips-Perron Test Results for Unit Root

Variables	At level	At first difference
	With constant With constant and trend	With constant With constant and trend
L(IP)	−5.0287−5.0623	−10.0784−10.0915
	(0.0001***) (0.000***)	(0.0000***) (0.0000***)
L(FDI)	−0.7142−0.9872	−11.8475−11.6247
	(0.8293) (0.5674)	(0.0000***) (0.0000***)
L(K)	−0.6875−2.6578	−13.7843−13.7217
	(0.9171) (0.0006*)	(0.0000***) (0.0000***)
L(L)	−1.26520.7853	−18.1784−18.0678
	(0.4823) (0.6147)	(0.0001***) (0.0000***)
L(H)	−3.0482−3.8745	−9.7847−9.1472
	(0.0232**) (0.0213**)	(0.0000***) (0.0000***)
L(FDI*H)	−5.5478−6.1498	−8.1245−8.0784
	(0.0003***) (0.0001**)	(0.0000***) (0.0000***)
L(TO)	−2.1475−4.4154	−9.1784−9.0072
	(0.0486**) (0.0021**)	(0.0000***) (0.0000***)

Source: Authors computation.

Notes: (*), (**), and (***) significant at 10%, 5%, 1% respectively.

t-stats (P-value).

Table 2

Results of Multicollinearity

Variable	Coefficient variance	Uncentered VIF	Centered VIF
C	10978.48	278.94750	NA
L	0.0845754	376.4515	1.9762
K	1.75E-09	298.1456	13.9846
H	0.008755	37.8455	1.6795
TG	0.000476	33.1487	5.7843
FDI	0.000784	16.4193	3.7164
FDI*H	0.000875	16.3216	6.3379
TO	87.289E-09	17.9541	6.1283
Y	1.29E-13	13.8734	1.3796

Source: Authors computation.

importance of absorptive capacity measured via technology gap and interactive variable (FDI*H). Human capital, along with its interaction with FDI, is significant in explaining the variation more than FDI alone in the long run, indicating the importance of human capital in the absorption of technology and know-how brought to the nation through FDI. Further, the technology gap (measuring absorption capacity) is found to be a major determinant affecting manufacturing sector output. Apart

Table 3

Bound Test Results

Computed F statistics 7.4936		
Critical value	Lower bound value	Upper bound value
1%	4.093	5.532
5%	2.947	4.088
10%	2.46	3.46

Source: Authors computation.

Table 4

ARDL Short and Long Run Results

Short run coefficients					Long run coefficients				
Variables	Coff	SE	t–stats	Prob	Variables	Coff	SE	t–stats	Prob
LnY(–1)	0.70614	.01562	4.5194	0.0001	LnY(–1)	–0.7847	0.3909	–2.007	0.0511
LnY(–2)	–0.1414	0.1718	–0.827	0.4127	LnL	1.1660	0.3689	3.161	0.0029
LnL	0.0299	0.1750	0.1714	0.8651	Lnfdi	0.3227	0.3988	0.808	0.4235
LnL(–1)	0.0144	0.1658	0.0872	0.9309	Lnh	0.4426	0.1139	3.885	0.0003
Lnh	1.3180	0.5085	2.5917	0.0133	Lnh(–1)	0.5175	0.6448	0.802	0.4265
Lnh(–1)	1.4356	0.4900	2.9297	0.0056	Lnh(–2)	1.278	1.4785	0.864	0.3918
Lnh(–2)	0.0901	0.0749	1.2024	0.2362	Lnfdi*h	0.6317	2.2152	2.851	0.0066
Lnfdi	0.1423	0.0571	2.4944	0.0165	Lnfdi*h(–1)	0.8850	0.3498	2.530	0.0151
Lnfdi(–1)	–0.1691	0.1801	–0.938	0.3530	Lnfdi*(–2)	0.1423	0.0393	3.619	0.0008
Lnfdi(–2)	–0.1841	0.4204	–0.448	0.6563	LnTO	–2.4135	2.4247	0.995	0.3249
Lnfdi*h	0.6555	0.1421	4.6117	0.000	LnTG	0.4663	0.0876	5.3189	0.0000
Lnfdi*h(–1)	1.1664	0.4352	2.6788	0.0104	cointEq(–1)	–0.5340	0.1160	–4.601	0.0000
Lnfdi*h(–2)	0.8850	0.4001	2.2117	0.0323					
Lnfdi*h(–3)	0.0195	0.5742	0.0341	0.9730					
LnTO	1.2754	1.4785	0.8646	0.3918					
LnTO(–1)	–2.4196	1.7108	–1.414	0.6877					
LnTG	0.3619	0.1266	2.8587	0.0072					
LnTG(–1)	0.2874	0.1165	2.4667	0.0188					
LnTG(–2)	0.2869	0.1093	2.6249	0.0129					

Source: Authors computation.

Notes: R^2 = 0.22, Adjusted R^2 = 0.18, F-statistics: 7.76 (0.000***), AIC: –2.134, Durbin-Watson (DW): 2.01L is the log value.

from FDI, labour and trade openness are found insignificant in explaining any variation in the long run. ECT is negative and significant, inferring the conversion of short-run shocks to long-run equilibrium at an adjustment speed of 53.4%.

Short-run dynamics of variables given by ARDL results (shown in *Table 4*) show that the first lag of manufacturing sector production, human capital and its first lag, FDI, the interactive variable of FDI and its first and second lag, as well as technology gap and its lags, have a positive and significant impact on the production of the manufacturing sector. Trade openness is found to have an insignificant impact in both the short as well as long run. However, it can be seen that in the short run, the impact of FDI is significant. The positive impact of FDI on the manufacturing sector indicates that FDI brings the required capital to expand manufacturing output [1, 4–8, 11, 20, 23, 32, 42]. Further, with an increase in foreign firms, demand for raw materials increases, which is met by increased production of domestic manufacturers. Further, the ARDL results reveal, the interactive term (FDI*H) has better power in explaining the variation of manufacturing productivity due to the presence of human capital, as higher human capital explains a better ability to absorb and adapt to improved technology and managerial know-how. This is in line with [9, 10, 35]. The impact of the technology gap and its lags are also positive and significant, similar to [9, 11], signifying that the economy is able to benefit through technology spillover.

Diagnostic Testing

The results of LM test of serial correlation and the Breusch-Pagan-Godfrey test of heteroskedasticity (summarised in *Table 5*) reveal the absence of serial correlation and heteroskedasticity respectively. Further, the results of the CUSUM of square test indicate the stability of the model as the model line does not cross either of the bounds (*Fig. 1*). Thus, indicating the model is fit for inference.

Table 5

Diagnostic Test Results

Test	Hypothesis		Results
Breusch-Godfrey serial correlation LM Test	Null= No serial Correlation	0.6623	No serial correlation
Breusch-Pagan -Godfrey	Null=no heteroskedasticity	0.6175	No heteroskedasticity
CUSUM of square test for stability	If the coefficient of the estimated model is in two bounds it is stable		Stable

Source: Authors computation.

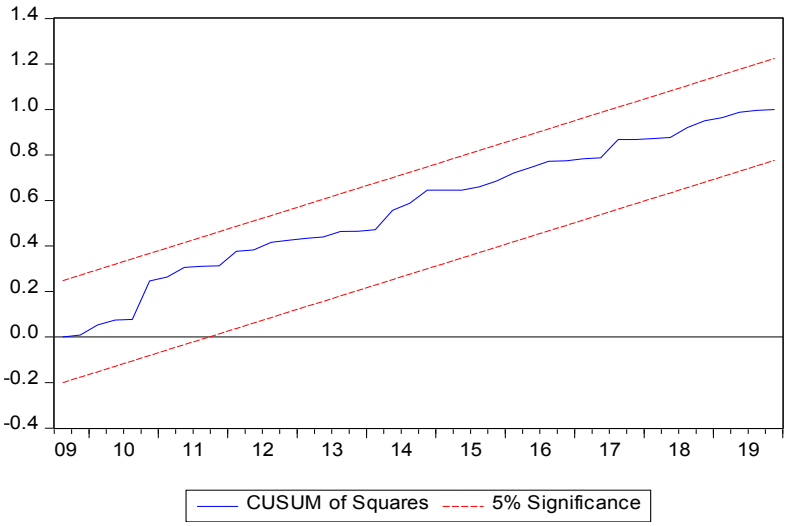

Fig. 1. **CUSUM of Squares Plot**

Source: Authors computation.

Short-Run Causality

The Granger causality test given by C. Granger [43] is used to examine the short-run causality among the variables in the given multivariate framework. Results of the Granger causality test at lag length 3 (shown in *Table 6*) indicate that the results are in line with those of ARDL, indicating short-run causality running from FDI, human capital, technology gap, and the interactive term (FDI*H) to the manufacturing sector production. However, Granger test results also show causality running from manufacturing sector output to FDI, showing bidirectional causality between FDI and production/ manufacturing sector output.

CONCLUSION AND IMPLICATIONS

This paper analysed the impact of FDI on the output of the manufacturing sector. Further, the absorption capacity (technology spillover) of the host country was assessed by the interaction of FDI and human capital (H) and the technology gap. The ARDL model has been used in the dynamic framework for a period ranging from 1991 to 2020.

The results reveal that the Indian manufacturing sector has registered a significant gain from the inflow of FDI. However, the percentage gains are not as high as reported in other countries. Out of the six explanatory variables, trade openness had no significant impact on manufacturing sector production similar to N. Samantha & H. Liu [22], indicating low exports of Indian manufacturing.

Even labour does not influence productivity in the short run but has a positive and significant impact in the long run. Further, FDI has a positive impact on production in the short run but has no influence in the long run.

Human capital and its interactive variables, along with the technology gap, have a positive and

Table 6

Results of Granger Causality Test

Variables From	Y	FDI	TG	L	H	FDI*H	TO	Direction of causality
Y	–	0.011*	0.7817	0.004*	0.0512	0.0873	1.0645	Y→L Y→FDI
FDI	0.023**	–	1.6241	0.1264	0.7814	0.041**	0.7435	FDI→Y FDI→FDI*H
TG	0.0092	0.4851	–	0.1247	0.3114	0.8475	0.9146	TG→Y
L	0.1875	0.9824	0.9134	–	0.0054**	0.0975	0.1428	L→H
H	0.001*	0.014**	0.4864	0.4173	–	0.004**	0.4318	H→Y H→FDI H→FDI*H
FDI*H	0.000*	0.1476	0.6425	0.9724	0.1746	–	0.6357	FDI*H→Y
TO	1.345	0.003*	0.9751	0.1784	0.9173	0.0036*	–	TO→FDI TO→FDI*H

Source: Authors computation.

Note: (*) and (**) indicate rejection of no causality at 1% and 5% level of significance respectively.

significant impact both in the short as well as long run. The positive impact of FDI indicates the inflow of foreign capital by bringing the required finance to raise manufacturing output. Similar results indicating the positive impact of human capital and technology gap were given by various researchers such as C. Idoko & U. Taiga [1], E. Ekienabor et al. [4], M. Sinha et al. [5], C. Azolibe [7], M. Oluwatoyin et al. [8], C. Malikane & P. Chitambra [11], L. Mounde [20], A. Afolabi et al. [23], E. Akpan & G. Eweke [32], and O. Nwosu et al. [42].

Also, human capital and the interactive variable (FDI*H) have a positive and significant impact both in the short as well as long run. This is in line with [9, 10, 35]. The result explains that an increase in FDI directly leads to an increase in the production of the manufacturing sector by providing the required capital. Also, FDI*H indirectly has a positive influence over the manufacturing sector growth, indicating the ability of skilled manpower to adapt to technological advancements and new ideas. Further, this study suggests that the greater the technology gap between a foreign firm and the host country's firm, the greater the amount of absorption or technology spillover. This view is supported by [9, 11].

With the growing importance of FDI and technology spillover in the manufacturing sector, it is essential to formulate policies to attract FDI. Thus, the study recommends that it is essential to develop human skills and increase research and development activities of the host country so they can gain the maximum by absorbing and adopting improved technology and managerial know-how. Government policies should aim at attracting a higher proportion of FDI, which could contribute to industrial production. For this, the government should focus on other push and pull factors affecting the FDI, related to the host as well as the home country. FDI brings the latest technology, capital, machinery, knowledge, and skill required for the development of the manufacturing sector, in turn, to the economy. Therefore, emphasis should be given to the policymakers to invest in infrastructural development, political and macroeconomic stability, and framing pro-FDI policies.

In addition, the government should encourage foreign investors to prioritise their investment in the manufacturing sector, as technology spillover is likely to benefit the entire economy. The government should also clearly lay down their

policies related to tax cuts, rebates, etc. with regard to the manufacturing sector for increasing the import of machinery and new technology and to enhance productivity in the manufacturing sector.

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Sh. Maitra — contributed to the conclusion and reviewed the paper.

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Regulation of Banking Groups and their Financial Stability in Russia

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ABSTRACT

More complex activities, financial reporting, and risk aggregation of banking groups increase the **relevance** of research on their financial stability. **The purpose** of our study is to analyze the effectiveness of banking groups' regulation in the Russian Federation and to develop proposals for its optimization. **The scientific novelty** includes the identification and proof of the hypothesis of the dependence of the banking groups' financial stability on the level of the group control, as well as measures to improve the regulation of activities and financial stability of banking groups in Russia. **The research methodology** is based on a linear model on panel data (fixed effects models, random effects models, and pool models). The empirical base of the study includes data on the 26 largest Russian banking groups and parent credit institutions of banking groups from 2010 to 2020. A hypothesis was put forward that the financial stability of the banking group depends on the effectiveness of the regulatory control within the group. To confirm the hypothesis, the authors assessed the financial stability of banking groups using the Z_{score}, while the banking groups were divided into two pools depending on the level of regulatory control. As a result, this hypothesis was confirmed. For banking groups with a high level of regulatory control, a model of financial stability and the factors that have the greatest impact on it were identified. The authors suggested the following measures to improve the regulation and financial reporting of the banking groups: 1) to expand the regulatory consolidation of the reporting of banking groups to the level of accounting, which will create the basis for a complete risk assessment; 2) to clearly define approaches to formalizing the assessment and management of the forced financial support risks for the group companies; 3) to unify the disclosure by banking groups of information about risks, methods for their assessment and management, including the relationship with the business model of activity. These measures are aimed at improving the risk management of credit institutions.

Keywords: banking risks; regulation; banking groups; systemically important banks; financial stability; control; regulatory consolidation; financial reporting

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INTRODUCTION

There are many factors influencing the process of formation of complex, integration formations — banking groups, the number of which is constantly increasing. For example, N. Cetorelli et al. [1] argue that the achievement of competitive advantages in confrontation with non-bank organizations providing specialized services forces banking groups to expand their activities. Other authors, such as R. Correa and L. Goldberg [2], believe that the key factor in the emerging trend is the introduction of more stringent regulatory restrictions on the banking sector, which encourages banks to provide financial and non-financial services within the banking group.

The purpose of the study is to analyze the effectiveness of regulation of banking groups in Russia in the context of ensuring financial stability and develop proposals for its optimization. Despite the attention of the Regulator to this problem and the availability of scientific papers in this and related areas of research, there are still many unresolved problems and debatable issues. To fill the scientific and regulatory gaps that have arisen, the following innovations are proposed: *firstly*, based on a detailed analysis of the modern system for regulating the activities and risks of banking groups in the Russian Federation, problems have been identified and a set of measures has been developed to eliminate them; *secondly*, using empirical data, an analysis has been made and a comparative assessment of the financial stability, efficiency and degree of risks of the activities of

parent credit institutions and banking groups in Russia has been given; thirdly, we have carried out statistical modeling and showed the dependence of the financial stability of banking groups on the level of control in the group. The factors influencing stability are revealed and their quantitative estimation is given.

LITERATURE REVIEW AND MAIN RESEARCH HYPOTHESES

According to the purpose of this study, the authors studied domestic and foreign literature in key areas of the subject area.

Development of banking regulation and its main results. Development of banking regulation and its main results. The development of banking regulation is considered by the authors in close connection with the adoption of the Standards of the Basel Committee on Banking Supervision (BCBS) as the basis for national financial stability. Almost all studies over the past thirty years assess the positive impact of banking regulation on the stability of the banking sector and its ability to absorb risks. Thus, the papers of J. Almenberg et al., J.R. Barth, and S.M. Miller [3, 4] show that capital regulation can reduce the likelihood of banking crises. At the same time, it is widely believed that the introduction of new capital standards contributes to a drop in the lending activity of banks D. VanHoose, S. B. Naceur [5, 6] and their effectiveness D. VanHoose, E. Bace and A. Ferreira [5, 7].

Assessment of the financial stability of banks. The financial stability of banks has historically been assessed using indicators that have focused on capital adequacy. Of interest in this regard is the unified methodology of the International Monetary Fund, presented in the document Financial Soundness Indicators: A Compilation Guide.[1] At the same time, the academic environment offers different approaches to assessing the financial stability of banks. Thus, the authors R. Rzayev and S. Babayeva [8] assess financial stability also on the basis of financial indicators, but the list of coefficients is different: capital adequacy ratio, the structure of the client base, its stability, dependence on interbank loans, asset turnover, the level of overdue debt, etc. Others, such as C. Glocker [9], believe that the main signs of a bank default are compliance with capital requirements and the formation of reserves. At the same time, these indicators are calculated, and therefore do not exclude some subjectivity. It is no coincidence that there is an approach that M.M. Ahamed and S.K. Mallick, F. Fiordelisi and D.S. Mare, M. Fratzscher et al. [10–12], in which the financial stability of banks is assessed through the Z_{score}. In doing so, the authors followed the evaluation model previously used by J.H. Boyd et al., L. Laeven and R. Levine [13–14]. The indicator is determined on the basis of financial statements, which minimizes the subjectivity of its assessment:

$$Z_{score} = \frac{ROA_{it} + \left(E_{it} / TA_{it} \right)}{\sigma ROA_{it}}, \quad (1)$$

where ROA_{it} — the return on assets; E_{it} — the balance sheet capita; TA_{it} — the total assets; σROA_{it} — the volatility of the variable ROA_{it}.

We also note that there are a number of studies linking banking stability with external factors, such as market structure and level of competition M. Albaity et al. [15], corporate governance C. Gaganis et al. [16], ownership structure H. Park and B. Oh [17], national culture P. Illiashenko and L. Laidroo [18], institutional environment Y. Fang et al. [19], political and economic uncertainty R.N. Killins et al. [20].

Features of assessing the financial stability (risks) of banking groups. Despite the relevance of this topic, there is a clear lack of research on this topic. The relationship between the organizational complexity of the group and its effectiveness is emphasized in the study by N. Cetorelli and L.S. Goldberg [21], s well as the risk R. Correa and L.S. Goldberg [2], while it is interesting that business diversification within financial groups is not considered as a risk minimization factor in the papers by T. Krause

[1] URL: https://data.imf.org/?sk=51B 096FA-2CD 2–40C 2–8D 09–0699CC 1764DA (accessed on 02.09.2022).

et al., L. Leaven and L. Levine [22, 23]. One of the latest publications on the topic is a study by I. Argimón and M. Rodríguez-Moreno [24], which presents an assessment of the impact of organizational complexity, business complexity, and territorial complexity on the risk of banking groups.

Based on the analysis of the results of the reviewed academic studies, scientific hypotheses regarding the Russian banking sector are formulated.

Hypothesis 1. The financial stability (riskiness) and efficiency of the activities of parent credit institutions and banking groups in Russia are different, which requires an appropriate regulatory response. To evaluate the hypothesis, we analyzed the main financial indicators for the 18 largest Russian banking groups and their parent credit institutions. For the analysis, we used financial reporting data in accordance with Russian and international standards based on the Orbis Bank Focus database [Bureau van Dijk Electronic Publishing (BvDEP)]. Following the approach of [8], we assessed the financial stability of parent credit institutions and banking groups based on asset quality; performance efficiency, and capital provision.

Hypothesis 2. The financial stability of banking groups depends on the effectiveness of control within the group. Among the factors influencing it, there are both external, macroeconomic, and internal, determined by the activities of a particular bank. Following F. Fiordelisi and D.S. Mare [11], we assessed the financial stability of banking groups based on Z_{score} (1). For modeling purposes, banking groups were divided into two pools according to the level of control, which was estimated through the ratio of the number of participants fully consolidated for the purposes of assessing financial stability in accordance with the approach of the Bank of Russia (regulatory consolidation) to the number of companies consolidated for accounting purposes (accounting consolidation) [24]. We analyzed the 26 largest banking groups, divided into two pools according to the level of control. The analysis was carried out on the basis of consolidated financial statements using the Orbis Bank Focus database.

Hypothesis 3. The activities of banking groups in Russia, the effectiveness of control within the groups, as well as the parameters of their financial stability on a consolidated basis, are currently not sufficiently regulated. To confirm this hypothesis, we analyzed in detail the regulatory documents of the Bank of Russia in the field of regulating the activities and financial condition (risks taken) of banking groups.

RESEARCH METHODOLOGY AND DATA ANALYSIS

Fig. 1 presents the research scheme.

Stage 1 formulated the scientific hypotheses presented above.

In Stage 2, we generated statistical data, evaluated and modeled them. *To test the first hypothesis*, we carried out a comparative analysis of the financial stability of parent credit institutions and banking groups based on an assessment of asset quality, performance efficiency, and capital provision.

An analysis of the quality of assets illustrates the difference in indicators for parent credit institutions and banking groups, while in some cases it is quite significant (*Fig. 2*). The share of non-earning loans is, as a rule, higher for parent credit institutions (except for Alfa-Bank and Home Credit & Finance Bank). The same picture is observed in terms of the level of formed reserves.

Efficiency analysis shows an uneven level of indicators for banking groups and parent credit institutions (*Fig. 3*). For example, the parent bank Otkritie Bank has a significantly higher return on assets compared to the group, while the situation is reversed for Home Credit & Finance Bank.

Capital adequacy, which is a comprehensive assessment of financial stability, varies significantly across *parent credit institutions* and groups in general (*Fig. 4*). Thus, this indicator is significantly higher for the banking groups of Raiffeisenbank Rosbank, UniCredit Bank, Home Credit & Finance Bank.

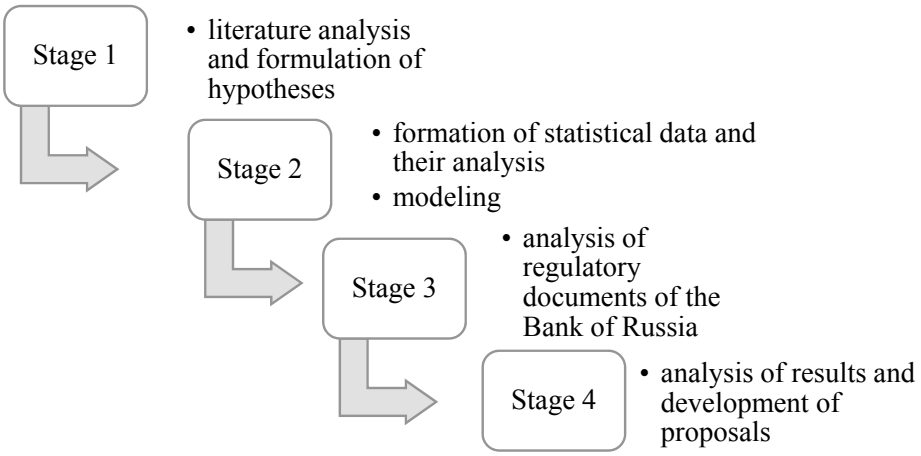

Fig. 1. **Research Scheme**

Source: Compiled by the authors.

To test the second hypothesis, we used the following approach. As noted earlier, we assessed the financial stability of banking groups using Z_{score} (1). This indicator is a simulated (explained) variable (Z_{it}) of the financial stability of the banking group No. $i = 1,2,\ldots,N$ in the time period $t = 2015,2016,\ldots,2020$ гг. The value Z_{it} is determined by the rule (1). Among the factors affecting the financial stability of banking groups, we considered external (macroeconomic factors), as well as internal factors determined by the activities of a particular bank and reflecting its efficiency, asset quality, and business model. Thus, the following variables (2) were taken as explaining the value (1): $NIM_{it} = x_{1it}$ — the net interest margin (%); $CI_{it} = x_{2it}$ — the cost-to-income ratio (%); $LTA_{it} = x_{3it}$ — the loans-to-total assets ratio (%); $LD_{it} = x_{4it}$ — the loans-to-deposits ratio (%); $ILLD_{it} = x_{5it}$ — the share of impaired loans (%); $y_t = x_{6it}$ — Russia's nominal GDP growth rate; $MPR_t = x_{7it}$ — Mosprime Rate; $Oil_t = x_{8it}$ — the Brent oil price growth rate; $D_t = x_{9it}$ — the US dollar exchange rate growth (the growth rate of the US dollar price in rubles).

The values of variables (1) and (2) form a set of panel data

$$\left(\begin{matrix} Z_{it}; NIM_{it}, CI_{it}, LTA_{it}, LD_{it}, \\ ILLD_{it}, y_t, MPR_t, Oil_t, D_t \end{matrix} \right)_{i=1.}^{N=26} \quad (3)$$

The general useful for practice linear model on panel data for the variable (1), taking into account the notation (2), has the form [25, 26]:

$$Z_{it} = \alpha_i + \sum_{j=1}^{9} a_j \cdot x_{jit} + u_{it}. \quad (4)$$

Here u_{it} — random perturbations generated by unaccounted-for factors. They are assumed to be independent of the explanatory variables x_{jit}, centered, uncorrelated, and having a constant variance σ_u^2. Model (4) is called the linear *fixed effects* model (*FE model*). We emphasize that in the specification (4) the absolute terms α_i are interpreted as constants for each banking group $i = 1,2,\ldots,N$.

The second version of the model (4), which is of interest for practice, is based on the assumption that the absolute terms α_i are random variables with a single mathematical expectation μ and a single variance σ_α^2. In such a situation, Model (4) is called the *random effects* model (*RE model*), and its specification can be represented as

$$Z_{it} = \mu + \sum_{j=1}^{9} a_j \cdot x_{jit} + \alpha_i + u_{it}. \quad (5)$$

With such a notation, the component α_i of the random perturbation $\alpha_i + u_{it}$ has a zero mathematical expectation.

Finally, the simplest version of the model (4) is called the *pooling model* and has the form

$$Z_{it} = \alpha + \sum_{j=1}^{9} a_j \cdot x_{jit} + u_{it}. \quad (6)$$

Here the absolute term α is interpreted as a constant for all banking groups $i = 1,2,\ldots,N$. We

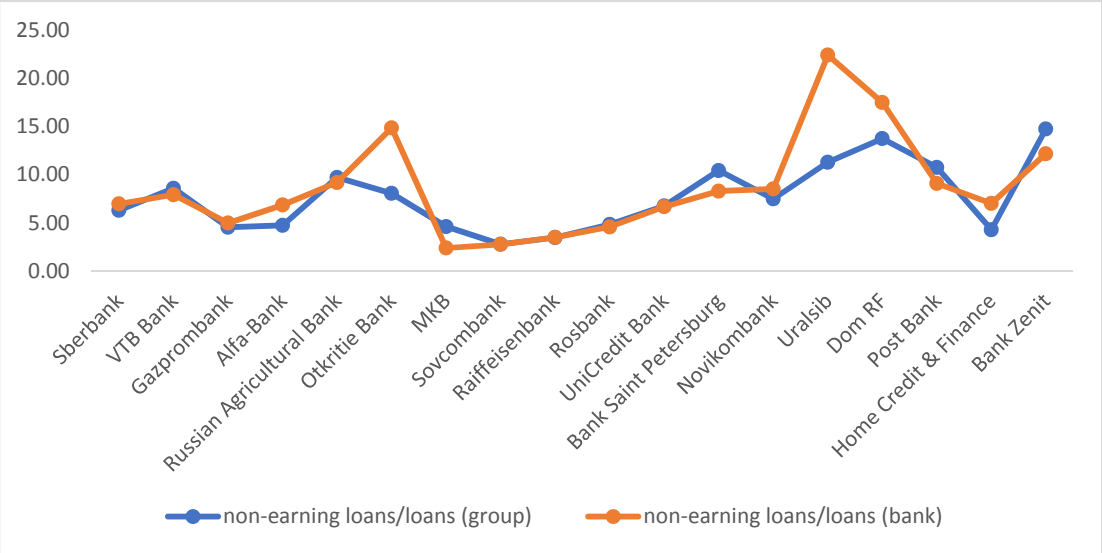

Fig. 2. **Share of Non-Earning Loans by Banking Groups and Parent Banks, 2020**

Source: Compiled by the authors.

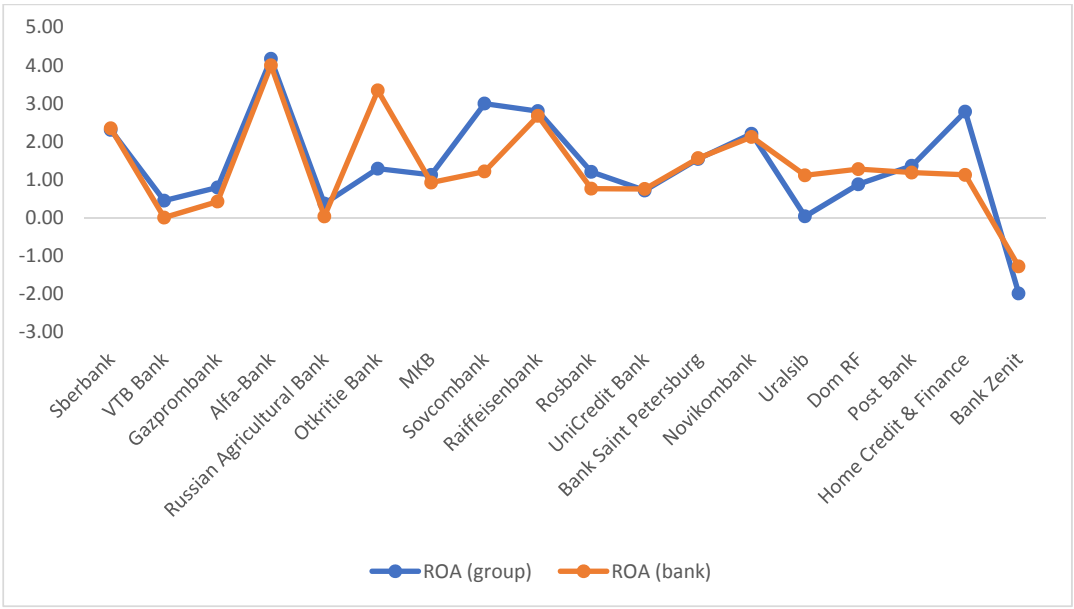

Fig. 3. **Return on Assets of Groups and Parent Banks**

Source: Compiled by the authors.

emphasize that in all cases (4)–(6) the coefficient a_j has the meaning of the expected change ΔZ_{it} of the variable Z_{it} in response to an additional unit of the variable x_{jit} (i.e., in response to $\Delta x_{jit} = 1$). So, the coefficient a_j reflects a partial effect of the explanatory variable x_{jit}.

The task of our study is to reasonably choose one of the models (4)–(6) of the indicator Z_{it} of the financial stability of a banking group and to estimate significant coefficients $(a_j)_{j=1,2,\ldots m}$ of particular influences on the value of Z_{it} explaining variables (2).

The set of panel data (3) is divided into two equal parts (by $N = 13$ banking groups) according to the ratio between the values of the number of participants in the group in accordance with regulatory (RMQ_i) and accounting consolidation ($MSFO_i$). The first included 13 banking groups with sharply different indicators of RMQ_i and $MSFO_i$. The second part included 13 banking

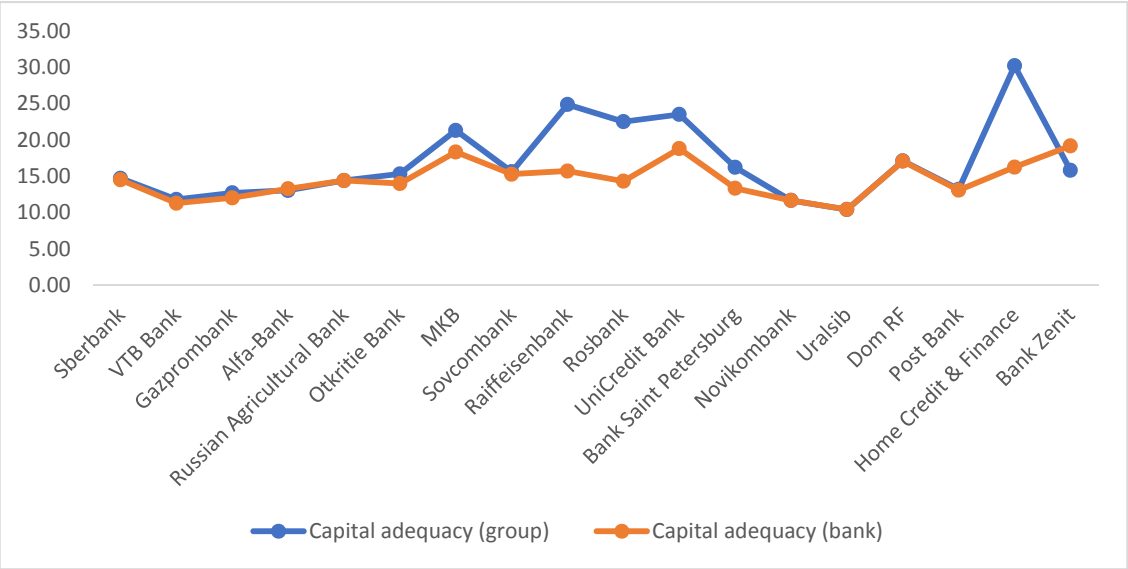

Fig. 4. **Capital Adequacy Ratios of Banking Groups and Parent Banks**

Source: Compiled by the authors.

groups with approximately equal parameters RMQ_i and $MSFO_i$. We emphasize that the first part includes the leaders of the banking sector of Russia in terms of total assets (TA_i): Sberbank, Gazprombank, Alfa-Bank, Russian Agricultural Bank. Based on the division of banking groups into two levels, further, an attempt was made to build models for assessing their financial stability.

Stage 3 is a detailed analysis of the current regulation of the activities and financial condition of banking groups in Russia, formed by systemically important credit institutions, which, taking into account their subsidiaries, control more than 70% of the total assets of the banking system, was carried out.[2]

The analysis showed that the banking group's regulatory reporting often does not coincide with the financial statements along the consolidation perimeter, which does not allow for an adequate assessment of the risks taken by the group. The differences in the consolidation perimeter that we have identified and used in modeling to confirm Hypothesis 2 are due to the approach established by the Bank of Russia Regulation No. 509-P dated December 3, 2014, "On the calculation of the amount of equity (capital), mandatory ratios and sizes (limits) of open currency positions of banking groups". Differences for the largest Russian banking groups are given in *Table 1*.

By regulation No. 729-P dated July 15, 2020, "On the methodology for determining equity (capital) and mandatory ratios, capital adequacy ratios, numerical values of mandatory ratios and the size (limits) of open currency positions of banking groups", the Bank Russia expanded the regulatory consolidation of banking groups but did not bring it to the level of accounting consolidation.

Next, we analyzed the completeness and quality of information disclosed by banking groups on the level of risks taken as part of the implementation of the Bank of Russia Directive No. 4482-U dated August 07, 2017, "On the form and procedure for disclosure by a credit institution (the parent credit institution of a banking group) of information on the risks assumed, procedures for their assessment, risk and capital management".

In Stage 4, we analyzed the results and formulated proposals aimed at improving the regulation of banking groups in Russia and their financial stability.

[2] Banks of Russia Association. The banking system in numbers and graphs. Q2, 2021 No. 2 (12). P. 36. URL: https://asros.ru/analytics/asros/bankovskaya-sistema-v-tsifrakh-i-grafikakh-2–12-ii-kvartal-2021-goda/ (accessed on 10.09.2022).

Table

Number of Banking Group Members Included in the Regulatory and Accounting Consolidation as of 01.01.2021*

Bank	Regulatory Consolidation (ICAAP)	Accounting Consolidation (IFRS)
UniCredit Bank	5	5
Russian Agricultural Bank	4	34
Raiffeisenbank	6	6
Otkritie Bank	21	31
Rosbank	11	11
Credit Bank of Moscow	4	19
Alfa-Bank	4	22
Sberbank	23	377

Source: Compiled by the authors based on the reporting data of the respective banks.

Note: * Latest disclosure date at the time of writing.

RESULTS AND DISCUSSION

Conclusions based on the results of Hypothesis 1 testing. According to the results of the study in terms of analyzing the financial stability of parent credit institutions and banking groups based on an assessment of the quality of assets, performance efficiency, and capital provision, Hypothesis 1 is not rejected. This fact indicates the need to study and regulate the financial stability and risks of banking groups on a consolidated basis (and not only on a sole basis, which is currently being implemented), while it is advisable to study both external and internal factors, determined directly, especially by banking groups.

Conclusions based on the results of Hypothesis 2 testing. On the basis of the structuring of banking groups by the level of organization of control, we attempted to build models for assessing the financial stability of banking groups.

The Z_{it} indicator model of the financial stability of a banking group was originally created for the leaders of the banking sector of Russia in terms of total assets TA_i: Sberbank, Russian Agricultural Bank, Alfa-Bank, VTB Bank, Gazprombank (7). Then an attempt was made to build a model for the entire first part and, finally, a model was created for the second part of the banking groups. Note that for banking groups with a low level of control, a model with a satisfactory explanatory power did not work out.

The estimated model of financial stability of the leaders (7) of the banking sector of Russia turned out to be a model with fixed effects (4) with the following regression equation:

$$\begin{cases} \tilde{Z}_{it} = \alpha_i + 58 \cdot NIM_{it} + 2.5 \cdot LTA_{it} + 4 \cdot y_t - 0.7 \cdot Oil_t \\ \quad (13) \qquad (2.0) \qquad (1.9) \quad (0.35) \\ R^2 = 0.54. \end{cases} \quad (8)$$

In parentheses are the standard errors of coefficient estimates.

Considering (8), we can draw the following conclusions:

1. The main factor that increases the financial stability of the leaders of the Russian banking sector is the level of net interest margin NIM_{it}. Indeed, an increase by one unit (i.e., by 1%) of the value of the variable NIM_{it} entails (with other factors unchanged) the expected increase in the value of $\tilde{Z}_{it}$ by approximately 58 units.

2. The loans-to-total assets ratio LTA_{it} also has a slightly positive impact on the financial stability of the leaders of the Russian banking sector.

3. Russia's nominal GDP growth rate y_t has a noticeable positive effect, while the Brent oil price growth rate Oil_t has a slightly negative impact on the financial stability of the leaders of the Russian banking sector.

Finally, we interpret the value of the coefficient of determination $R^2 = 0.54$. The value of 0.54 means that the correlation coefficient of the real value of the index Z_{it} of the financial stability of the leaders of the Russian banking and the value of $\tilde{Z}_{it}$ calculated by the model (1.8) is approximately equal to $\sqrt{0.54} = 0.73$.

The estimated model of financial stability of the second part of banking groups (banking groups with a high level of regulatory control) turned out to be both a random effects model (5) and a pooling model (6) with the following regression equation:

$$\begin{cases} \tilde{Z}_{it} = 97 - 1.5 \cdot CI_{it} + 11 \cdot y_t - 2.6 \cdot Oil_t - 3.2 \cdot D_t \\ \quad (36)\ \ (0.4)\ \ \ (4.9)\ \ \ (1.1)\ \ \ \ (1.1) \\ R^2 = 0.24. \end{cases} \quad (9)$$

In parentheses are the standard errors of coefficient estimates.

Considering (9), we can draw the following conclusions:

1. The main factor positively affecting the financial stability of the second part of the banking groups is Russia's nominal GDP growth rate y_t. Indeed, an increase by one unit (i.e., an increase in Russia's nominal GDP by 1%) in the value of the variable y_t entails (with other factors unchanged) the expected increase in the value of $\tilde{Z}_{it}$ by approximately 11 units.

2. The cost-to-income ratio rise CI_{it} has some negative impact on the financial stability of banking groups.

3. The Brent oil price growth rate Oil_t has a significant negative impact, and the growth rate of the US dollar price D_t has a significant negative impact on the financial stability of banking groups.

Finally, we interpret the value of the determination coefficient $R^2 = 0.24$. The value of 0.24 means that the correlation coefficient of the real value of the Z_{it} indicator financial stability and the predictive value of $\tilde{Z}_{it}$ is approximately equal to $\sqrt{0.24} = 0.5$.

Thus, we believe that the modeling that we conducted made it possible not to reject the hypothesis that the financial stability of banking groups depends on the effectiveness of control in the group. Indeed, according to banking groups with a low level of regulatory control, we could not build a model to assess the financial stability of Z_{it} with a satisfactory explanatory ability. The exception was the five largest banking groups, a model of financial stability was built for them [a model with fixed effects (4)]. For the second part of banking groups (with a high level of regulatory control), a financial stability model was built, which was both a model with random effects (5) and a pooling model (6).

Conclusions based on the results of Hypothesis 3 testing. The analysis of the current regulation of activities and the financial condition (accepted risks) of banking groups in Russia, and an assessment of information disclosure on the risks of banking groups made it possible to draw the following conclusions.

Firstly, the regulatory reporting of the banking group does not coincide with the financial statements along the consolidation perimeter, which does not allow an external user to obtain an adequate assessment of the risks taken by the group.

Secondly, the IFRS standards for disclosure of information on capital adequacy for banking groups do not require the mandatory calculation of the consolidated amount of capital and risks under IFRS. It is the Group's sole discretion as to which capital adequacy ratio to disclose in these financial statements. Unified standards, unfortunately, have not been established.

Thirdly, the analysis of disclosure by banks of information about the risks they take and their management procedures showed the heterogeneity of data presentation, which is due to the lack of clearly structured requirements for information disclosure. Banking groups also often do not disclose the relationship between the group's business

model and the risks it takes. Considering that a significant number of the group's companies remain outside the perimeter of regulatory consolidation, a significant gap is the lack of formalized requirements for banks to disclose the risks of forced support for companies remaining outside the perimeter of regulatory consolidation.

The identified problems require the appropriate regulatory measures.

1. It seems appropriate to expand the perimeter of the regulatory consolidation of the reporting of banking groups to the level of accounting, which will create the basis for a full account of the risks inherent in the companies of the group.

2. Clearly define approaches to formalizing the assessment and management of the risk of forced financial support for the group's companies.

3. Information about risks, methods of their assessment, and management, including in connection with the business model of activity, disclosed by banking groups, requires unification.

CONCLUSIONS

The conducted research allows us to draw the following conclusions.

1. An analysis of the financial stability of banking groups and parent credit institutions separately led to the conclusion that the level of generally accepted indicators characterizing the assessment of asset quality, performance efficiency, and capital provision differs, and in some cases significantly. This confirms the need both to study the financial stability of banking groups on a consolidated basis and to apply special approaches to regulating their activities.

2. In accordance with the established practice, the regulatory reporting of the banking group does not coincide with the consolidated financial statements along the consolidation perimeter, which does not allow investors and creditors to get a complete picture of the risks assumed by the group. This fact allowed us to assume that the financial stability of banking groups depends on the effectiveness of control within the group.

3. To test this hypothesis, an assessment of the financial stability of banking groups was carried out using the Z_{score} indicator (1). To do this, banking groups were divided into two pools according to the level of control. In total, the 26 largest Russian banking groups were analyzed, divided by the level of control into two pools. Based on the simulation result, one can judge the validity of the proposed hypothesis. Thus, for banking groups with a low level of regulatory control, we failed to build a model for assessing financial stability Z_{it} with a satisfactory explanatory power. For the second part of the banking groups, a financial stability model was built, which turned out to be both a random effects model (5) and a pooling model (6). This made it possible to identify factors that affect the financial stability of groups with a high level of control. The constructed model of financial stability of the leaders of the Russian banking sector turned out to be a model with fixed effects (4). At the same time, the net interest margin indicator has become the main factor that positively affects the financial stability of these groups.

4. Based on the results of our analysis of the regulatory documents of the Bank of Russia in the field of regulating the activities and financial condition (risks taken) of banking groups in Russia, as well as studying their reporting on risk and capital management, measures were proposed to improve the regulation of financial stability and disclosure of information by banking groups about accepted risks.

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***Authors' declared contribution*:**
I.V. Larionova — analysis of regulatory documents of the Bank of Russia on the research topic, description of the analysis results, and writing of research paper conclusions.
V.A. Byvshev — data preparation, statistical modeling, description of the research results.
E.I. Meshkova — statement of the problem, development of the conceptual framework of the article, critical analysis of the literature, collection, and analysis of statistical data, preparation of research paper conclusions.

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Policy Interest Rate and Bank Profitability-Scheduled Commercial Banks in India

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ABSTRACT

The main **aim** of this research study is to inspect the relationship between interest rate (monetary policy) and bank profitability, along with some bank specific, industry specific, and macroeconomic variables. The **research methodology** includes balanced panel data comprising 50 Indian scheduled commercial banks for 12 years from 2008 to 2020. Fixed effect and random effect model regression have been used to know the required relationship. Due to the presence of heteroskedasticity, the results for robust standard error have been presented. The **result** shows a positive association between the interest rate spread and two banks' profitability indicator return on assets (ROA), return on equity (ROE) while interest rate has an insignificant negative relationship on bank profitability. The study **concludes** that the central bank can increase or decrease the interest spread to maintain the surplus or deficit liquidity problem in the economy. Banks are advised to make the appropriate change in lending rate or deposit rate with respect to policy rate to make transmission channel efficient. Also, identify some other factors that affect the bank's profitability. It will help the bank manager to improve the bank's profitability.

Keywords: monetary policy; interest rate; bank profitability; bank specific; macroeconomic; panel data; fixed effect; random effect

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INTRODUCTION

To achieve the desired level of inflation and economic growth, central banks in various countries depend on the instrument of monetary policy. One of the significant monetary policy tool is interest rate, also known as the policy rate [1]. The interest rates have fallen during the previous two decades in most advanced countries. The low interest rate has formed a competitive environment for financial organizations. Low interest rate has increased competition in the financial industry and enhanced risk appetite of the financial organizations [2]. There has been a significant fall in interest rate in India during previous two decades similar to other advanced countries. In 2019, reserve bank has reduced repo rate from 6 to 5.15% and further repo rate was reduced from 4.40 to 4% in 2020. The reduction in repo rate was made due to coronavirus outbreak. It is significant to note that repo rate was 7.75% in March 2007, which is considerably higher than the present repo rate of 4%. In major developed countries, interest rates of short term have wilted to close zero and interest rates of long term were historically low in several countries [3]. The central banks' hostile reaction during the initial phase of the financial crisis was acute to prevent an economic and financial meltdown. Though, there has been a serious concern in recent years that benefits of lengthy monetary accommodation may be decreased due to its adverse impact [4]. One reason for such effect is negative impact of lower interest rate on banks' profitability.

The link between monetary policy and bank profitability has been reported in the early literature review [5–6]. Some empirical studies have been dedicated specifically to the influence of interest rates on bank profitability [7–10]. These studies investigate the link between interest rates and bank profitability in different countries during different time frames. We find none of the studies in India that explored specifically the link between interest rates and bank profitability of commercial banks. Although, some studies focused on Bank lending channel of monetary policy.

Studies reveal that there could be heterogeneity in the reaction of banks to monetary policy. It may depend upon the competition in the banking sector.

The reaction of banks to monetary policy lies in the quality of balance sheet. Several factors like capital, assets, size, liquidity, ownership, are the bank specific variable that may impact the bank's financial position and responses of banks to monetary policy. A study by J. Peek, E. Rosengren [11] stated that significant factor of banks' response is capital to total assets ratio. Banks may be reluctant to provide credit even there is plenty of demand for credit if banks find it expensive to raise capital. R.P. Kishan, T.P. Opiela [12] indicates that undercapitalized and small banks are most affected by monetary policy. A study of [13] concluded that monetary policy has a substantial impact on the credit supply of banks with low ratio of securities to total assets.

In this research study, we investigated the link between interest rate (monetary policy) and bank profitability along with some factors of bank specific, industry specific and macroeconomic variables to gain more insight. The study has undertaken 50 Indian scheduled commercial banks over a timeframe of 12 years. We saw return on assets (ROA) and return on equity (ROE) for bank profitability. The regression results of this study found an overall negative insignificant link between interest rate and banks' profitability. The other independent variables show mixed results of positive and negative relationships with bank profitability.

LITERATURE REVIEW

Several studies have been executed to know the bank profitability in different economies across the globe. Though there were similar streams in the previous literature work of bank profitability, all investigated studies have common purposes as well as outlines. These studies have examined the factor contributing towards banks' profitability in diverse economies as well as from different areas [14–19].

Only few research that examined the link between monetary policy and performance of commercial banks. Though, it is no clear consensus among researchers and academicians on the impact of monetary policy has a positive or negative influence on bank performance. A recent study V. Kumar, S. Acharya, LT. Ho [1] on 19 commercial banks from New Zeeland covering a timeframe from 2006 to 2018 reveals that a rise in short term interest rates increases the profitability of banks. M. Brei, C. Borio, L. Gambacorta [20] examine how lengthy period of low interest rate impacts the intermediation activity of banks by employing data of 113 international banks in 14 developed economies from 1994 to 2015. This study finds that low interest rate persuades banks to change their activities from interest producing to fee allied and trading activities. On average, one percent reduction in policy rate leads to 0.93% increase in revenue from fees as well as commission. Another study by C. Borio, L. Gambacorta, B. Hofmann [3] investigated 109 international banks from 14 advanced economies from 1995 to 2012 shows a positive link between interest rate and bank profitability. H. Genay and R. Podjasek [21] propose that banks can easily compensate for the impact of low interest rates on profitability by changing their business practices, possibly through high fee income and low loan loss provisions. H. Berument, R.T. Froyen [9] studied Finnish retail banks from 2004 to 2014, when there was a substantial change in policy rate as well as market interest rate, this study also discloses a positive relationship. There is a belief among researchers and economists that tightening of monetary policy resulted in an economic contraction in the short run, whereas expansionary monetary policy leads to expansion of economy W.B. English [22]. The higher interest rates decrease credit demand and credit growth in the economy. Borrowers are likely to default at higher interest rates, and therefore, banks have to upsurge their loan loss provision to prevent these probable losses. Interest-free income also declines with the contraction of the real economy. The indirect impacts are generally believed to have negative impacts on performance of banks [23]. On the other hand, J. Stráský, H. Hwang [7] investigate 50 European banks from 2014 to 2018 by using quarterly bank level data and established a weak negative link between monetary policy and banks' profitability. Research performed by C. Madaschi, I. Pablos Nuevo [8] in Denmark and Sweden banks found that banks' profitability increased during negative interest rates. R. Busch, C. Memmel [24] also reveal short run negative impacts for Germany, while opposite results were seen in the long run where an upsurge in interest rate by 100 basis points resulted in around 7 basis points increase in the interest margin of the

Table 1

Research studies on Monetary Policy and Bank Performance

Paper	Result	Unit and Period
V. Kumar, S. Acharya, LT. Ho [1]	Positive	19 banks, 2006–2018
J. Stráský, H. Hwang [7]	Negative	50 Banks, 2014–2018
C. Borio, L. Gambacorta, B. Hofmann [3]	Positive	109 banks, 1995–2012
C. Madaschi, I. Pablos Nuevo [8]	Negative	2 Countries, 2005–2016
H. Berument, R.T. Froyen [9]	Positive	Finnish banks, 2004–2014
R. Busch, C. Memmel [24]	Negative Short run, Positive Long run	Germany, 1968–2013
P. Alessandri, B.D. Nelson [10]	neg. SR, pos. LR	44 UK banks, 1992–2009
W.B. English [22]	Negative	355 US banks, 1997–2007

Source: Compiled by the authors.

banks. Similar results were reported for UK banks in the study [10]. W.B. English [22] works on the issue of interest rate risk and interest margin by investigating interest rate volatility. The study assumes that steeper term structure increases interest margins and volatility of interest rate has negative influence on net interest margin. The maturity mismatch as well as repricing frictions is mainly responsible for suppressed profits.

Although earlier studies are attempting to examine the relationship between profitability of banks and monetary policy on different economies, evidence from emerging and developing economies provides mixed or ambiguous results as shown in *Table 1*. None of the studies focus on the link between the interest rate and profitability of banks in India. Therefore, this study focuses on the relationship between interest rate and bank profitability of India by considering some variables as a control variable. Bank profitability is measured by return on assets and return on equity. Further, the present study extends and contributes to past studies from different economies as it considered panel data of 50 commercial banks covering a timeframe from 2008 to 2020. The rest of research paper is presented as follows. Section 2 consists of the methodology used for analysis and required data on variables for the study. The data analysis is reported in the third section. The results of regression analysis are presented in the fourth section. Lastly, conclusion emphasizes important findings as well their implications in the fifth section.

DATA AND METHOD

Description and Sources of Data

The present study has taken secondary data for investigation. The required variables such as bank specific as well as macroeconomic statistics have been taken from published reports of RBI. The period considered for the current study is 12 years from 2008 to 2020. For better understanding, 50 scheduled commercial banks which include 12 public banks, 20 private banks, and 18 foreign banks, have been considered. Therefore, it makes a balanced panel data comprising 600 observations.

Descriptive Statistics

Summary statistics of all variables have been reported in *Table 2*. This table presents the number of observations, mean, minimum, maximum, and standard deviation to provide insights into the distribution of variables. The average value of ROA is 0.89%, ROE is 7.11% during the study period. A high standard deviation has been reported by liquidity (14.61) which indicates that liquidity of sample banks varies. The result depicts that capital has the highest average value, i.e., 17.6, followed by inflation (INF), repo rate (RP), size (SZ), net interest margin (NIM), nonperforming assets NPA, spread (SP), liquidity (LIQ), and CR3 as 7.70, 6.72, 4.69, 2.99, 1.96, 0.98, 0.85, and 0.36 respectively.

Method

The variables used in the present study to investigate the relationship between bank

Table 2

Descriptive Summery

Variable	Observations	Mean	Minimum	Maximum	Std. Dev
ROA	600	.8953	−9.62	4.21	1.340
ROE	600	7.111	−67.5	25.02	12.76
RP	600	6.720	4.92	7.94	.9551
SP	600	.9858	.250	2.68	.6337
CA	600	17.66	1.12	277.4	13.92
NIM	600	2.996	.946	.130	6.56
NPA	600	1.965	0.00	15.33	2.578
LIQ	600	.8572	.0453	358.2	14.61
SIZE	600	4.692	.630	6.60	.8174
CR 3	600	.3601	0.32	.410	.0353
INF	600	7.708	3.10	12.4	2.713

Source: Compiled by the authors.

profitability and monetary Policy, along with some other determinants shown in *Table 3*. Bank profitability are measured by ROA and ROE. Two models have been used to examine the link between interest rate and bank profitability.

$$ROA_{it} = \alpha + \sum\beta_{x1} MP_{it} + \sum\beta_{x2} SP_{it} + \sum\beta_{x3} CA_{it} + \\ + \sum\beta_{x4} NIM_{it} + \sum\beta_{x5} NPA_{it} + \sum\beta_{x6} LIQ_{it} + \\ + \sum\beta_{x7} SZ_{it} + \sum\beta_{x8} CR_{it} + \sum\beta_{x9} INF_{it} + \varepsilon_{it}. \quad (1)$$

$$ROA_{it} = \alpha + \sum\beta_{x1} MP_{it} + \sum\beta_{x2} SP_{it} + \sum\beta_{x3} CA_{it} + \\ + \sum\beta_{x4} NIM_{it} + \sum\beta_{x5} NPA_{it} + \sum\beta_{x6} LIQ_{it} + \\ + \sum\beta_{x7} SZ_{it} + \sum\beta_{x8} CR_{it} + \sum\beta_{x9} INF_{it} + \varepsilon_{it}. \quad (2)$$

The effect of monetary policy is measured by considering the repo rate as an independent variable. Repo rate is an interest rate levied by the Reserve bank for lending resources to commercial banks. Therefore, it is probable to have both positive and negative influences on bank profitability. Net interest margin shows the proportion of net interest income relative to total interest earning assets and therefore, banking profitability is expected to move in a similar direction as NIM. CAR is measured by equity to total assets. The capital adequacy ratio indicates the capital strength of the organization. Sufficient capital provides firm security against unforeseen shocks. Nonperforming assets indicate the credit risk of banks are measured by the ratio of net NPA to net advances. Bank profitability is estimated to move in the opposite direction of nonperforming assets. Liquidity management is measured by ratio of liquid assets to customer deposits. A balanced liquid asset is required to meet current financial obligations without hampering its profits. A large proportion of liquid assets implies less profit as existing assets bear a lower return rate. Generally, firms with large size are probable to achieve economies of scale and therefore increase bank profitability. Size variable is measured by the natural log of total assets. For industry specific variables, concentration ratio is measured by CR3, it shows the level at which market is regulated by big banks in the industry. As per the structure conduct performance (SCP) assumptions, a high concentration in the market leads to enhance market share and therefore, leads to monopoly revenue. Inflation generally affects the actual value of cost as well as revenue of banks. Banks can alter their interest rate in order to increase revenue than costs if inflation rate is projected. On the other hand, a bank cannot make appropriate changes in interest rates which leads to a faster increase in cost as compared to revenue in case inflation is unanticipated.

DATA ANALYSIS

Correlation Matrix

Table 4 displays the correlation matrix, representing the relationship between independent variables. All independent variables are not

Table 3

Description of Variables

Variable	Measurement	Description	
Return on Assets (ROA)	Net Income / Total Assets	ROA indicates the profit generated by using the existing assets. It is used to measure the organizations' profitability	
Return on Equity (ROE)	Net Income / Shareholder's equity	ROE shows the proficiency to create profits by utilizing shareholders' equity. It shows the firm's financial performance	
Independent Variable	Measurement	Description	Expected Sign
Monetary Policy			
Interest Rate (Repo)	Average Repo Rate	Repo rate is the interest rate levy by reserve bank for lending funds to banks	+/–
Spread (SP)	Repo rate-Reverse repo rate	Spread indicates the gap of interest rate between repo rate and reverse repo rate	+/–
Control Variable			
Capital Adequacy (CA)	Equity / Total Asset	Capital adequacy shows the part of owners' funds accessible to provide support to a firm's business activities	+
Net Interest Margin (NIM)	(Interest Earned-Interest Paid) / Total Assets	NIM indicates the net interest income earned with respect to total assets	+
Nonperforming Assets (NPA)	Net Nonperforming Assets/ Net Advances	This ratio represents the asset quality of a bank. It indicates the percentage of loans which has not received any interest or principal income	–
Liquidity Management (LIQ)	Cash and Cash Equivalent / Customer Deposits	It measures the liquid assets sustained by an organization in respect to its current liabilities	+/–
Size (SZ)	Natural log (Total Assets)	This indicates the size of assets held by a firm	+
Concentration (CR3)	Total Assets of Three Largest Banks / Total Banking Assets	Concentration indicates the competitiveness level in the industry	–
Inflation	Growth rate of CPI–IW	Consumer price index for industrial workers includes specific services, and measured depend on retail prices, and is used to decide the dearness allowance for employees, is the most appropriate indicator of general inflation	+/–

Source: Compiled by the authors.

strongly correlated with each other. Therefore, multicollinearity will not be a serious issue in regression analysis. D.N. Gujarati and D. Porter [25] stated that correlation above 0.8 leads to the issue of multicollinearity. Further, this study has calculated variance inflation factor (VIF) to check the problem of multicollinearity, and results are reported in *Table 5*.

Diagnostic Test

The current study has executed some diagnostic tests to know the suitability of the models. Levin Lin Chu unit root test has been applied to know the stationarity of selected variables. All variables are stationary as result indicates that null hypothesis is rejected as p value calculated for individual variables is below 0.05. The existence

Table 4

Pairwise Correlation Matrix between Internal Variables

	RP	PC	CAR	NIM	NPA	LIQ	SIZE	CR 3	INF
RP	1.000								
SP	0.221	1.000							
CAR	0.035	0.025	1.000						
NIM	0.055	0.169	0.281	1.000					
NPA	−0.069	−0.273	−0.065	−0.342	1.000				
LIQ	−0.077	0.033	−0.018	0.032	−0.010	1.000			
SZ	0.002	−0.219	−0.436	−0.302	0.255	−0.157	1.000		
CR3	−0.540	−0.295	−0.094	−0.176	0.271	−0.000	0.161	1.000	
INF	−0.056	−0.432	−0.081	−0.215	0.325	−0.034	0.177	0.681	1.000

Source: Compiled by the authors.

of heteroskedasticity has been checked by Breusch Pagan Test. Both models have problems of heteroskedasticity as presented in *Table 5*. Robust standard error results have been interpreted and reported in the current study. The results of Wooldridge test agreed with the null hypothesis that no first order autocorrelation. The presence of multicollinearity has been checked by VIF. The average value of VIF is below 10 for the independent variable which suggests no existence of multicollinearity. Further, Hausman test has been done to choose the appropriate model among fixed effect or random effect as presented in *Table 5*.

REGRESSION RESULT AND DISCUSSION

The regression results of panel data are reported in *Table 6*. The final results for ROA model have been extracted from the fixed effect and ROE results from random effect. The current study shows the presence of heteroskedasticity in models, to overcome the issue results of robust standard error have been displayed. The result derived for equation 1 by taking ROA as bank profitability has been represented in *Table 6*. The result provides the fitness of model 1 as F value was found substantial at 5%. The rho (ρ) value is 0.339, which implies that error term with dependent variable. The value of R^2 (within) is 48.02 per cent over the timeframe that signifies the explanatory power of model 1. Discussing the impact of predicting variables, a sufficient number of determinants were found to be significant influences on ROA.

Interest rate has a negative insignificant impact on ROA at 5% level. The interest rate is expected to have a positive impact on bank profitability as their revenue is likely to be higher when interest rate on loans are high (keeping every other thing constant). However, given that a higher interest rate also increases the bank funding costs (the increase is accompanied in the deposit rate too besides the lending rate). It is not so much the Interest rates that matter for the profitability but rather the net interest margin. In a prolonged lower interest rate regime during a weakened economy, the credit offtake slumps on account of reduced economic activity besides the refinancing of the long-term loans and advances at the lower rates, thereby leading to negative effect on banks' profitability. It has also been observed that banks generally tend to keep the net interest margin in their favor during the low regime rates by holding back the lending rates but decreasing the deposit rates to improve their profitability. This has been time and again raised by RBI in recent times advising banks to pass through from policy rates to bank lending rates. Earlier studies have mixed results on the link between interest rate and bank profitability. The previous studies [15, 26] show significant negative impact on bank profitability. An investigation by M. Brei et al. [20] recommends that decrease in interest rate by one percent leads

Table 5

Diagnostic Test and Model Selection

	ROA		ROE	
Breusch-Pagan Test	χ^2 (9) = 412.9	P > χ^2= 0.000	χ^2 (9) = 304.5	P > χ^2 = 0.000
Wooldridge Test	F (1,49) = 0.91	P > F = 0.344	F (1,49) = 0.09	P > F = 0.754
VIF (Mean)	1.87		1.87	
Hausman Test	χ^2 = 29.70	P > χ^2 = 0.0005	χ^2 = 2.450	P > χ^2 = 0.9823
Model	Fixed Effect		Random Effect	

Source: Compiled by the authors.

to 0.93% increase in the non interest income. The decay interest rates also decrease the debt burden and inspires banks to increase their lending portfolio through aggressive lending which results in higher profitability. JA. Bikker, TM. Vervliet [2] and C. Borio, L. Gambacorta, B. Hofmann [3] argue that rise in short term interest rates increases the profitability of banks because most banks borrow funds on a short-term basis and lend these funds on a long-term basis that will improve the lending margin as well as profitability. Some of the studies show the insignificant influence of interest rate on bank profitability [27, 28]. Interest spread has a positive significant influence on bank profitability in our study at a level of 5%. Generally, spread is increased to make central bank standing facilities costlier to encourage interbank trading and activities. It implies that if interest corridor increases bank borrows or lend their money to each other to deal with the issue of deficit and surplus liquidity. With this approach, Banks can borrow more funds to their customers and earn interest on it. An investigation by U. Bindseil, J. Jablecki [29] suggested that a wider corridor is associated with greater interbank turnover and large short-term volatility. Another independent variable, as expected positive relationship of NIM on bank profitability has been seen in table 6, and impact is significant at 5% level. A higher net interest margin leads to high productivity. B.S. Bodla, R. Verma [30] stated that positive association between bank profitability and net interest margin.

A similar result was also provided by the study [31]. The capital adequacy ratio shows a positive significant impact on ROA at 5% level. Capital adequacy provides the banks a buffer stock that protects them from unforeseen risks, therefore a positive impact on bank profitability. K. Bougatef [32] and O.O. Ebenezer, WA. WB. Omar, S. Kamil. [16] demonstrated positive link between capital and bank profitability while A.T. Yahya [33] stated negative influence on the banks' profitability. Nonperforming assets are serious concern in banks as it has an inverse relationship with banks' profitability. As expected, the result of present study shows a negative significant impact of nonperforming assets on ROA at 5%. Similar, results can be found in this study [34]. Inadequate liquidity is another factor of deteriorating bank profitability. Thus, adequate funds are required for the smooth working of banks. Liquidity management has significant positive association with ROA. K. Bougatef [32] and N. Salike, B. Ao [35] provide empirical evidence of positive association between bank profitability and liquidity while [36] reported negative influence of liquidity on bank profitability. C.T. Albulescu [37] found liquidity has a mixed impact. Bank size is found to be positively insignificant on ROA at 5% level. The result of this study is consistent with [34] who established that bank size does not influence profitability significantly. Previous studies [32, 38] show positive influence of bank size on bank profitability. The competition in banking industry has a positive link with banks' profits. High concentration leads to less competition in the market place and a large portion of the market share is in hands of large players. The empirical result shows negative association of concentration with profitability. The result is parallel to [39] who reported that negative concentration relation with banks' profitability and

Table 6

Regression Results

	ROA		ROE		VIF
Variables	**Coefficient (t-value)**	**Robust stand error**	**Coefficient (Z-value)**	**Robust stand error**	
RP	–.04465(–1.23)	.03638	–.45423(–1.70)	.26644	2.14
SP	.34457(3.24)*	.10623	4.2316(7.34)*	.57686	1.44
CA	.00341(2.27)*	.00149	.03661(1.13)	.03235	1.32
NIM	.50218(3.93)*	.12786	1.9479(3.72)*	.52392	1.26
NPA	–.22320(–6.55)*	–.2232	–3.0940(–9.88)*	.31305	1.29
LIQ	.00640(2.55)*	.00250	.06497(10.65)*	.00609	1.04
SZ	.33074(1.20)	.27548	4.5455(7.65)*	.59415	1.45
CR3	–3.8447(–2.63)*	1.4613	–44.809(–2.38)*	18.819	3.78
INF	.00837(0.43)	.01966	–.09638(–0.52)	.18462	3.14
_cons	–.50826(–0.35)	1.4332	1.0835(0.14)	7.7882	-
Sigma_u	.5451		3.250		-
Sigma_e	.7596		7.465		-
Rho	.3399		.1594		-
R^2 (Within)	0.4802		0.5807		-
Model Fit	F (9,49) = 149.97 P > F = 0.000		Wald χ^2 (9) = 888.48 P > χ^2 = 0.000		-

Source: Compiled by the authors.

Note: Significance exists at 0.05 level.

Table 7

Result Summary

Result Obtained				
Independent Variable	**Expected Sign**	**ROA**	**ROE**	**Supported by**
Interest rate (repo)	Positive/Negative	Negative insignificant	Negative insignificant	[28, 29]
Capital Adequacy	Positive	Positive significant	Positive insignificant	[16, 33]
Net Interest Margin	Positive	Positive significant	Positive significant	[31, 32]
Non-Performing Assets	Negative	Negative significant	Negative significant	[35]
Liquidity Management	Positive/Negative	Positive significant	Positive significant	[33, 36]
Size	Positive	Positive Insignificant	Positive significant	[35, 39]
Concentration	Negative	Negative significant	Negative significant	[40]
Inflation	Positive/Negative	Positive insignificant	Negative insignificant	[41, 43]

Source: Compiled by the authors.

thus, no empirical evidence to support SCP hypothesis. Lastly, Inflation has a positive insignificant influence on banks' profitability. This result is similar to the previous study [40] which found that inflation does not impact bank profitability. According to the study of S. Gul, F. Irshad, K. Zaman [41] found a direct link between inflation and ROA. It implies that if banks suppose that inflation may be higher in the near future, the bank can upsurge their prices without facing any drop in demand for their product. Based on the condition that predicted inflation will be equivalent to actual inflation, thus, there will be no decline in business activities. On contrary, other empirical results such as [42, 43] show the negative link between inflation and bank profitability.

The result estimated for equation 2, measuring the bank profitability for ROE is reported in *Table 6*. The overall fitness of the ROE model shown by Wald χ^2 is sufficiently higher and substantial at the level of 5 percent. The explanatory power of model 2 has fairly well as indicated by R^2 (58.07), rho (ρ) is 0.1594 which means a change in the dependent variable is explained by error term. Interest spread has a positive significant impact at 5%. A larger impact of interest spread is recorded on ROE as compared to ROA, which shows an increase in the shareholder wealth due to an increase in interbank trading activities. Interest rate shows the negative and insignificant influence on ROE. Other independent variables except inflation have the same sign for ROE as shown in ROA. INF has a negative association with bank profitability (ROE) that indicates that banks cannot make appropriate changes of interest rate which leads to faster increase in cost as compared to revenue if inflation is unexpected which results in decline in shareholder wealth. The summary of results is presented in *Table 7* along with empirical evidence of previous studies.

CONCLUSION AND POLICY IMPLICATIONS

Banking profitability plays a vital role in the development of an emerging economy. To measure the profitability ROA and ROE have been considered in the study. To know the relationship between interest rate and bank profitability, some control variable has been considered along with interest rate that affects bank profitability. This study shows the negative insignificant relationship between interest rate and two indicators of bank profitability. It is the net interest margin that affects the bank profitability not interest rate. It has been perceived that banks usually keep net interest margin in their favor during the low interest rate regime by decreasing the deposit rate and holding back the lending rate to improve the profitability. The interest spread has a positive significant relationship on the bank profitability. As the spread increases, banks are encouraged to engage in interbank business activities that help them address the deficit and surplus liquidity problem. This study reveals that some other independent variables also influence bank profitability. Capital adequacy, net interest margin, and liquidity management have a significant positive relationship on ROA while NPA and concentration have negative significant impact on ROA. In the second ROE model of bank profitability, net interest margin, liquidity management, and size have significant positive influence whereas NPA and concentration have negative significant impacts on bank profitability. Lastly, Inflation does not show any significant impact on bank profitability in both models.

The result informs policymakers and economists about the influence of interest rate on the profitability of banks and helps them in taking significant decisions related to any change in the policy rate. Banks are advised to make the appropriate change in lending rate or deposit rate with respect to policy rate to make transmission channel efficient. The central bank can increase or decrease the interest spread to maintain the surplus or deficit liquidity problem in the economy. Also, identify some other factors that affect the bank's profitability. It will help the bank manager to improve the bank's profitability. Nonperforming assets are one of the vital causes of deteriorating banks' profits for several years.

Bankers must work on their loan portfolios otherwise problem of the NPA in long run may risk the survival of banks. Bank management should pay attention to liquidity management as deficit liquidity may reduce bank profitability. The finding of this study shows that interest spread, nonperforming assets, net interest margin, liquidity,

and concentration are significant factors that affect bank profitability. The policymakers and regulators should consider these determinants to increase bank profitability in India.

The present study suffers from limitations that open a new idea for future studies. Different panel data for the bank group wise can be investigated, and comparisons can be analysed between different bank groups. Similarly, cross country examination can also be performed to investigate and compare the influence of interest rates between nations.

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B.P. Sahoo — discussed variables, research methodology and research findings.

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Sanctions Pressure on the Russian Economy: Ways to Overcome the Costs and Benefits of Confrontation within the Framework of Import Substitution

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ABSTRACT

The sustainable development of the national economy, taking into account the creation of mechanisms for ensuring economic security, technological sovereignty and preventing threats to the localization of import supplies of final and intermediate consumption goods, is one of the priority directions of economic policy in the conditions of systemic restrictions formed under the pressure of sanctions. In this regard, the study of the key externalities generated within the framework of the sanctions confrontation is an extremely popular task, both for science and practice. In this paper, the authors pay attention to both the actualization of the problem posed and an overview of some of the costs and benefits that can be extracted in the new reality for the national economic system of the Russian Federation. The main purpose of the study is to systematize and analyze the key parameters of economic growth in the Russian Federation under the sanctions pressure of the 2022 model and substantiate the policy of intensification of import substitution as a key mechanism for ensuring sustainable development in the medium and long term in the new reality. The subject of the study is the restrictions imposed by a number of Western countries in relation to the Russian economy, the costs they generate and the opportunities for building a new model of economic growth. As the main results of the study, it is necessary to highlight the systematization of sanctions and restrictions imposed on Russia in 2022; identified trends in the formation of key macroeconomic parameters of the Russian economy, revealing the features of labor market development, GDP formation, investment and business activity, etc.; systematization of risks and prospects of economic growth, including the projection of theoretical models of economic dynamics (IS-LM, AD-AS) on the received estimates; identification of the dependence of the national economy of the Russian Federation on the import of technologies and intermediate/final consumption goods, followed by justification and development of a model to stimulate the policy of import substitution within the framework of the activation of NTR.

Keywords: sanctions pressure; sustainable economic development; risks; opportunities; import substitution; scientific and technological development; modeling; crisis

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INTRODUCTION

Increasing sanctions pressure on the Russian economy predetermines significant risks of sustainable development and the need to adapt reproduction processes to the new reality. Restrictions are forming in foreign trade and cooperative activities and manifesting in the localization of access to imports of raw materials, technologies, services, goods of final and intermediate consumption, using to degrees by different sectors of the economy in the organization of economic relations [1, 2].

"Sanctions, in general terms — are a break-up of integration and cooperative ties, which is essentially a blow to the theory and practice of the international division of labour, which ultimately reduces the costs of production according to production in the most favorable conditions" [3]. Sanctions against the Russian economy by some Western countries made it impossible to maintain imports at the same level. Logistic and cooperative ties are being transformed, in connection with which the question of finding models of eliminating risks and reaching the path of sustainable development of the most "suffering" sectors of the national economy arises acutely.

Considering the increased demand for research aimed at finding and justifying mechanisms of technological sovereignty and the implementation of import substitution policy at both the macro- and mesolevels, research devoted to this issue, began to appear more often in domestic scientific literature.

One of the first issues in the domestic scientific literature of sustainable economic development under external pressure on the economic system, which generates a high level of restrictions on imports of technologies and goods, raised the academic L. I. Abalkin. In accordance with the views of the scientist "the State, especially in the force majeure crisis situation, is forced even in its own loss to produce what it can not do without" [4]. Thus, the priority of economic security of the country and the focus on the need to stimulate the policy of import substitution especially in the «acute» phases of cyclical development of the economy are actualized.

This position is echoed by I. I. Pichurin and D. V. Blinov [5]. In their paper, the researchers point out that "the increase of imports has never brought benefits to the Russian economy, and now it has reached such a scale that the very existence of Russia is "threatened" [5].

V. S. Osipov is substantiating own position in his research, according to which, as a result of the adoption of prescription of the Washington Consensus, the "third world" countries lost their industry, as world markets opened too quickly. The flow of imported goods into the national market primarily devastated the industry, which led to a decline in the income of the population (after all, the increasing returns were lost, and the diminishing returns is remained)" [6].

The problem of substantial dependence on imports in the manufacturing sector of production is also substantiated in researches by A. P. Tsypin [7], N. A. Nevskaya [8] and other Russian scientists.

It is also important to note that the issues of theoretical and applied understanding and research of import substitution policies and the formation of sustainable cooperative ties, which are not sufficiently exposed to the global environment, has also received considerable attention among foreign researchers in recent years. The most notable of these are: researches by S. Stone, D. Flaig and F. Van Tongeren,[1] L. Feng, Z. Li, D. Swenson [9], K. Malik, V. Wickramasinghe [10], G. Hufbauer, J. Schott, K. Elliott, B. Oegg [11] etc.

[1] OECD, Trade and Agriculture Directorate. URL: https://www.gtap.agecon.purdue.edu/resources/download/7203.pdf (accessed on 07.03.2021).

In general, it should be noted that, despite separate works devoted to the problems of technological and product sovereignty of national economic systems, issues of empirical substantiation of models of import substitution and formation of stable cooperative ties in the conditions of system limitations are invulnerable world conjuncture, and have not received proper development at both national and regional levels. This causes and actualizes the need to increase research in this area. These issues are particularly important in the current agenda in the Russian Federation, faced with external barriers to imports and the need to find directions and mechanisms for modelling new cooperation chains under the conditions of sanctions restrictions, which raised the problem of stimulating import substitution policies and ensuring technological sovereignty. The present article is devoted to understanding and some solution of the issues raised and the main purpose of which is systematization of threats and opportunities for growth for the national economy under external pressure.

MATERIALS AND METHODS

It is advisable to use methods of system analysis of data, their aggregation and processing, methods of logical and descriptive analysis, as a methodical tool of research issues raised about the impact of sanctions pressure, the most important consequence of which is to restrict imports and disrupt logistics and value chains. In this regard, the most important methodological basis of the study is the search for patterns of economic development in the new reality, determining on this basis prospects for emerging new trends in economic dynamics and potential consequences as positive, and negative.

Key and methodical tools, forming the basis for finding solutions to the tasks, are the systematization of the sanctions imposed on the national economy. As of October 2022, 8 packages of sanctions were adopted against Russia, which made it "leader" in the world on this indicator. In total, more than 10 000 sanctions were imposed on the country (*Table 1, Fig. 1*).

Sanctions pressure on the national economy of the Russian Federation and subsequent adjustments of key macroeconomic indicators demonstrate two stages of adaptation to systemic transformations. The first of them is characterized by increased volatility and reaction to foreign policy "shock" (large-scale sanctions in February–March of 2022). The second is characterized by systemic adaptation to the perturbations that occurred. The most obvious dichotomous basis of adaptation processes to the sanctions pressure on the Russian economy was visible on the financial markets.

The Central Bank of Russia raised the key interest rate by 2.5 times in the Q1 of 2022 in order to combat the turbulence that led to the rapid rise in credit prices [from 8.5% (February of 2022) to 20% (March of 2022)]. Later, the rate declined to 7.5% (October of 2022).

The most important consequence of the rise in the interest rate was a reduction in GDP and investment activity, which is completely organic fits into the IS–LM model (*Fig. 2*).

The depreciation of the ruble (Q2 of 2022) led to higher import prices Substantial inflation in 2022, according to the Keynesian models of economic growth, could not but reflect on GDP (*Fig. 3*). The result of these patterns was a significant decline in GDP in 2022.

The most important feature of this crisis is diametrically opposed adjustments of base assets relative to other crisis phases of the Russian economy. While in the framework of the 2008 cyclical global crisis and the 2014 sanctions year, energy prices

Table 1

Eight Packages of Sanctions Against the Russian Federation, 2022

Economic sector	Key sanctions
Oil production	– freezing of existing contracts with individual companies and imposition of restrictions on new contracts; – restriction on the export of technologies related to oil and other energies production and refining; – restrictions on oil transportation; – oil embargo; – implementation of the G7 agreement on marginal oil prices, etc.
Gas industry	– sanctions against selected companies in the industry to freeze existing contracts and refuse to enter into new projects; – embargo by the European Union for the supply of LNG; – ban on insurance of ships with fuel
Oil and gas chemical complex (OGCC)	– embargo on the supply of OGCC products; – implementation of the G7 agreement on marginal oil prices; – ban on new investments in the Russian energy sector; – ban on insurance and reinsurance of maritime transport of oil in third countries; – ban on the export of certain goods and technologies, including those related to the energy sector, as well as the prospecting, exploration and production of oil, gas and minerals; – imposed "block" sanctions against large companies (Rosneft, Transneft, Gazprom Neft and others) etc.
Financial and banking industry	– limit access of Russia to EU capital markets and financial services; – the European Union disconnect major Russian banks from SWIFT; – a complete ban on any transactions with four "key Russian banks", including Sberbank, VTB; – ban on providing audit, accounting services, consulting services on business strategy and GR services; – ban on buying, importing or transferring (directly or indirectly) gold of Russian origin; – extension of the ban to take deposits etc.
Real sector of economy	– restrictions on the supply of dual-use goods (goods with both civilian and military applications); – ban on the Russian air carriers to land, take off or fly over EU territory; — "block" sanctions against large companies (Rosneft, Transneft, Gazprom Neft, Kamaz, Rosteh, Uralvagonzavod, Sovkomflot and others); – ban on the provision of tourism services, etc.
Industry	– ban on import of steel and iron products; – ban on new investments in the Russian energy sector, except for civil nuclear energy and transportation of certain products to the EU; – ban on the export, sale, transfer of equipment and technology; – ban on the import of all types of Russian coal, etc.
Trade	– ban on transactions with the Russian Maritime Register of Shipping; – ban on the import from Russia and Belarus of wood, cement, as well as seafood and alcohol; – ban of Russian ships and ships operated by Russia to enter EU ports; – export ban on quantum computers, semiconductors and transport equipment; – restrictions on trade and investment associated with certain economic sectors and infrastructure projects; – ban on imports from Russia of processed and semi-processed steel products, machines and equipment, plastics, vehicles, textiles, shoes, leather, ceramics, some chemical products and jewelry not made of gold, etc.

Source: Developed by the authors according to the VEGASLEX portal. URL: https://www.vegaslex.ru/upload/medialibrary/9da/VEGAS_LEX_Alert_Sanctions_Feb_2022_RUS_ver3.pdf?ysclid=la9jg8sv7w731664266 (accessed on 10.11.2022).

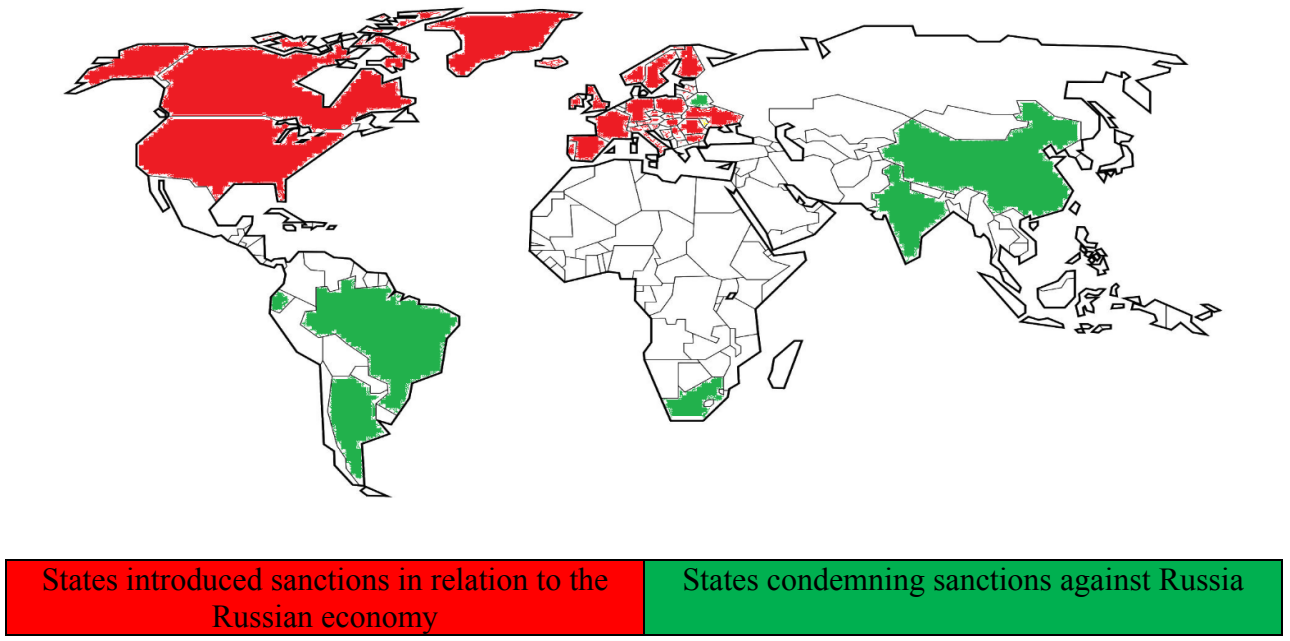


Fig. 1. **The Attitude of the Countries of the World to the Sanctions Pressure on the Russian Economy**

Source: Developed by the authors according to: URL: https://www.gd.ru/articles/12177-sanktsii-dlya-biznesa?ysclid=la9jj5fqle388143546 (accessed on 05.11.2022); https://delprof.ru/press-center/open-analytics/izmeneniya-v-eksporte-i-importe-rf-v-2022-godu-vliyanie-sanktsiy-na-mezhdunarodnuyu-torgovlyu/?ysclid=lab0lhemj5811160288 (accessed on 05.11.2022).

and the ruble fell by more than half, in 2022 there were diametrically opposite trends (*Table 2*).

It is important to note that adaptation of the national economy of the Russian Federation in 2022 was more sustainable and effective relative to the previous crises of 2014 and 2020. This highlights, in many ways, the development of a kind of immunity from business, population, public authorities to overcome the crisis processes formed both within the sanctions pressure and pandemic. These mechanisms of adjustment to the new reality were noticeable in the initial phase of the crisis in 2022, when the sanctions were most clearly manifested in the pressure on the monetary and financial system (freezing of gold-currency reserves) of the Russian economy, as well as to limit the mechanisms for the development of the real sector in the framework of perturbation of cooperation, logistics, production linkages and value chains.

Meanwhile, a number of macroeconomic indicators in the first three quarters 2022 showed noticeable signs of emerging crisis manifestations and risks of sustainable development. Among the most important can be:

- reduction of technological sovereignty by banning the import of certain technologies and goods of final/intermediate consumption;
- a decline in the volume of exports in the trade balance (as a result of the introduction in 2023 of marginal prices for Russian energy resources and systematic rejection of some of them), which predetermines a reduction in budget revenues and forms the risks of creating a budget deficit;
- a decline in net exports as a result of lower export revenues determines a decline in GDP;
- G7 decisions on marginal Russian oil prices in November determine the risks of a decline in export revenues, sequestering of net exports and, consequently, an increase in the ruble exchange rate adjustment, including within the budget balancing;
- disruption of the financial sustainability of the banking sector as a result of the

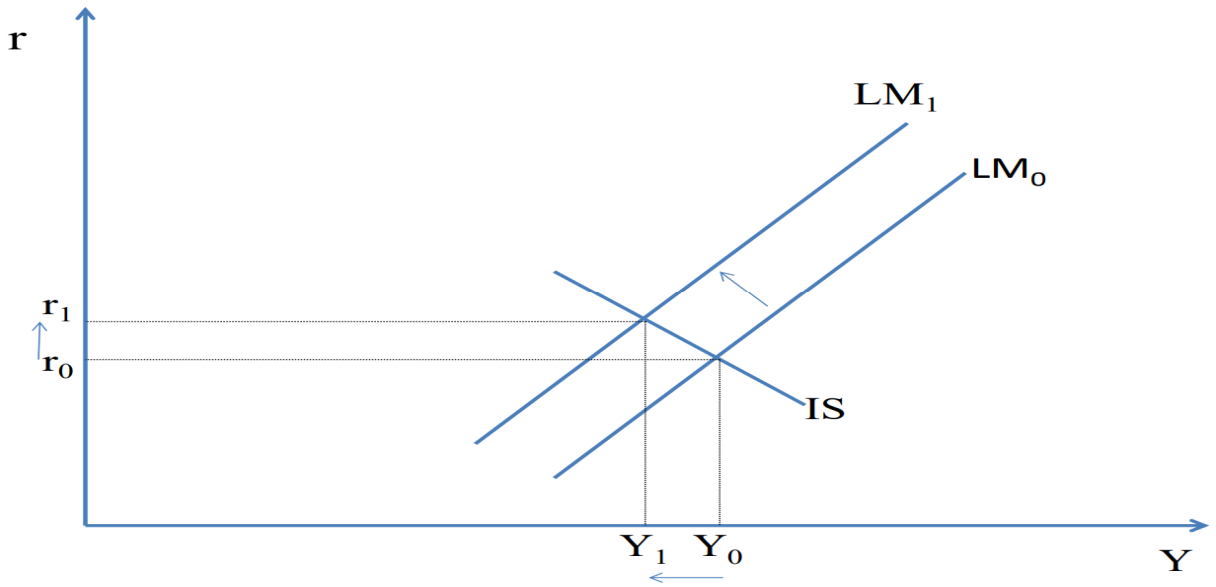
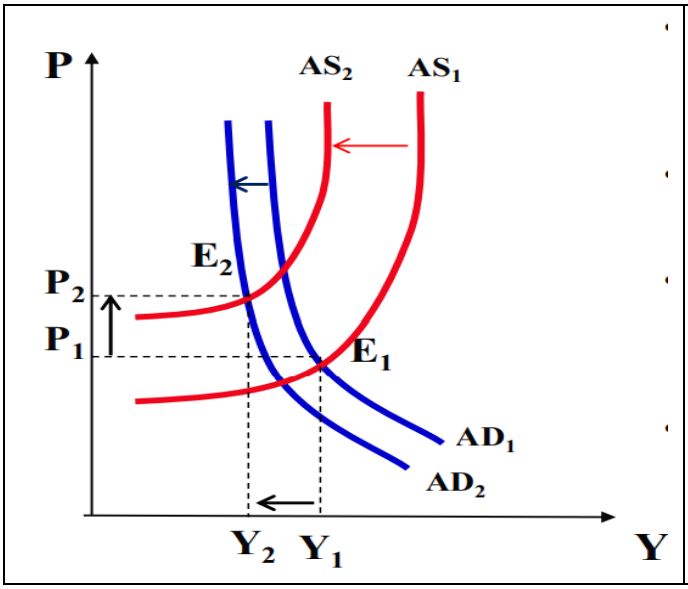


Fig. 2. **Graphical Interpretation of Interest Rate Growth in 2022 (IS-LM Model)**

Source: Developed by the authors according to URL: https://www.rea.ru/ru/org/cathedries/Kafedra-otraslevojj-i-biznes-statistiki/Documents/ Нуреев%20P.M._MP-2017.pdf (accessed on 05.11.2022).



a) Higher prices reduced aggregate demand (AD curve shift from position 1 to position 2).
b) Lower demand reduced aggregate supply (AS curve shift from position 1 to position 2).
c) Macroeconomic equilibrium shifted from E_1 to E_2, indicating that the rise in prices has led a decline in GDP (shift the equilibrium point that determines the volume of GDP at fixed price level from Y_1 to Y_2)

Fig. 3. **The AD-AS Model as a Tool for Substantiating the Changes that have Occurred in the Russian Economy (Sample II–III Quarters of 2022)**

Source: Developed by the authors according to EMISS data: URL: https://www.rea.ru/ru/org/cathedries/Kafedra-otraslevojj-i-biznes-statistiki/Documents/Нуреев%20P.M._MP-2017.pdf (accessed on 05.11.2022).

decline in real incomes of the population and the reduction in the solvency of economic agents;

- reduction of the overall level of competition in the economy as a result of exit of foreign companies from the national market predetermines deterioration of the competitive environment and decrease in the quality of organizational and managerial decisions, etc.

RESULTS AND DISCUSSION

A brief excursion into the system of externalities caused by sanctions pressure

Table 2

Comparative Analysis of the Fall in Oil Prices and the Growth of the Dollar in 2008 and 2022

Price	2008		2014		2022	
	$	%	$	%	$	%
Futures for Brent oil	from 139 to 45	–68% ⇓	from 112 to 53	–53% ⇓	from 80 to 104	+30% ⇑
US $	from 23.4 to35.9	+53% ⇓	from 34 to 64.3	+89% ⇓	from 76 to 60	–21% ⇑

Source: Developed by the authors according to: URL: http://ru.investing.com/ (accessed on 11.11.2022).

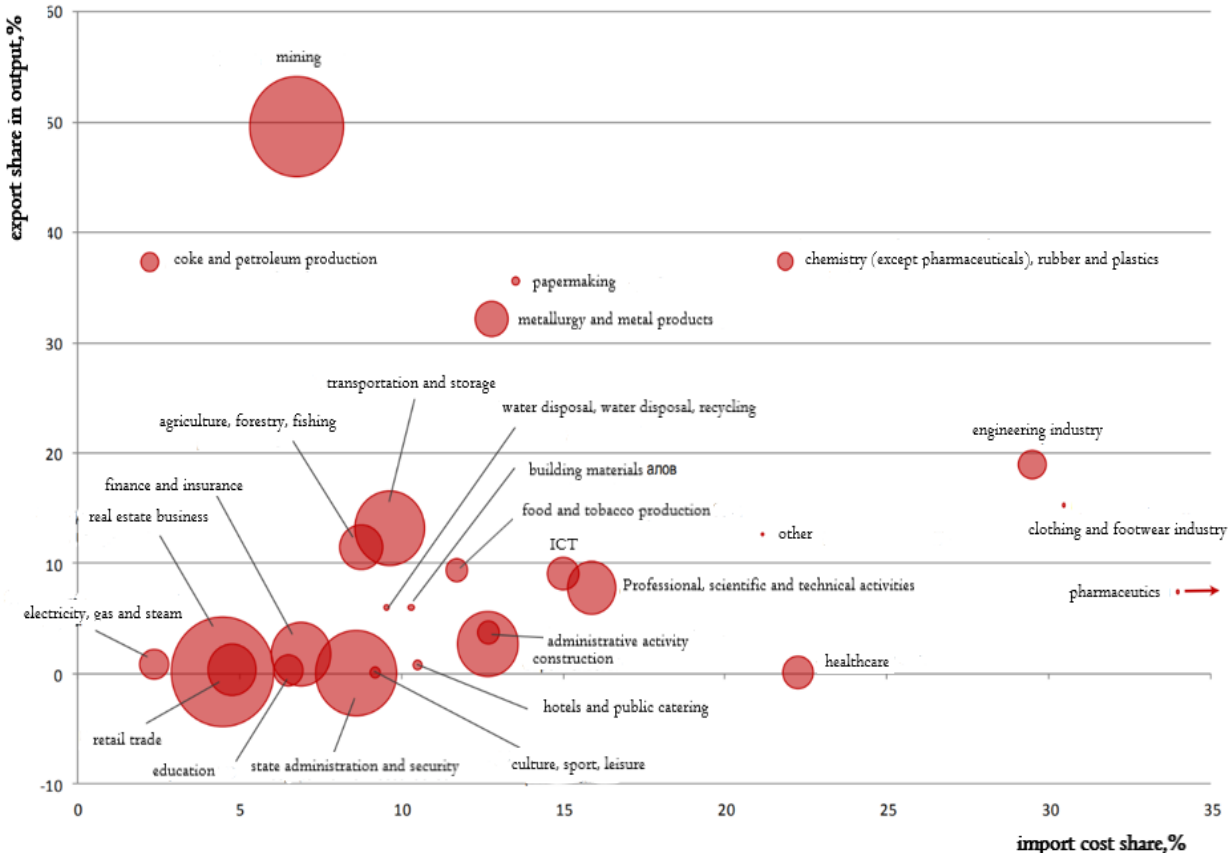


Fig. 4. **Export-Import Dependence of the Russian Economy, 2021. The Size of the District Means the Segment's Share in the Economy**

Source: Developed by the authors according to: URL: www.forecast.ru/_ARCHIVE/Presentations/DBelousov/2022–07–15Kolomna.pdf (accessed on 10.11.2022).

on the Russian economy predetermines and largely confirms the earlier theses on the need to develop measures of State mechanisms for stimulating economic dynamics, where import substitution is most important [12–14]. This is due not only to the fact that the share of imports in the structure of the Russian economy is significant and, in some sectors, very high (*Fig. 4*), but also to the fact that the niches released form the potential for development of the so-called endogenous model of economic growth, based on an autonomous development policy that is largely based on

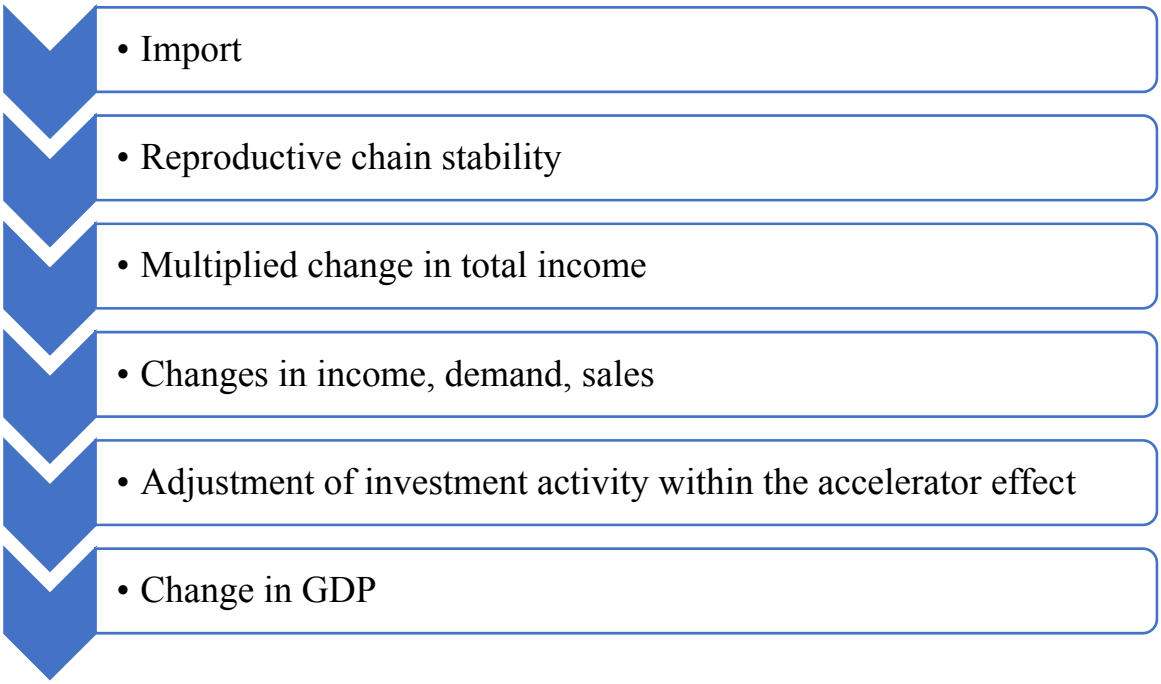


Fig. 5. **The Process of Import Influence on GDP Dynamics within the Framework of the Accelerator Effect Application**

Source: Developed by the authors.

the need to intensify the process of import substitution [15–17].

Meanwhile, based on the presented data (*Fig. 4*), it is important to note the need for differentiation and prioritization of approaches to the implementation of mechanisms of import substitution, based on five important factors:

- vulnerability and dependence of economic sectors on imports of technology and goods for final/intermediate consumption (share of imports from unfriendly countries);
- speed of readjustment of new logistics channels of supply of imported raw materials and intermediate goods;
- possibility and prospects of import substitution within the framework of intensification of scientific-technological development and formation of new cooperation value chains;
- research capacity in selected fields of activity as a tool of operational and strategic import substitution;
- industry orientation to external and internal markets.

These factors should largely determine the stages of implementation of import substitution policy.

It is important to emphasize that restriction of carrying a imports are two key threats: the first is, as already noted, to ensure the sustainable development of reproduction processes, and the second (in accordance with the neo-Keynesian concept of accelerator effect) — is to limit the dynamics of gross income and subsequent decline in investment [16, 18].

Based on the basic postulates of economic theory, formally, the import effect on GDP can be described as follows (*Fig. 5*).

The direct proof of this algorithm of relationships is the analysis and evaluation of the impact of the change in import volumes on the dynamics of the gross domestic product of the Russian Federation. As part of the construction of the simplest econometric models, it can be found (according to data for the last 10 years) that a decrease in the volume of imports by 1 mln USD leads to a decrease in the GDP of

Fig. 6. **Three-Stage Model of Stimulating Import Substitution Policy**

Source: Developed by the authors.

the Russian Federation to 417 mln rubles (*Table 4*). At the same time, the statistical significance of the obtained estimates is not much doubt about the analysis of the values of determination coefficients and other parameters characterizing the verification of calculated data (R-squared = 0.92).

The presented assessments sufficiently clearly demonstrate the acute of the current question on the search for the most effective and adaptive solutions aimed at ensuring the technological and product sovereignty of the national economy of the Russian Federation at the current stage of its development. In general, it should be noted that the current situation, characterized by the need to stimulate economic dynamics under sanctions pressure and the need to replace foreign technologies and goods, focuses on the implementation of the key directions and mechanisms of import substitution, that presented on *Fig. 6*.

CONCLUSION

Based on the results of the research, it should be noted that in the Russian Federation the issues of import substitution are pays close attention. Actively implemented programs and mechanisms at the federal and regional levels contribute significantly to the fact that business demonstrates very effective methods of adaptation to emerging perturbations. Moreover, as demonstrated above when considering the positive externalities for the national economy associated with the sanctions pressure, new and unique «windows of opportunities» are opening for Russian entrepreneurs within emerging market niches when exiting foreign companies.

In addition, it should be emphasized that the implementation of the presented model of stimulation of the import substitution policy should largely rely on the research of the structural components that form the scientific and technological sovereignty. These should include: education, science, innovation, financial provision of scientific-research work and scientific-educational infrastructure [19, 20]. Their assessment and analysis will not only reveal "bottlenecks" of import substitution in the framework of creation of domestic analogues of used foreign technologies, but also to ensure the identification of directions and opportunities for realizing

the potential of innovative development in accordance with the principles and adaptive mechanisms for integrating the national socio-economic system into a new paradigm of economic growth, consistent, inter alia, not only import substitution policy, but also the organic integration into the fairway of the sixth technological order.

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Methodology for Calculating the Job Loss Insurance Rate

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ABSTRACT

The relevance of the research topic is confirmed by the fact that in the context of globalization, job search and job loss have become rather common. Therefore, the working-age population needs to be protected from job loss when looking for a new job. The purpose of the article is to develop a methodology for calculating the job loss insurance rate for citizens. The methodology is based on an actuarial approach that allows a comparison of the net rate and the gross rate paid by the insured. The scientific novelty of the study lies in the consideration of the net rate based on the reasons for employee termination, and the analysis of the possibilities of distributing the net rate between the employee and the employer. Main research methods include tabular and graphical methods, analysis and synthesis, comparison, induction, and deduction. As a result of the introduction of job loss insurance, the social protection of the population in the context of COVID-19 is being strengthened, and opportunities for temporary coverage of expenses during the job search period are being increased. The author concludes that this type of insurance is promising in a market economy and may become not only a new and interesting insurance product but also an effective tool for the social protection of the population in regions with high labor market turbulence.

Keywords: job loss insurance; actuarial calculations; employee; employer; insurance rate; insurer; methodology for calculating the insurance rate

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INTRODUCTION

In the modern system of social protection of a person from the risks associated with the loss of livelihood (old age, illness, disability, unemployment, etc.), social assistance or social insurance may prevail. As a rule, social assistance is funded at the expense of budgetary funds of different levels.

In case of disability of members of society, the state guarantees their provision at the level of the subsistence minimum. The amount and payment of benefits are not related to the length of service and the previous size of wages. When assessing a person's need for benefits, the family composition, mandatory payments, size and income from property, etc. are taken into account.

Therefore, it is necessary to develop such a methodology for calculating the job loss insurance rate for citizens, which will protect the working-age population from job loss for the period of looking for a new job. To do this, it is advisable to use the method of actuarial calculations, adapted to the specifics of the problem being solved and the available initial data.

LITERATURE REVIEW

A sufficiently large number of domestic experts were involved in the analysis of foreign experience in insurance against job loss. In particular, I.N. Kuropatenkova and Yu.M. Zenovchik consider the experience of organizing unemployment insurance in the Republic of Belarus [1], and O.B. Pichkov analyzes the role of insurance in the implementation of US social policy [2]. In turn, V.P. Shram conducts a historiographic analysis of the pension insurance reform in Croatia [3], and the papers of A.V. Yakovleva and A.G. Kim are devoted to the Swedish system of job loss insurance [4]. We also want to distinguish the studies of J. Clasen and E. Viebrock [5].

The allocation of budgetary funds for the provision of social assistance directly depends on the economy and finances of the state. According to V.D. Roik, "this model initially assumes smaller state guarantees, and hence a lower level of sources for financing benefits" [6]. According to A.S. Tokmakov, "when using social insurance, the principle of residual budget financing of social expenditures is overcome and it becomes possible to increase social payments by investing free balances of insurance funds in highly profitable assets" [7].

Yu.P. Kalmykov in his paper notes that "insurance orients people, first of all, to rely on themselves, leaving, as a last resort, collective provision on a national scale from the authorities or the regional government" [8]. From the foregoing, it follows that compulsory social insurance of basic risks has significant advantages over the budgetary mechanism for providing social assistance [9]. The prospects for job loss insurance are reflected in the works of I.L. Soloshchenko [10] and Ya.A. Kovtun with M.A. Pisarevskaya [11], A.V. Logacheva and A.A. Smagin [12], as well as S.I. Maksimov and D.A. Rusinov [13].

Certain methods and mechanisms of insurance protection of employees as a result of negative events in the labor market were considered by A.V. Poletaev [14], general insurance principles of unemployment protection were studied by F.I. Mirzabalaeva, S.E. Pashkova, and G.V. Antonova [15], L. Yu. Laskina and A.V. Yakovleva [16], as well as A.A. Bykov [17]. It is important to note the issues of using risk management models in the system of job loss insurance. This issue was considered in detail by E.V. Matveeva, I.S. Ukraintsev, and D.A. Ukraintseva [18], as well as T.V. Mikhina [19]. It should also be noted a number of studies on the methodology of insurance calculations, which include the papers of M.D. Tinasilov and A.R. Urkumbaeva [20], as well as I.V. Sukhorukova and N.A. Chistyakova [21].

METHODOLOGY OVERVIEW

The characteristic of negative events of labor activity suggests the possibility of using various structural deductions and distributing the load between the employee and the

Table 1

Insurance load in Germany in 2019

Type of insurance	Employer, %	Employee, %
Health insurance	7.3	7.3
Pension insurance	9.30	9.30
Occupational accident insurance	1.6	–
Nursing care insurance	1.525	1.525
Job loss insurance	1.25	1.25

Source: Statistics Germany (Statistisches Bundesamt). URL: https://www.destatis.de/DE/Themen/Querschnitt/Jahrbuch/statistisches-jahrbuch-2019-dl.pdf?__blob=publicationFile (accessed on 18.01.2022).

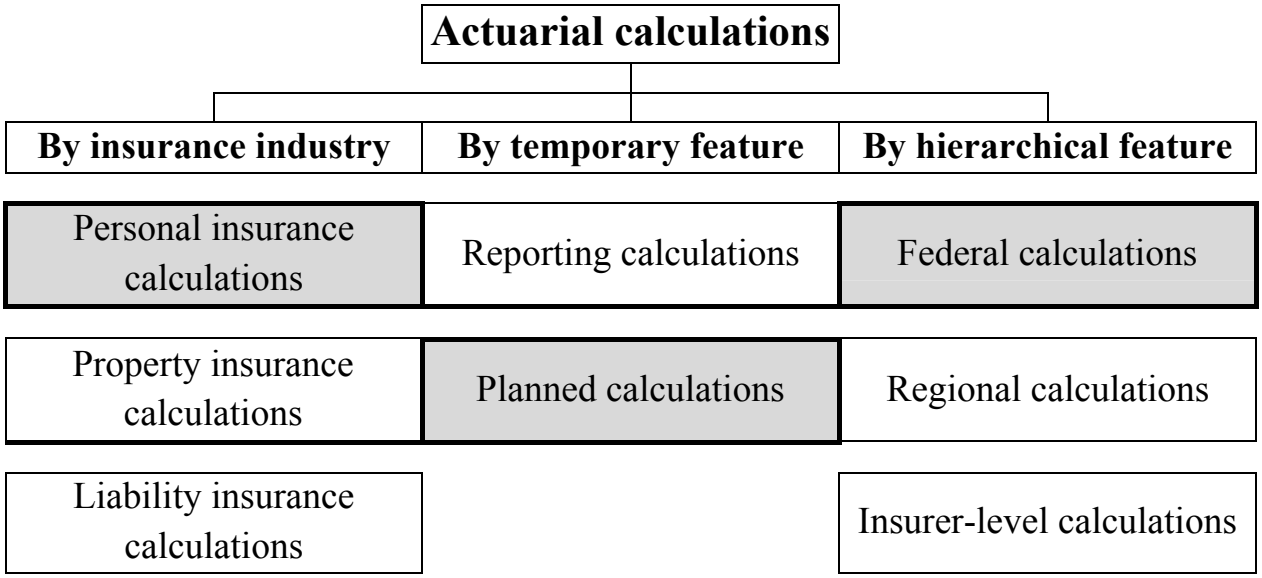

Fig. 1. **Classification of Types of Actuarial Calculations**

Source: Compiled by the author based on M.D. Tinasilov, A.R. Urkumbaeva [20].

employer. This is evidenced by information on the insurance load in Germany in 2019, presented in *Table 1*.

The experience of developed countries shows that job loss risk insurance, unlike other types of social insurance, is associated with the greatest difficulties [2]. To implement the insurance mechanism for the payment of unemployment benefits, it is necessary to justify the amount of payments, as well as the mechanism for the formation and size of the insurance fund [4].

For a preliminary assessment, it is advisable to use actuarial calculations, which can be classified according to various grounds (*Fig. 1*). Taking into account the task of calculating

Insurance rate (gross)			
Net rate	Load		
Directed to the insurance compensation payments	Management expenses	Preventive fund	Insurer's profit

Fig. 2. **The Structure of the Insurance Rate**

Source: Compiled by the author based on: Pricing Models for Insurance Products URL: https://studref.com/530041/strahovoe_delo/modeli_tsenoobrazovaniya_strahovye_produkty (accessed on 12.09.2021).

the size of the fund and the parameters of unemployment insurance *Fig. 1* highlights the elements related to the ongoing calculations.

By insurance industry, the issue under consideration relates to personal insurance, since the insured is a specific individual, an insured event, which is the subject of an insurance contract. On a temporary basis, the actuarial calculations carried out can be considered planned, since they are made when a new type of insurance is introduced, for which there are no clear risk indicators and it is required to assess the scale of insurance payments. On a hierarchical basis, the actuarial calculations can be federal, as they cover the labor market across the country.

The insured will be an employee who meets specific requirements for the length of service and the reasons for termination of the employment contract. For example, in order to receive insurance compensation for the loss of a job, an employee must work at the current workplace for a certain period of time (3 months, 6 months, 12 months, or more).

Also, as an insured event, in our opinion, the reason for termination of the employment contract should be taken into account. Currently, the general reasons for the termination of an employment contract are considered in Art. 77 of the Labor Code of the Russian Federation.[1] We believe that only those reasons that do not imply a voluntary decision of the employee should be an insured event. Otherwise, abuse by unscrupulous citizens and losses of the insurer due to unreasonable payments are possible.

The insured in the conditions under consideration is an employee who indirectly, through the employer, pays insurance premiums to form an insurance fund. Thus, all parties to the contract have been established, which allows us to proceed to the analysis of the structure and size of the insurance fund, as well as to determine the parameters of the insurance rate. In accordance with the general rule, the universal structure of the insurance rate has the following form (*Fig. 2*).

MAIN RESEARCH RESULTS

It is important to understand that the insurer's profit is included in the rate only if this activity is delegated to insurance companies. If insurance payments are managed by the state fund, this part of the rate is equal to zero [8]. Accordingly, in the described model, actuarial calculations are required to establish the size of deductions and quantify the parameters of the rate. The size of the net rate, in our opinion, directly depends on the following parameters:

1) the basic payment to the insured person;
2) the number of payments;
3) the ratio of the number of employed to the number of unemployed (the probability of an insured event).

Then the formula for calculating the specific insurance compensation per insured takes the following form:

$$ic_j = \sum_{i=1}^{I} \left(s_i \cdot n_i \right), \quad (1)$$

[1] Labor Code of the Russian Federation No. 197-FZ dated December 30, 2001 (as amended on June 28, 2021) (as amended and supplemented, effective from September 1, 2021). Adopted by the State Duma on December 21, 2001. Approved by the Federation Council on December 26, 2001.

Table 2

Basic Structure and Amount of Insurance Payments for the Insured

Payment / Amount	First payment to an employee	Second payment to an employee	Third payment to an employee
Payment 1 amount	Minimum wage	Minimum wage	Minimum wage
Payment 2 amount	75% of wage	60% of wage	40% of wage
Payment 3 amount	Average wage at the place of work	Average wage at the place of work	Average wage at the place of work

Source: Developed by the author.

where ic_j — the amount of insurance compensation per j-th insured person;

s_i — the base amount of the i-th payment;

n_i — the number of i-th payment.

In particular, this formula describes the payment mechanism that existed before 2001 using the following parameters:

s_1–75% of wage at the last place of work;

s_2–60% of wage at the last place of work;

s_3–40% of wage at the last place of work;

$n1 = n2 = n3 = 1$.

In our opinion, it is advisable to consider the following options for the amount of insurance compensation for an employee (*Table 2*). The table discusses the options for the amount of payments, which, firstly, should compensate the insured for losses as a result of involuntary termination of employment. Secondly, the amount and number of payments should be stimulating, i.e. encourage the insured to look for a new job or self-employment.

We believe that employees can choose the option with the amount and number of payments. At the same time, at their request, options for a one-time payment of any of the amounts are allowed. That is, an employee can receive a one-time payment in the amount of the average wage at the place of work three times the amount. These options do not change the total amount of the payment, therefore, do not affect the size of the insurance fund. Then the total amount of payments for insured events during the year will be:

$$IFN = \sum_{j=1}^{J} ic_j, \qquad (2)$$

where IFN — the total amount of the net insurance fund that is spent on payments to the insured as a result of the occurrence of an insured event;

J — the total number of payments (the total number of insured events during the year).).

The official data of state statistics provide information on the number of employed and unemployed, which makes it possible to assess the probability of an insured event (*Table 3*).

Moreover, as the data show, the job loss probability in men slightly exceeds that of women. That is, when calculating the size of the insurance rate, this feature can be taken into account [10]. However, we believe that this indicator does not give an objective idea of the size of the net insurance rate, since it does not take into account the various periods of formation of the general wage fund and the insurance fund. To assess it, we consider the necessary information according to Rosstat. The median monthly wage per employee in the Russian Federation in 2019–2020 is presented in *Table 4*.

Thus, based on the data on the number of employees and median wages, it is possible to calculate the total amount of funds allocated in the year under review for wages. For 2019, this amount is as follows:

Table 3

Estimation of the Probability of Occurrence of the Insured Event "Job Loss" Depending on the Gender of the Employee

Data	2015	2016	2017	2018	2019
Labor force, thousand people	72,324	76,636	76,285	76,190	75,398
Total:					
employed	72,324	72,393	72,316	72,532	71,933
unemployed	4,264	4,243	3,969	3,658	3,465
Job loss probability	5.90%	5.86%	5.49%	5.04%	4.82%
Men – total	39,433	39,470	39,291	39,175	38,758
employed	37,136	37,201	37,188	37,259	36,912
unemployed	2,296	2,269	2,102	1,916	1,846
Job loss probability	6.18%	6.10%	5.65%	5.14%	5.00%
Women – total	37,155	37,166	36,995	37,015	36,640
employed	35,187	35,192	35,128	35,272	35,021
unemployed	1,968	1,975	1,867	1,743	1,619
Job loss probability	5.59%	5.61%	5.31%	4.94%	4.62%

Source: Calculated by the author based on Rosstat. URL: https://rosstat.gov.ru/labour_force (accessed on 12.09.2021).

Table 4

Median Wage, Rubles

Research period	2019	2020
Russia	30,458	32,422

Source: Data for the indicator were compiled in accordance with Article 3 of the Federal Law No. 473-FZ dated December 29, 2020 "On Amending Certain Legislative Acts of the Russian Federation" based on the Methodology for Calculating the "Median Wage" Indicator approved by Rosstat Order dated 31 December 2020 No. 870.

Note: The indicator is calculated on average per year for 1 workplace for 1 paid month.

71,933 thousand people · 30,458 rubles · · 12 / 1,000,000 = 26,291.224 billion rubles per year

Rosstat provides statistics on the total number of laid-off workers for 2019 (*Table 5*).

In accordance with the assumption proposed above, from this number, it is necessary to subtract those who terminated voluntarily. However, to estimate the total volume of the insurance fund, this assumption can be neglected. If we assume that all those who lost their jobs during the analyzed year were insured, then the total amount of payments for all insured events will be equal to the values presented in *Table 6*.

Table 5

Total Number of People who Lost their Jobs in 2019, People

Type of economic activity	Q1 2019	Q2 2019	Q3 2019	Q4 2019
A	624	3,952	1,780	1,570
B	1,246	1,154	696	1,511
C	8,174	8,362	12,563	8,320
D	1,556	3,883	1,555	1,168
E	987	1,087	997	944
F	1,274	2,399	3,668	4,034
G	965	1,361	1,501	1,194
H	3,412	2,732	1,891	2,922
I	311	626	1,337	514
J	851	1,305	1,739	1,148
K	2,917	3,299	2,399	3,957
L	677	1,743	1,062	863
M	2,443	1,737	2,085	2,427
N	2,095	1,147	1,107	1,673
O	9,109	6,744	7,715	18,004
P	2,509	4,497	5,208	2,417
Q	2,936	3,464	3,140	2,829
R	447	1,124	918	714
S	72	85	147	219
T	0	0	0	0
U	0	0	0	0
Total	42,605	50,701	51,508	56,428
Total per year				201,242

Source: The number of retired employees on the payroll. URL: https://showdata.gks.ru/report/274190/ (accessed on 08.09.2021).
Note: Codes of types of economic activity are given according to «OK 034–2014 (KPES 2008). All-Russian classifier of products by type of economic activity (OKPD 2)» (approved by Order of Rosstandart dated 31.01.2014 № 14-st) (version from 04.02.2022).

Table 6

The Total Amount of Payments for Insurance Compensation, Depending on the Basic Structure and Size of Payments, Billion Rubles

Amount of payments	Total for the first payment	Total for the second payment	Total for the third payment	Total payments
Payment 1 amount	2,270	2,270	2,270	6,810
Payment 2 amount	4,597	3,678	2,452	10,727
Payment 3 amount	6,129	6,129	6,129	18,388

Source: Calculated by the author.

Note: Data on the size of the minimum wage in 2019 are taken from the official website of the Ministry of Labor and Social Protection of the Russian Federation. URL: https://mintrud.gov.ru/labour/salary/113#:~: text=%D0%A1%201%20%D1%8F%D0%BD%D0%B2%D0%B0%D1%80%D1%8F%202019%20%D0%B3%D0%BE%D0%B4%D0%B0%20%D1%80%D0%B0%D0%B7%D0%BC%D0%B5%D1%80%20%D0%9C%D0%A0%D0%9E%D0%A2%20%D1%81%D0%BE%D1%81%D1%82%D0%B0%D0%B2%D0%B8%D1%82%2011%20280%20%D1%80%D1%83%D0%B1%D0%BB%D0%B5%D0%B9 (accessed on 08.09.2021).

Table 7

Unemployment Insurance Net Rate

Net rate	In % to wage	Per 100 rubles wage
Net rate option 1	0.026	0.026
Net rate option 2	0.041	0.041
Net rate option 3	0.070	0.070

Source: Calculated by the author.

Table 8

Selected Data on the Activities of Insurance Companies in 2020

No.	Company	Insurance premiums received in 2020, million rubles	Business expenses, million rubles	Ratio
1	Allianz	5,078.2	34.5	0.68%
2	Ingosstrakh	116,027.3	23,678.7	20.41%
3	RESO-Garantia	109,683.4	26,319.4	24.00%
4	SOGAZ-LIFE	76,069.9	12,069.0	15.87%
5	Sberbank Insurance	21,818.5	17,861.6	81.86%
6	Alliance Life	15,150.0	775	5.12%
7	Total	343,827.3	30,705.6	8.93%

Source: Compiled by the author.

Table 9

Results of Calculating the Gross Unemployment Insurance Rate Depending on the Share of Expenses for Preventive Measures, %

Gross rate	10	11	12	13	14	15
Option 1	0.031	0.032	0.032	0.032	0.032	0.033
Option 2	0.049	0.050	0.050	0.051	0.051	0.052
Option 3	0.084	0.085	0.086	0.087	0.088	0.088

Source: Calculated by the author.

Table 10

The Amount of the Monthly Payment, Depending on the Chosen Insurance Compensation Option and the Amount of Expenses for Preventive Measures, Rubles

Monthly payment	10%	11%	12%	13%	14%	15%
Option 1	9.53	9.62	9.70	9.79	9.88	9.96
Option 2	15.01	15.15	15.28	15.42	15.56	15.69
Option 3	25.73	25.96	26.20	26.43	26.67	26.90

Source: Calculated by the author.

Thus, as a result of a preliminary assessment of the total amount of payments, it becomes clear that the maximum proposed amount of payment is 1.7 times higher than in 2001, which allows the employee to secure a comfortable income while looking for a new job. Accordingly, on the basis of data on payments and the annual size of the wage fund in the Russian Federation, a basic net rate per 1 ruble of wages is formed (*Table 7*).

For example, the maximum additional payment of an insurance premium in the amount of the net rate for this type of insurance for the median wage will be:

30,458 rubles · 0.070% =
= 21 rubles 30 kop. per month

As mentioned earlier, this calculation does not take into account the assumption that the labor relationship between the employee and the employer can be terminated for various reasons. To assess the part of the rate allocated for preventive measures, it is advisable to establish a net rate standard, for example, 10% of the net rate.

We propose to estimate the rate for management expenses based on establishing the relationship between the management expenses of the largest insurance companies and the total amount of assets under management. The rating of insurance companies in Russia and the data for analysis are presented in *Table 8*. The table shows that the weighted average ratio of the cost of doing business to the total amount of insurance premiums is 8.93%. This calculation makes it possible to estimate the part of the rate aimed at compensating the insurer's management expenses.

The size of the fund, taking into account the data received, is formed as follows:

$$IFT = IFN + k_p \cdot IFN + 8.93\% IFT,$$

where IFT — the total size of the insurance fund, taking into account the load;

k_p — the coefficient for calculating the volume of preventive measures (previously, the value of 10% was considered).

Let us carry out transformations in order to express IFT through IFN and completely compose the rate based on the net rate:

$$IFT - 8.93\% IFT = IFN + k_p \cdot IFN,$$

$$0.9107 \cdot IFT = \left(1 + k_p\right) \cdot IFN,$$

$$IFT = \frac{\left(1 + k_p\right)}{0.9107} \cdot IFN.$$

Then, taking into account the assumption about the size of the rate for preventive measures, for example, in the range from 10 to 15%, it is possible to calculate the final rate for the previously considered payment options in accordance with the size of the load (*Table 9*). The analysis shows that taking into account the load, the rate changes slightly — the maximum excess over the net rate is 1.26 times or 26% of the net rate.

We also estimated the amount of the employee's total monthly payment based on the median wage (Table 10). As the analysis shows, the monthly payment does not exceed 27 rubles, which is an acceptable price for compensating for the involuntary job loss risks.

CONCLUSION

Thus, based on the performed actuarial calculations, the following conclusions and recommendations can be drawn.

1. At present, it is advisable to create a job loss insurance protection mechanism. However, it is necessary to determine which reasons for termination of the employment contract are an insured event to be protected at the expense of the insurance fund. In our opinion, the most appropriate are those reasons, the source of which is not the employee.

2. When assessing the amount of payment, the length of service of the employee at the last place of work should be taken into account. Only those employees who worked at their last place of work for at least six months should be covered by insurance. Otherwise, the probability is high that the employee and the employer will collude to manipulate insurance payments. Another important issue is the term of insurance. As a rule, the term of insurance is limited to one year. However, in the type of insurance under consideration, this period can be extended for the duration of the employment relationship between the employee and the employer at the place of work.

3. When assessing the size of the insurance fund, one should take into account the number of people laid off during the period. Due to the fact that the labor market in different regions has certain characteristics in terms of the nature of work, wages, and the direction of migration, it is advisable to differentiate the rate and structure of the fund by region. For this, it is required to carry out regional actuarial calculations according to the methodology proposed in the research work in order to clarify the amount of financing for preventive measures and the remuneration of the insurer.

4. The question of choosing an insurer for this type of insurance remains open. On the one hand, a single specialized fund supported by the state, such as an employment fund, could consolidate the funds of the insurance fund throughout the country. On the other hand, centralization, as a rule, leads to an increase in the cost of insurance and an increase in the insurance rate. Commercial insurance companies, on the other hand, are focused on making a profit and stricter risk management. In the context of the digitalization of employment paperwork, it is advisable to conduct an experiment on choosing an insurance model and evaluate the results.

5. Sectoral differentiation of the insurance fund is possible only on the condition that preventive measures in certain areas of

economic activity can be significantly more expensive than in other types of activity. However, it is necessary to take into account the number of people employed in specific types of economic activity, therefore, after testing the basic insurance model, additional actuarial calculations can be carried out to make changes to the rate formation procedure.

6. The procedure and frequency of payment of insurance compensation may be established individually for each insured person. It is advisable to resolve this issue in the insurance contract when determining the conditions for each insured. It is very important to decide who will be insured and pay insurance premiums. In our opinion, the basic paradigm should be the transition to individual payment of premiums for all types of insurance, so the insured should be an employee who determines the procedure and frequency of payment.

7. A very important issue that goes beyond actuarial calculations is the question of the moment of commencement of the insurance contract and the procedure for its conclusion. There may be a contradiction between the desire of the state to create an unemployment insurance mechanism and consumer protection legislation. That is, the introduction of a new insurance product will require changes in labor legislation, as well as in insurance legislation.

In general, it can be argued that this type of insurance is promising in a market economy and can become not only an interesting new insurance product but also an effective tool for the social protection of the population in regions with high labor turbulence. The long-term development of this area of insurance will require efforts to clarify rates and improve the quality of insurance fund management.

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Role of Export Credit Insurance and the Development of Russian Export Trade

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ABSTRACT

Since the Russian Agency for Export Credit and Investment Insurance (EXIAR) was established in 2011, only a few scientists have bothered to substantiate of the Agency's economic policy. **The aim** of the paper is to investigate the role of EXIAR economic policy in promoting the growth of Russia's export trade. The current study conducts **methods** such as statistical, comparative and empirical analysis of panel data on the basis of econometric models. **The results** of the research suggest that export credit insurance can be useful for the development of Russian export trade, especially for exports to high-risk developing countries and to high-value-added Russian exporting enterprises, such as machinery, electrical and chemical-pharmaceutical industries. The authors **suggest** that Russia should raise the status of export credit insurance, increase the penetration rate of high-tech goods into key countries-importers, improve the foreign trade opportunities of exporting enterprises.

Keywords: export credit insurance; Russian export trade; foreign trade development; policy effects; EXIAR

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INTRODUCTION

The relevance of the EXIAR study is predetermined by its economic and institutional role in the Russian export trade development and national sustainable economic growth provision. In export credit, exporting companies providing commercial credit as well as financial institutions providing financial credit face as a rule property and non-payment risks [1]. Trade credit insurance can include a component of political risk insurance which is offered by the same insurers to insure the risk of non-payment by foreign buyers due to currency issues, political unrest, expropriation etc. (See *Fig. 1*) [2].

Export credit insurance is an important credit management tool to control risk, to provide clients' payment discipline improving one's payment behaviour, obtain important information about buyers and monitor risks, thereby managing the risk of importers being unable to pay their accounts receivable for export transactions due to commercial factors such as delinquency and bankruptcy of importers and political factors such as trade barriers, local either regional wars [3]. Global Export Credit Insurance has played an important role in supporting exporters, facilitating cross-border trade by introducing a range of new tools to provide flexible liquidity support to affected exporters and importers as a reliable response to the political and economic shocks caused by different global threats including the new coronavirus pandemic [4].

According to the Berne Union[1] (the international union of credit and investment insurers), nowadays 12–15% of the global trade volume is achieved with the annual support of export credit insurance. Export credit insurance agencies in some countries provide export credit insurance cover that exceeds 25% of their total exports. EXIAR was established in 2011. The Agency is a dedicated government export support institution for the implementation of export credit and investments export protection

[1] The International Union of Credit and Investment Insurers (Berne Union) is a not-profit association, representing the global export credit and investment insurance industry since 1934.

instruments. EXIAR serves as the national export credit agency (ECA). Since its establishment, the government has developed and implemented a range of systemic initiatives to promote export activities both at the national economic level and within specific business lines and sectors (innovations, aircraft construction, agricultural products, SME's export, etc.).

LITERATURE REVIEW

The relationship between export credit insurance and foreign export is demonstrated by Hideki Funatsu (1986) who used a theoretical model of microeconomics and argued that governmental export credit insurance promotes export by exporters' protection against importers' political and commercial risks meaning the effective instrument for boosting export volume growth [5]. Abraham and Dewit (2000) also conclude that export credit insurance provides export by conducting a regression analysis of data on export credit insurance schemes and export in Belgium, and thus argue that the World Trade Organization (WTO) and the European Union (EU) are right not to make a ban on export credit insurance [6]. Moser, Nestmann and Wedow (2008) also consider the impact of political risk on export trade, suggesting that public export insurance policies reduce the higher hidden costs of political risk, and using German export credit insurance data, demonstrate that export insurance policies have a positive effect on international trade [7]. Baltensperger and Herger (2009) have found through empirical tests that official export credit insurance agencies had a strong facilitating effect on exports to countries with higher political and commercial risk in 30 OECD (The Organisation for Economic Co-operation and Development) countries over the period 1999–2005 [8]. Pradhan, Zohair and Alagawadi (2013) using an empirical test of export trade data for the Indian state of Karnataka has found that policy instruments such as export credit insurance have contributed significantly to Karnataka's export growth [9]. Some Chinese scholars — He Shenyuan etc. [10], Huang Lijiang etc. [11], Zhang Tianxiang etc. [12] — have focused their attention on the overall pulling effect of China's export credit insurance for foreign trade and have demonstrated the causal relationship between these two parameters. Other Chinese scholars such as Wei Qiaoqin [13], Wu Xiangyou [14] and Wang Guojun [15] have verified that China's export credit insurance has a strong "counter-cyclical" effect on China's foreign trade development, and have proved that there are certain industry differences in the value of export credit insurance in the Chinese market. Chinese scholars such as Yu Jinping [16], Liu Weilin [17] and Su Li [18] have shown that export credit insurance has a significant impact on the transformation of foreign trade and national industrial upgrading as well as on the development of Chinese SMEs. Wang Youxin [19] observed that the change in the structure of trade export led to domestic employment rise, while the change in the structure of processing trade exports reduced domestic employment. In general, since China's accession to WTO, export credit insurance has been of great significance to Chinese enterprises in terms of productivity improvement, industrial transformation and upgrading. These studies have also laid an important foundation for Chinese researchers and practitioners-exporters to gain a comprehensive understanding of export credit insurance and its role in the economic development.

Export credit insurance not only facilitates the development of export trade by avoiding political risks and reducing the cost of exporting, but also fits the strategic development of different countries according to their national conditions. Regarding the influence of export credit insurance on export to specific markets, Rienstra-Munnicha and Turvey (2002) use Canadian export credit insurance to bilateral trade data between Canada and its less developed trade partners-importers to apply an econometric model finding that export credit insurance does increase the volume of export. These empirical results argue that a government can increase exports to underdeveloped countries through subsidies to exporters [20].

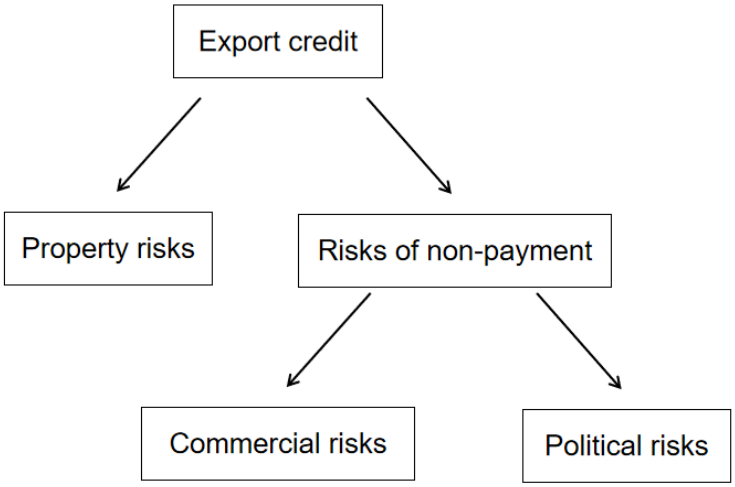

Fig. 1. **Structure of Risks in Export Credit**
Source: Karyakin M.Y. [1].

The situation in Russia concerning the theory and practice of export credit insurance application is different. In fact, the earliest research on Russian policies to help exports dates back to the Soviet Union in 1920, and BLACKBALSEA[2] (f. in 1925) could serve a prototype of such support. Arkhipov's A.P. study detailed the USSR's 20–30-s XX century incessant exploration and research of policies to support export development [21]. The Soviet scholar Rykov A.B. (1984) considered export credit insurance as a means of the capitalist countries to monopolize export trade of third world countries, breaking the fair international competition, but at the same time recognized the role of export credit insurance in stimulating national export trade [22]. The Russian scholar Ulitina E.M. (2007) suggests that Russia should learn from the Swedish experience and set up its own export credit insurance institution to stimulate the country's export trade [23]. A.A. Gavrilov (2011) argues that Russia should increase its financial support for export trade and diversify its export products [24].

The structure of foreign trade is a comprehensive reflection of the country's level of economic and technological development, the situation of industrial structure, the international competitiveness of goods and other factors in the international division of labor and international trade [25]. Although energy export has helped Russia to become an important part of world trade and have an increasing impact on the development of the world economy as a whole, the long-term depends on energy export reflects Russia's homogeneous industrial structure and the instability of its economic development. In the wake of the global financial crisis in 2008, Russia ended nine consecutive years of economic growth, and GDP was down by 25% in one year. At the same time an analysis of I. Asmundson, T. Dorsey, A. Khachatryan (2011) found out that the effect of export credit insurance was strengthened during the financial crisis of 2008 — mid-2009, premium income of global export credit insurers increased by 30–50% and the share of export credit insurance in global trade was up by 1–2 percentage points [26]. Wang Guojun and Wang Debao (2014) use Chinese export credit insurance data from 2002 to 2013 to demonstrate that export credit insurance helped to increase exports, promoted market diversification, increased support for key sectors and enterprises showing certain "counter-cyclical" effects in response to the 2008 international financial crisis [27]. Unfortunately, in 2008 Russia did not have export credit insurance agency of its own but the chain of economic and political shocks stimulated its creation. In 2014 another economic crisis in Russia happened, accompanied and resulted by the US sanctions,

[2] Black Sea and Baltic General Insurance Company Limited — an insurance company set up by the Soviets in Great Britain in 1924 to secure the USSR's foreign trade with Western Europe, discontinued in 2003.

that caused the devaluation of rouble and a precipitous fall in the Russian economy, which affected negatively the country's foreign trade hampering it for more than two years, in spite of the fact that EXIAR was already organized in 2011 and functionally. The main strategic priority of EXIAR's activities is defined as qualitative innovations growth and nowadays focuses on supporting industries that provide the largest stable volume of Russian non-commodity non-energy exports such as metallurgy, mechanical engineering, and the pharma-chemical industry, support for which in 2019 accounted for 85% of the supported export volume. In 2020, for the first time in two decades, export of energy resources (oil, gas, coal) accounted for less than half of the total Russian export (49.6%).[3]

The export sector of a country's foreign trade has a positive effect on the structural optimization of the domestic industrial sector, that via upgrading the export sector will have a significant impact on the national economic development [28]. Felbermayr and Yalcin (2011) conducted an empirical study using data on German exports 2000–2009 and found out that the export promotion effect of German export credit insurance agencies was more significant and particularly effective in certain industries and exporting countries through static and dynamic panel models [29].

Summing up we should point out that the specific role played by export credit insurance was not explored thoroughly by the named foreign and Russian researchers in the context of analyzing the role and impact of EXIAR as a new institution on economic development of Russia presuming the most important variables of foreign trade dynamics investigation. To determine these parameters, the authors, concentrate their attention on the value of Russian exports, importing countries and exporting industries within the specific time horizon (t), a specific exporting country/spacial dimension (i), a specific industry (s).

[3] RosBusinessConsulting. How Russia's trade with other countries has changed over the year. URL: https://www.rbc.ru/economics/15/02/2021/6028f9c79a794754fdb4362e (accessed on 20.12.2021).

DATA AND DESCRIPTIVE STATISTICS

Selection of Variables

This paper selects data on Russia's exports to 188 countries for the period 2016–2020 for 1,197 export commodity categories, and divides these 188 countries into seven groups of countries according to the strategic importance of Russia's export trade development: CIS, Western Europe, Eastern Europe, Asia, South America, Africa, and others. By the way, for reasons of missing data, it was not possible to separate out China for analysis, but since China has been Russia's largest trading partner for 11 consecutive years and is a large country in terms of population and GDP, the results of the analysis of the Asian group will also be of great relevance to the development of trade between China and Russia. In the industry data, as the data from the Russian Customs Service "Table on the distribution of Russia's most important exports by country" used by HS 4 marks, based on a strategic study of Russian commodity exports and the EXIAR grouping concept, these 1,197 commodity categories were summed into Machinery and electrical products, Chemical products, Metal products, Service Industry, Foodstuff, Timber and paper products, Fuel and Mineral, Other Sectors.

In addition, the penetration rate of export credit insurance is an indication of the share of export credit insurance to the value of exports, it can also be the penetration rate to a particular country or to a sector (value of exports/value of the cover), this parameter appeared to be a very important index.

Figure 2 depicts a graph of the trend in the total export trade of Export Credit Russia from 2013–2020 (solid line, left axis) and the penetration rate of Export Credit Russia (dashed line, right axis). Russia's export plummeted in 2014 due to the economic crisis and the US sanctions. In 2016, the country's export growth increased considerably, the penetration rate having increased. Russian export fell again in 2020 due to the global pandemic, but by this time the increased penetration rate had already played a role in the sudden trade risk, so this time there was only a small drop and not a big impact, and if the penetration rate was above 10% at this stage, the possibility of reverse growth could

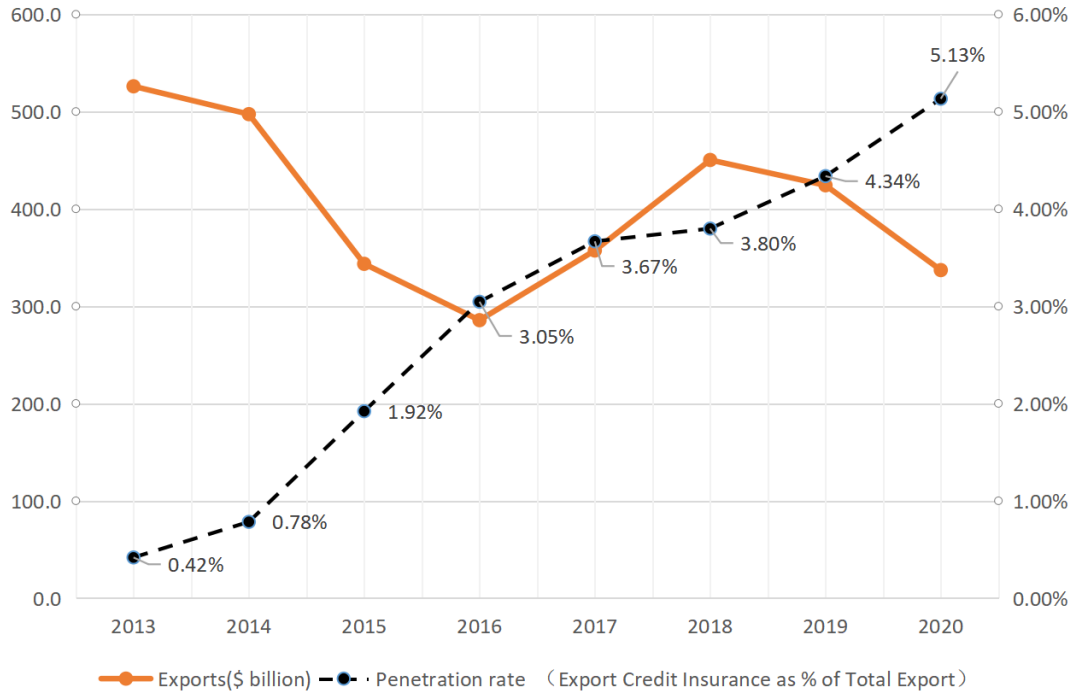

Fig. 2. **Growth in Export Credit Insurance Penetration in Russia**

Source: Compiled by the authors.

Table 1

Intervals for All Categories

Risk index	A	B	C	D	E
Start of interval	1	41.4	81.8	122.2	162.6
End of interval	41.1	81.8	122.2	162.6	203

Source: Compiled by risk map methodology of EXIAR.

not be ruled out, as it was for China in the 2008 economic crisis. This process shows the importance of this data. The penetration of export credit insurance determines the role of export credit insurance for export trade. Export credit insurance agencies in developed countries typically have a penetration rate of 25%, and China's has reached 31% in recent years, but Russia's penetration rate is currently only 7%.

There are many other factors that influence the development of export. That's why we will also include in this test three important control variables: GDP, population and country risk index. Country Risk Index is based on an internal scoring model consisting of six blocks of statistical indicators grouped thematically — Macroeconomics (30%), Trade (20%), Balance of Payments (15%), Public Finance (5%), External Debt (5%) and Political Risk (25%). Finally, a total score is obtained by adding up the six scores, which are divided into five grades A-E. The intervals for all categories are shown in the *Table 1*.

According to the named EXIAR methodology we have divided the 188 countries into 7 country groups, we will add up the scores of all the countries in the group to derive an average score after dividing by the mean, and then derive an average country risk index, expressing A-E as values 1–5, with higher values indicating higher risk, resulting in the following *Fig. 3*.

Source of Data

Export data from the Russian Customs Service, export credit insurance data from EXIAR's

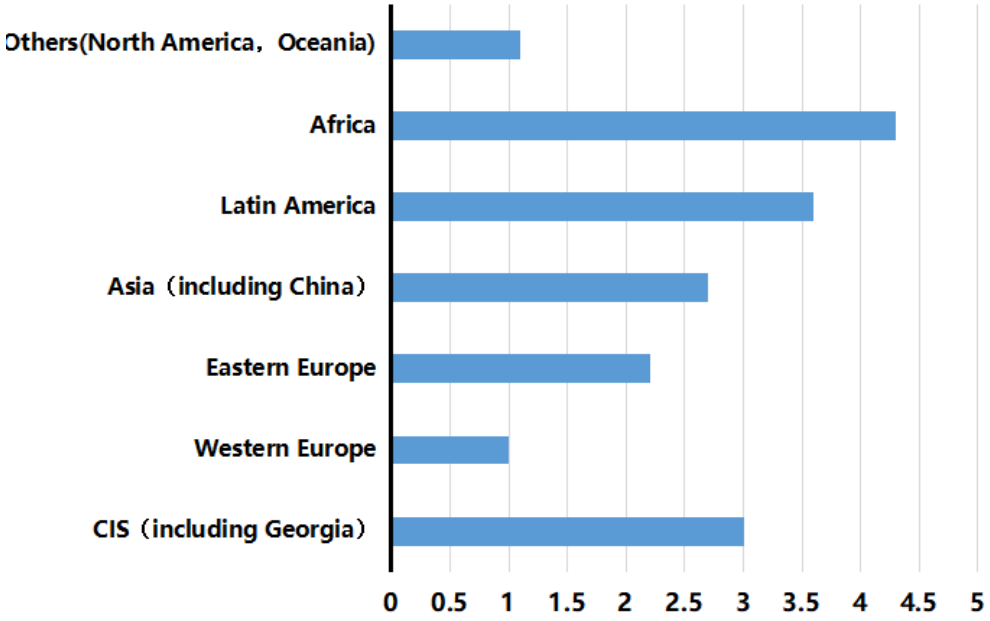

Fig. 3. **Risk Scores for Country Groups**

Source: Compiled by the authors.

Table 2

Descriptive Statistics

Description	Variable	Obs	Mean	Std. Dev.	Min	Max
Export value$_{i,t}$	*y*	35	52.93543	43.3026	3.6	144.74
EXIAR$_{i,t}$	*x*1	35	1.793314	1.008083	0.174	3.591
RISK$_{i,t}$	*x*2	35	2.557143	1.151543	1	4.3
GDP$_{i,t}$	*z*1	35	1535.6	149.6492	1277	1687
Population$_{i,t}$	*z*2	35	144.366	0.1465499	144.1	144.5

Source: Compiled by the authors.

annual report (2016–2020), population and GDP data for each country from World bank, country risk data from EXIAR's website, services, export data from the Eurasian economic commission. A special explanation of the industry's insurance coverage data is provided, so far as EXIAR's annual reports have only specific percentage values for 2016 and 2017, and reports after 2018 are presented in bar charts with no data. Hence, these figures can only be calculated by prognosis, within a 5% error.

TEST RESULTS

Test results are studied via four consequent steps: 1) model setting and descriptive statistics of variables; 2) descriptive statistics; 3) linear regression analysis; 4) finalizing econometric application of linear regression analysis to 8 industries.

Step I. Model setting and descriptive statistics of variables

This study is more concerned with the risk of a buyer country and the change in exports of an industry, while the specificity of a particular enterprise is not the focus of this paper, so the data are combined into the form of year, industry and buyer country and an empirical model is constructed. (*i*) denotes the country of export (i.e. export destination) and (t) denotes the year. Firstly, the paper takes the export value (*Y*) of exports

Table 3

Tests of Correlation

Variate	y	*x*1	*x*2	*z*1	*z*2
y	1				
*x*1	0.3529** (0.0376)	1			
*x*2	-0.4908*** (0.0028)	0.0958 (0.5842)	1		
*z*1	0.1854 (0.2863)	0.4154** (0.0131)	-0.0000 (1.0000)	1	
*z*2	0.0966 (0.5810)	0.0281 (0.8727)	0.0000 (1.0000)	0.4352*** (0.0090)	1

Source: Compiled by the authors.

Table 4

Regression Analysis

y	Coef.	Std. Err.	*t*	*P* > *t*	[95% Conf.	Interval]
*x*1	17.73103	6.779493	2.62	0.014	3.8854	31.57661
*x*2	−19.94131	5.303803	−3.76	0.001	−30.773	−9.109495
z1	−0.008235	0.050472	−0.16	0.871	−0.1113	0.0948423
*z*2	28.77404	46.85463	0.61	0.544	−66.915	124.464
cons	−4069.216	6730.422	−0.6	0.55	−17814	9676.14

Source: Compiled by the authors.

from Russia to each country (*i*) for the period 2016–2020 (*t*) as the dependent variable, the EXIAR underwriting (*X*1) and country risk index (*X*2) as the independent variables, the country GDP (*Z*1) and population (*Z*2) as the control variables, and gives the following estimate equation:

$$Y_{i,t} = \beta_0 + \beta_1 \times X_{1i,t} + \beta_{2i,t} \times X_{2i,t} + \beta_3 \times \text{Control}_{i,t} + \mu_{i,t}.$$

Step II. Descriptive statistics

This paper uses stata16.0[4] software to collate data on selected Russian exports and EXIAR export credit insurance related variables for 2016–2020, the results of which are shown in *Table 2*.

According to the descriptive statistics, the minimum and maximum values of Y and *X*1 have a relatively large difference, indicating that there is a relatively large difference in the amount of exports and EXIAR coverage for different countries at different periods of time, and the main reason for such situation may be caused by *X*2, which has a minimum value of 0.174 and a maximum value of 3.591, indicating a large difference in the risk ratings of different countries, while *Z*1 and *Z*2 — the mean and maximum values are not very different, which may happen due to the relatively short period in which the data was selected (only 5 years), the country's population has not changed significantly and there has been some growth in GDP.

When P-value < 0.01, then the test is significant at the 1% level and the marker *** (strongly correlated). When 0.01 < P-value < 0.05, the test is significant at the 5% level and is marked ** (more relevant). When 0.05 < P-value < 0.1, the test is significant at the 10% level and is labelled * (weakly correlated). According to the test of correlation, there is a strong correlation between *Y* and *X*1,

[4] Stata 16 is a big release, which our releases usually are. This one is broader than usual. It ranges from lasso to Python and from multiple datasets in memory to multiple chains in Bayesian analysis.

Table 5

Linear Regression Summary by Sector

Variables	Sectors	$P>\|t\|$
$Y_{s,t}1$	Machinery and electrical products	0.0150**
$Y_{s,t}2$	Chemical products	0.0173**
$Y_{s,t}3$	Metal products	0.245
$Y_{s,t}4$	Service Industry	0.106
$Y_{s,t}5$	Foodstuff	0.059*
$Y_{s,t}6$	Timber and paper products	0.268
$Y_{s,t}7$	Fuel and Mineral	0.288
$Y_{s,t}8$	Other Sectors	0.854

Source: Compiled by the authors.

indicating that there is a strong correlation between the underwriting and the amount of exports, and a strong correlation between *Y* and *X*2, indicating that foreign trade exports are strongly influenced by the risk of the countries to which they are exported, and this is also consistent with the actual situation (*Table 3*). The strong correlation indicates an interaction between population and GDP, and these are also logical. While *Y* and Z1 and Z2 are not direct enough to be correlated, probably still due to the relatively short years of data selection, the country's population and GDP have not changed much. As already mentioned, the limited data available in EXIAR may not be conducive to our analysis, but since we have refined the data to include data on country risk, as well as the variables of population and GDP, we have been able to prove the correlation between export credit insurance coverage and the value of Russian exports through a correlation test analysis, so that we can proceed to the next Step III (*Table 4*).

Step III. Linear regression analysis

From the regression analysis we conclude that there is a positive correlation between *Y* and *X*1, with a p-value of 0.014, which is almost close to a strong correlation, indicating that the development of export credit insurance has a certain contribution to the development of export trade in Russia, and there are two possible reasons for not reaching a strong correlation (p-value < 0.1): firstly, the development of EXIAR is not fast enough and the penetration rate is not high enough, with the penetration rate by 2020 only 5.13%, failing to achieve a strong boost to export trade; secondly, the positive correlation boost may be affected by the decline in export value due to the new crown pandemic in 2020. And there is a strong negative correlation between the export value and the risk index of the export destination country, with a p-value of 0.001, which indicates that the higher the risk of the export destination country, the lower the export value, which makes it more necessary for the support of export credit insurance to help enterprises share the export risk and increase the underwriting amount in developing countries with higher risk in order to be more conducive to the development of Russia's export trade.

The same method was then used to test the amount of coverage for each sector, with the sector represented by (s), to obtain the formula:

$$Y_{s,t} = \beta 0 + \beta 1 \times X1_{s,t} + \beta 2 \times \text{Control}_{i,t} + \mu_{i,t}.$$

Step IV. Finalizing econometric application of linear regression analysis to 8 industries

This step could be considered as the final stage of our analysis. A linear regression analysis was done for each of the eight industries according to this formula and the final statistics are shown in *Table 5*.

From the results of the analysis, it is clear that the export credit insurance has a more obvious role in promoting the machinery, electrical

and chemical products sectors, which should be explained by the fact that these two sectors are characterized by high risks and high value added. They are two of the most important export sectors for the country to develop. In addition, we find a certain boost to the food industry, probably due to the changing world trade situation giving Russia the opportunity to export more food products. For example, China, the world's largest consumer of food, has gradually opened up its imports of soy, dairy and meat products from Russia because of the trade war with the Americas, which has led to a reduction in import quotas from Canada, Australia and New Zealand. In 2020, China imported 1.8 tonnes of meat and beef from Russia, up 169% year-to-year, and 47% of imported alcoholic products, up 47% year-to-year.

In this experiment, using panel data on total Russian exports and EXIAR coverage for 2016–2019, as well as population and GDP indicators, plus a risk index for the country of destination of exports, we demonstrate using correlation tests and linear regression analysis that EXIAR, the Export Credit Insurance Agency, has a positive impact on the growth of Russian exports and finds a strong correlation between country risk and export value added. This is all logical. The data was then segmented into 8 sectors, and it was found that EXIAR had a significant effect on the machinery, electrical and chemical products sector, and that there was a strong potential for growth in the food export sector.

CONCLUSIONS AND RECOMMENDATIONS

This paper constructs an econometric model to investigate the contribution of export credit insurance to the development of export trade in Russia in a number of dimensions.

The main results of the empirical analysis are as follows:

1. Export credit insurance has a certain promotion effect on the development of Russian export trade;

2. The promotion effect of export credit insurance is more pronounced for exports to developing countries with high risks (Africa, Latin America, CIS countries, Asia), for high risks and high value added sectors such as: machinery, electrical and chemical products;

3. Export credit insurance has had a relatively significant contributing role in driving trade growth, promoting trade market diversification and helping the development of related trade sectors, particularly in terms of export trade volume and credit insurance coverage growth trends in 2016–2019.

Based on the above findings, this paper makes the following recommendations:

First, further clarification, the policy status of export credit insurance, introduction an export credit insurance law as soon as possible, gradual improvement the export credit insurance system, and pointing out the important role of export credit insurance in Russian export trade.

Second, further increase the penetration rate of export credit insurance, especially in key countries with more complementary trade and industries where the country needs to develop production urgently, support national strategic development and actively explore more possibilities in the international market.

Third, further use of export credit insurance to promote the diversification of export markets, optimizes the structure of export products, accelerates the transformation of export industries and promotes the diversification of production enterprises that enables Russia to occupy a more important position in international trade, improve the country's overall competitiveness and import-substitution ability to withstand the economic and sanctions challenges.

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***Authors' declared contribution*:**
W. Xie — statement of the problem, development of the concept of the article, critical analysis of literature.
N.P. Kuznetsova — description of the results and the formation of conclusions of the research.
N.K. Toan — econometric modeling, collection of statistical data, formation of tables and figures.

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Current Problems of Ensuring the Financial Sovereignty of Russia in the Context of International Sanctions

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ABSTRACT

The relevance of the topic of the article is due, first, to the growing geopolitical challenges and threats, escalation of international sanctions that undermine the foundations of economic and financial sovereignty of Russia, and, second, to the need to develop science-based solutions, ensuring the ability of the national financial system to maintain stability and independence from external shocks. The **purpose** of the research is to identify the current problems of Russia's financial sovereignty and to develop reasoned proposals to ensure it in the context of the international sanction's matrix. The **novelty** of the research is that the authors for the first time presented and described a matrix of international sanctions against the financial sovereignty of Russia, as well as developed economically feasible recommendations for its protection in modern conditions. When preparing the theoretical section of the publication, a group of general scientific **methods** was used: observation, comparison, measurement, analysis and synthesis, method of logical reasoning, critical review of scientific literature and professional publications. In the preparation of the analytical section and development specific recommendations, specific scientific methods (static analysis, graphical method) were used, expert method was used to form scenarios for assessing the future state of the financial sovereignty. The essence of the concept of "financial sovereignty" in the context of the international sanction's matrix was considered. Available official state and other verified statistics of the number and structure of sanctions against the financial system was collected and processed, as well as points (zones) of application of their destructive influence was identified. As **conclusions**, expert judgments were formulated on possible tools to protect financial sovereignty and assessed their positive and negative effects, taking into account the volatility of sanctions. The materials of this research can be used as a basis for further justification of promising solutions to protect national financial sovereignty, taking into account foreign economic and military-political trends. The results of the research will be useful to experts in the sphere of state regulation of the national financial system, as well as specialists in the formation of forecasts of socio-economic development of the state.

Keywords: financial sovereignty; anti-Russian sanctions; banking system; digital ruble; default

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INTRODUCTION

The modern paradigm of the world order is clearly aiming to devaluation of such a fundamental feature of the state as "financial sovereignty", explaining this feature of a new spiral of human development and its transition to the digital economy, based on a seamless common financial space. In fact, behind such a beautiful veil lies the cynical interests of the centers of political and economic power of the collective West, aimed at destroying the basis of statehood in countries, which are not followers of its set of values and do not fit into a development strategy. For Russia the question to protect of financial sovereignty becomes more urgent as the escalates of sanctions pressure on its national interests in the world financial market. Today it is a question of preserving the State and its right to represent its interests in the international political and economic arena. That is why the main topic of the business program of the Moscow Financial Forum, held in September 2022, and was called: "Financial sovereignty of Russia: myth or reality".

The *purpose* of the research is to identify actual problems of financial sovereignty of Russia and develop reasoned proposals for its provision in the context of the matrix of international sanctions.

The scientific hypothesis of the research is the thesis about the destructive impact of sanctions on the financial sovereignty of the State.

REVIEW OF THE LITERATURE AND RESEARCH

A feature of the scientific researches is the study of the financial sovereignty of the state through the prism of international sanctions, which imposes special requirements for the preparation of a review of thematic publications of academia and experts-practitioners, including their degree of immersion in the topic. Among the Russian personalities the most authoritative publications are considered *representatives of the State power vertical:* A. G. Siluanov, M. V. Mishustin, E. S. Nabiullina, M. S. Oreshkin and A. L. Kudrin. *Academia* is represented by scientific works of I. N. Timofeev (expert in the field of international sanctions, including financialx), O. V. Andreeva, A. V. Minakov, J. L. Iriarte Angel, A. S. Linnikov, A. V. Sereda, A. V. Kuznetsov, S. V. Kazantsev. The article by O. V. Andreeva, which summarizes the problems and mechanisms of ensuring the financial sovereignty of Russia, is quite interesting. [1]. The content of State sovereignty in the financial sphere is revealed in the paper of N. V. Omelekhina [2], including in the context of its internal and external manifestation.

The authors used statistical data from international expert platforms (Bloomberg, S&P, Global Times, DWN) as well as statistical material from the Bank of Russia and annual reviews of sanctions dynamics to form the analytical component of the research.

The first step we consider it necessary to reveal the essence of financial sovereignty in the context of the matrix of international sanctions for the correct construction of scientific research and the subsequent formation of scientifically-based conclusions and proposals (*Table 1*).

It can be concluded that the *common view* presented in the author's *Table 1* should include the need to modify the model of international financial relations in order to leveling the destructive impact of sanctions. Among the *distinctive features*, the "profile dispersion" stands out, i. e. each of the representatives of the regulators declares his accent as a management dominant, which carries potential risks of conflict of interests of the parties and contradictions in auditing the architecture of international financial relations of Russia with the

Table 1

The Essence of the Concept of "Financial Sovereignty" in the Context of the International Sanctions Matrix

Author	Definition of Essence, Characterization of Features
E.S. Nabiullina	Ability of the State to implement independent and self-sufficient financial and credit policy, resilient to external shocks and risks, by revising the architecture of the relationship with the global financial system. Description of specific features: focus is on preserving the status quo of Russia in the world financial system by forming a new model of international relations with its friendly countries and financial institutions of the EAEU, China
M.S. Oreshkin	Ability of the national financial system to function sustainably despite external challenges and threats by strengthening the national currency, introducing new attractive conditions for investment from friendly countries, ensuring the trust of all market participants through the implementation of all the commitments by state regulators. Description of specific features: in the definition are detailed condition for achieving and maintaining financial sovereignty in the context of international sanctions
A.G. Siluanov	Ability of state regulators (Ministry of Finance, Bank of Russia) to form and maintain a balanced budget, as well as to ensure sufficient transparency and stability of the financial market, including through formation of their own infrastructure of settlement, storage and management of investors' assets. Description of specific features: the definition focuses on: a) maintaining a balanced budget (the country should "live on its own resources"); b) the formation of an independent financial infrastructure that will reduce the risks of interference in the national interests of the Russian Federation; c) building of confidence by investors to the national financial market

Source: Compiled by the authors according to the materials of the Internet portal of the Rossiyskaya Gazeta. URL: https://rg.ru/2022/09/08/prestizh-v-fokuse-ekonomiki.html (accessed on 27.09.2022).

collective West (objectively understand that it is impossible to exclude this subject from relations).

RESULTS AND DISCUSSION

We presented a graph containing the results of quantitative analysis of sanctions directed against the national financial system of the Russian Federation (the focus given to the availability of data is on banking institutions) and their structure for the period from 2014 to Q2 of 2022 (see *Fig.*).

As the diagram in the *figure* shows, the main impact falls on the industry banks subject to SSI-sanctions.[1] In the second group — gent banks of State budget and extra-budgetary funds and development programmes. It can be concluded that the long-term goal of sanctions is to deeply destabilize the processes of socio-economic development and the formation of panic in society, as well as to comprehensively suppress business activity in Russia. Closer to 2022, systemically important banks began

[1] SSI (Sectoral Sanctions Identifications) — special sectoral sanctions aimed at restricting support to specific industries in every way (energy, mining, military-industrial complex, IT-sector).

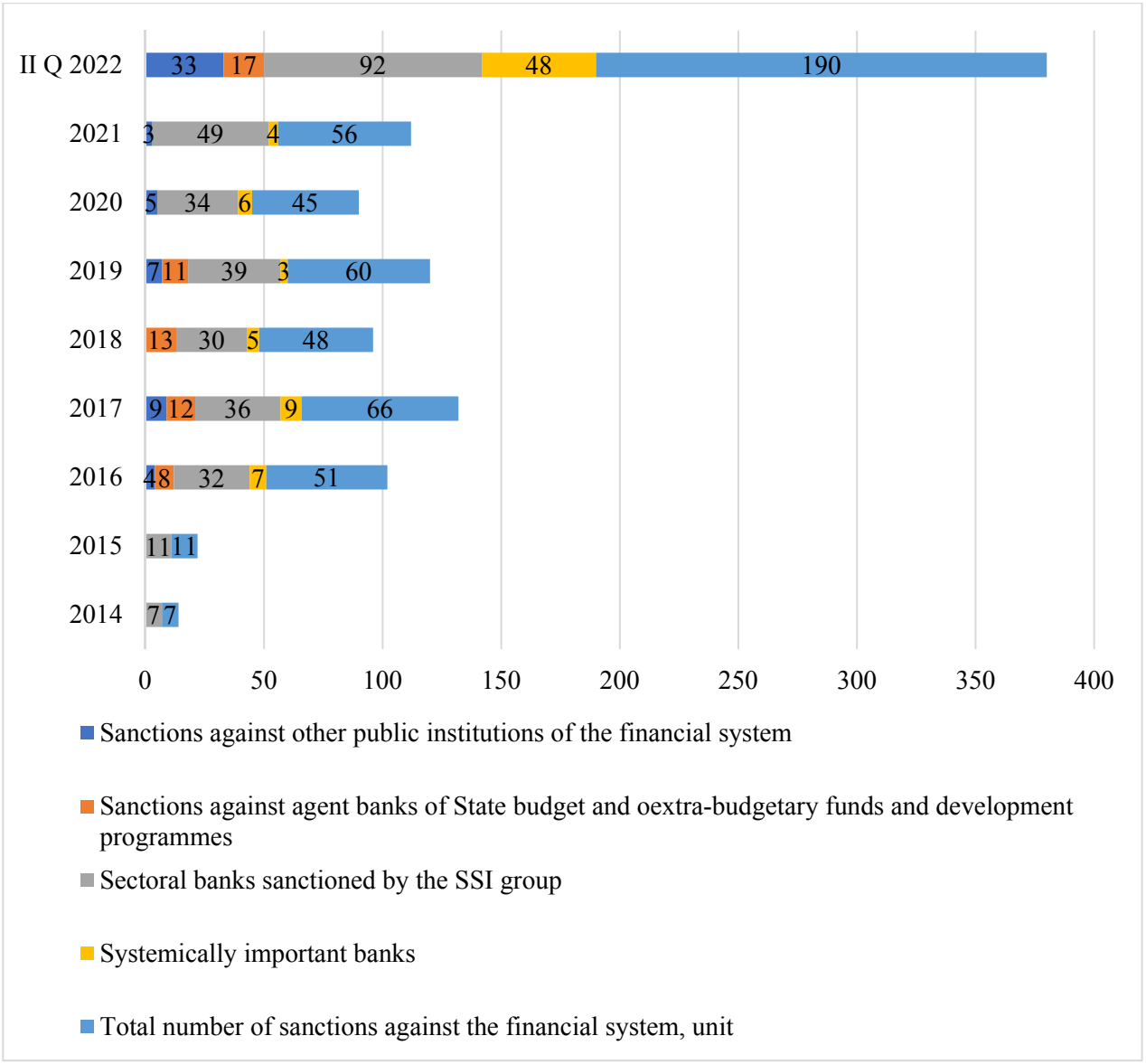

Fig. **Number of Sanctions Against the Russian Financial System and Their Subjects' Structural Composition in 2014 – Q2 of 2022**

Sources: International Sanctions Policy Review (24.12.2018). URL: https://russiancouncil.ru/analytics-and-comments/columns/sanctions/obzor-mezhdunarodnoy-sanktsionnoy-politiki-dekabr-2018/ (accessed on 27.09.2022); International Sanctions Policy Review (30.12.2019). URL: https://russiancouncil.ru/analytics-and-comments/columns/sanctions/obzor-mezhdunarodnoy-sanktsionnoy-politiki-dekabr-2019/ (accessed on 27.09.2022); International Sanctions Policy Review (30.12.2020). URL: https://russiancouncil.ru/analytics-and-comments/columns/sanctions/obzor-mezhdunarodnoy-sanktsionnoy-politiki-dekabr-2020/ (accessed on 27.09.2022); Full list of Russian banks under sanctions for September 1, 2022: what do sanctions threaten customers (31.08.2022). URL: https://pravoved-garant.online/ what-banks-have-been-sanctioned / (accessed on 27.09.2022).

to fall into the orbit of sanctions: according to data for the Q2 of 2022, their number was already 48 (for comparison in 2021 there were only 4 of them).

Table 2 presents a systematic matrix of key sanctions imposed by the Western coalition against Russia's national financial institutions.

Forces of the collective West against the financial sovereignty of the Russian Federation get clear border from the data given in *Table 2*.

Our analysis reveals the key problems of ensuring the financial sovereignty of Russia. Among them:

1) an increasing destructive influence of collective Western sanctions directly on the fundamental basis of the normal functioning of the banking system by weakening the major banking institutions, acting not only airbag for the whole financial system of the country, but also strategic creditors of almost all federal sustainable development programs of Russia [5, 6];

2) risk of exhaustion of domestic financial resources while not being able to replenish them from external sources at the most cost-effective terms and for technical reasons (so-called technical default), which up to now has been constrained by rising oil and gas revenues from speculative energy asset prices [7];

3) the emergence of Asian dependence on China's "financial assistance": China is one of the most likely foreign partners whose financial system can afford large long-term financing of another country in a hybrid form in conditions of Russia's emerging financial isolation. For example, the Chinese leadership has a long-term plan to increase its share in the oil and gas and metallurgy business. Separately it should be noted the trend of acceptance by Moscow of the terms of export settlements in yuan: so, according to Bloomberg, the share of Chinese currency in the foreign currency reserves of the Bank of Russia in 2021 amounted to 13.1% (for comparison in 2017–0.1%).[2] In addition, the National Welfare Fund and the Bank of Russia hold Chinese bonds in the amount of 140 bln USD, which is almost 25.0% of foreign ownership in the domestic bond market of China [8];[3]

4) technological imperfections and risks of banking system degradation from introduction of digital ruble — hot topic in 2020/2021years is emission of Central Bank Digital Currency (CBDC) for "legal circumvention of sanctions" and increase of general transparency of financial system. However, it should be borne in mind that for a fully functioning transformative business model of money circulation (strictly speaking, experts of the Bank of Russia allocate 4 models with different levels of participation of the State regulator) requires significant technological modernization of the infrastructure of the payment system, and in some cases — creation from scratch (for example, a network of digital wallets; processing and settlement platforms with CBDC), which raises the question of technological self-sufficiency of the country, and in the case of their acquisition from third-party manufacturers — there is a risk of cybersecurity of the payment instrument itself or the payment system becoming dependent on another country (such situation can be seen on the example of the system of international settlements SWIFT, anti-Russian sanctions by the payment systems Visa, Mastercard) [9, 10];

5) the problem of effective investment of excess funds of the National Welfare Fund (NWF), derived from the boom in oil and gas market prices — due to the introduction of sanctions, NWF management has reduced to almost zero the options of investing in reliable foreign securities or in the form of direct investment in joint, cross-border projects, for example, in energy infrastructure, logistics, agro-industrial complex and aerospace. It should also be noted that the Russian NWF is only the 17th largest capital

[2] Borders of dependence: how Russia needs China's help now (12.03.2022). URL: https://www.forbes.ru/biznes/458409-granicy-zavisimosti-naskol-ko-rossia-nuzdaetsa-sejcas-v-pomosi-kitaa (accessed on 29.09.2022).

[3] Russia may own $ 140 billion worth of Chinese bonds, ANZ Says, (02.03.2022). URL: https://www.bloomberg.com/news/articles/2022–03–02/russia-may-own-140-billion-worth-of-chinese-bonds-anz-says?srnd=premium-europe&sref=QmOxnLFz (accessed on 29.09.2022).

Table 2

The Matrix of Sanctions Against Russia's Financial Sovereignty and their Characteristics

Name	Characteristics of Sanctions
1. Restriction (ban) of access of banks to SWIFT system	*Type*: sanctions of the international settlement group. *Goal*: creation of restrictions and barriers to international settlements of banks considered as trusted financial agents of State regulators and (or) members of systemically important institutions. *Destructive impact*: destabilization of the established system of correspondent relations of Russian banks with the world financial market, growth of transaction costs, disruption of monetary rhythm, loss of customer base and deterioration of financial stability of banks. *Initiator*: European Commission, Central European Bank
2. Restriction (ban) of international transactions by individual banks	*Type*: sanctions of the international settlement group *Goal*: closing access to banks serving strategic industries: oil and gas (Gazprombank), agro-industrial complex (Russian Agricultural Bank), military-industrial complex (Promsvyazbank), as well as managing partner of state funds for infrastructure development (GC VEB.RF). *Destructive impact*: creation of barriers to normal payments for export-import deliveries of a certain range of products, reduction of investment attractiveness of certain sectors of economy, termination of long-term export contracts. *Initiator*: U.S. Treasury, State Department
3. Freeze of financial assets in foreign financial institutions	*Type*: sanctions of the investment operations group. *Goal*: closing access to banks' profitable assets in foreign jurisdictions, to reduce banks' capitalization, profit rate and investment potential. *Destructive impact*: banks lose a portion of their profitable assets, thereby worsening their financial position in terms of sustainability and operational safety and ability to perform their obligations to customers. *Initiator*: European Commission Department of International Cooperation, Trade and Investment, Office of Foreign Assets Control
4. Outflow of foreign capital from "toxic" banks	*Type*: sanctions of the investment operations group. *Goal*: weakening international investment position of banks, reduction of their financial potential and capitalization. *Destructive impact*: deterioration of banks' rating and subsequent decapitalization of their shares, freezing (interruption) of financial investment processes in the banking sector. *Initiator*: European Commission Department of International Cooperation, Trade and Investment, Office of Foreign Assets Control, State Department
5. Restriction (ban) on the provision of international funding from sanctioned banks	*Type*: sanctions of the macroprudential regulation group. *Goal*: restriction (exclusion) the access of sanctioned banks to foreign financial markets for short- and long-term interbank financing for their normal functioning. *Destructive impact*: deterioration of the resource base of banks, increase in the cost of attracting capital and increase in the risks of non-compliance with the norms of safe operation in terms of credit risks, the rate of capital coverage of liabilities, and in the future — reduction of liquidity and capitalization. *Initiator*: EU Council; the Union Minister for Foreign Affairs and Security Policy; European Commission Department for International Cooperation, Trade and Investment; Office of Foreign Assets Control, Ministry of Finance, State Department

Source: Developed by the authors according to the data [3, 4].

fund in the world, so the choice of projects for investment is becoming more complex [11–13].[4]

The domestic stock market is now characterized by "Brownian behavior" of investors whose goal is almost entirely focused on speculation, and therefore does not contribute to the transformation of capital into new real assets, which also makes it impossible to consider the institution as a potential successor to capital [14, 15];[5]

6) active pressure of the USA on the countries — supporters of Russia in terms of restriction of the use of the payment system "MIR". Development of the national payment discipline by the Russian banking regulator and its integration among the EAEU countries and potential trading partners with a neutral policy course was to be a response to threats and implemented measures to disconnect from SWIFT banking Russian systems, however, during 2022 a number of banks of partner countries "MIR" system began to refuse cooperation due to the threat of sanctions against their own financial interests, which causes a new round of barriers to international settlements and the migration of private capital (according to the data on 21.09.2022, the geography of the payment system is limited only to Belarus, Vietnam and Kyrgyzstan, the latter also introduces certain restrictions on the use of cards "MIR") [13, 15].[6]

The elaboration of specific, and even more cost-effective, recommendations on the protection of national financial sovereignty becomes more complex under the circumstances. Based on the available statistics and analysis of official sources presented above, the authors propose:

- to ensure the transfer to the Bank of Russia of part of the funds of the NWF for "financial injections" in the most important under the sanctions and system-forming banks;
- to organize the use of the infrastructure of non-bank and fintech companies for international settlements and "disguise" individual financial operations;
- actively promote financial collaboration with China's banking system;
- to carry out "operations of deep readjustment" of the banking sector and create quasi-monopoly banking agglomerations [16–20].

Each of these proposals has both an expected positive impact on ensuring Russia's financial sovereignty and possible risks that require separate analysis.

CONCLUSION

Objective complexity and multifaceted problem of ensuring the financial sovereignty of the country becomes apparent, which is due both to the growth of sanctions pressure on Russia from the collective West, and the features of the construction and design of the financial system itself.

There is no consensus on the solution of the issue of ensuring Russia's financial sovereignty, as the number and combination of destructive factors are very high volatility. In this regard, the proposals presented are of an expert nature and their application should be combined with a group of non-financial instruments of influence, including diplomatic channels and power tools. However, their analysis and assessment are beyond the scope of this research, while we understand that their synergistic impact directly or indirectly affects the State of Russia's financial sovereignty.

[4] Experts assessed the impact of future NWF investments on economic growth (01.12.2019). URL: https://www.rbc.ru/economics/01/12/2019/5de0ec7f9a79473f015b8649 (accessed on 29.09.2022).

[5] The time for embezzlement: how Russia's use of National Welfare Fund will lead (12.08.2019). URL: https://www.forbes.ru/finansy-i-investicii/381689-blizok-chas-rastraty-kuda-privedet-rossiyu-ispolzovanie-sredstv-iz-fonda (accessed on 29.09.2022).

[6] "MIR" will not. USA is forced to abandon the Russian payment system (28.09.2022). URL: https://ria.ru/20220928/ekonomika-1820105079.html (accessed on 29.09.2022).

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M. N. Dudin — statement of the problem, development of the concept of the article, preparation of the matrix of sanctions against the financial sovereignty of Russia, formation of the conclusions of the study.
S. V. Shkodinsky — critical analysis of the literature and research, conducting analytical research, development of recommendations to protect national financial sovereignty.
M. O. Ivanov — critical analysis of the literature and research, preparation of the matrix of sanctions against the financial sovereignty of Russia.

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Digitalization in the Processes of Classification of the Country's Budget Expenditures

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ABSTRACT

The study of the processes of planning and accounting of budget expenditures in the context of digitalization and the development of the processes of classification and coding of costs is an important urgent task of improving public financial management. The purpose of the study is to generalize the classification of the country's budget expenditures to justify the need for changes in the order of planning and cost accounting on digital platforms. The research methods included: analysis and synthesis; regression analysis; modeling; scientific abstraction; logical method. The novelty lies in the proposed logical justification of the provisions of the theory of financial informatics as a synthesis of two scientific disciplines — the theory of finance and the theory of computer science. The author's view on the digital content of the classification of budget expenditures is proposed, which represents a multi-dimensional hierarchical system for constructing a graph of budget expenditures. Regression models of the dependence of the resource intensity of the conditional classification budget code of expenditures on the quality of financial management of the GRBS have been developed. The conclusions of the study confirmed the hypothesis that the more detailed the differentiation (classification) of budget expenditures, the more opportunities there are for competent organization and management of their financing processes, which is facilitated by the development of ICT. The recommendations are reduced to the need for further research of the scientific and applied provisions of the development and organization of the functioning of digital platforms in the system of public financial management to improve the efficiency of the use of the country's budget resources. Further development of scientific and applied methodological provisions for the development of the electronic budget is required in order to turn it into a form of the digital budget of the country.

Keywords: budget classification; digitalization of accounting; coding of expenses; regression equation

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INTRODUCTION

New technology platforms reveal opportunities that were not available in the traditional forms of organization of any activity — productive (various activities), social, domestic, behavioral and other. At the same time, critical areas for society, such as healthcare, received an important safety cushion in the fight against the pandemic, as Alexey Timoschuk emphasized in his report "Digitalization as a factor of counteraction to a pandemic" on IX International Conference of Civil Society Researchers[1]: "Notably, one of the main results of the pandemic was the worldwide introduction of remote labor, with the help of which the skills of web-classes were increased, familiarity with cloud storage technologies was held, as well as an important component of life was the implementation of large-scale online activities". This postulate applies to the distribution of the state's GDP through the country's budget system also.

DIGITAL TRANSFORMATION AND STATUS OF THE COUNTRY'S BUDGET EXPENDITURE CLASSIFICATION PROCESS

One of the most important elements of the system of budget organization and the functioning of the unified budget system of the country is the subsystem of classification of the planning and accounting of relevant public expenditures. Our **hypothesis** in the study of the processes of formation and classification of budget expenditures is the following: **the more detailed the differentiation (classify) of budget expenditures, the more opportunities to competent organization and manage their formation and financing processes for public needs and solve social problems of the population.**

The essential content of the concept, as "financial informatics", is on the interdisciplinary boundary of two fundamental theoretical scientific disciplines — the theory of finance and the theory of informatics.

The distribution function of finance as an economic category plays an important role in the system of constantly developing processes of organization of State and municipal administration. This fact is developed in the papers of domestic scientists (see report[2] and papers [1, 2]).

New qualitative opportunities of ICT, contributing to talk about such a format as the digital budget — is the development of the electronic budget, which is facilitated by the processes of further transformation and improvement of the fiscal State corporate platforms in Russia [3, 4].

At the moment, many scientific researches and applied developments are devoted to the problems of digitalization of public administration and budget regulation. N. A. Povetkina [5] considers two major ICT groups to the "institute of information resources in the budgetary sphere".[3]

Article [6] notes: "Classification — is a general scientific method of systematization of knowledge, directed at the organization of a certain set (multiple) of studied objects of different areas of reality, knowledge and activity, into a system of subordinated groups (classes) by which these objects are distributed based on their similarity in certain essential properties".

The unified budget classification of expenditures and revenues of the country's budgets was established in 1995. The 20-bit classification of budget expenditures is currently in effect. The code consists of expenditure directions and details budget allocations by expenditure direction, specifying (if necessary) funding of

[1] Transformation of the third sector in the digital age. URL: https://grans.hse.ru/news/414816050.html (accessed on 10.10.2021).

[2] The State as a platform: people and technology. Report of RANEPS. Moscow. 2019. 111 p. URL: https://cdto.ranepa.ru/media/sum_of_tech/materials/attached_pdfs/Государство_как_платформа.pdf (accessed on 10.01.2023).

[3] Information on the official website of the Federal Treasury. URL: https://roskazna.gov.ru/gis/ (accessed on 14.09.2021).

individual activities. In the scientific theory of "databases" the considered extended provisions of interpretation of the content of the budget classification of expenditures, their various structuring represent elements of the database management system, which are studied in the papers [7, 8].

Now we can talk about the budget classification as a system of "big data", which is the foundation and basis of the construction of the digital economy. "Big data" in a broad sense is spoken of as a socio-economic phenomenon associated with the emergence of technological capabilities to analyze huge amounts of data, in some problem areas — the whole world data, and the resulting transformational consequences" [9].

One of the stages of development of the practice of budget classification was the creation of appropriate guidelines for the budget classification of resources of the programme budget in the Russian regions.[4] These recommendations make it possible to construct such a classification of budget expenditures, which allows to study the program section of budget financing and the effectiveness of the use of funds in the implementation of targeted programs [10–12].

The potential of digital platforms gives an even larger field of scientific-applied activity to expand both analytical and predictive procedures of planning, management and evaluation of results of the use of budget expenditures, as noted in the papers [13–15]. This thesis is based on the fundamental premise of the following logical reasoning and generalizations.

First. The budget hierarchy of the construction of the system of expenditures allows from the lower level (municipal level) to the upper level (federal authority) to obtain such a consolidated component of budget expenditures, which at the top level of construction of the economic system (pyramid) sometimes hardly noticeable and insignificant, but generally felt and relevant.

Second. Digital content classification of budget costs is a multi-dimensional system set of budget digital parameters (databases), which on all procedural planning processes, financing and analysis can provide a multi-vector form of construction of numerical parameters of the budget system.

Third. Digital transformation of budget processes raises the entire technological chain of both planning and budget execution to a new level. All procedures of planning calculations parameters of the expenditure budgets get huge volumes of digital information databases, which can allow much faster and more accurate determination of the necessary values of budget expenditures in the conditions of multi-factor modeling of their formation.

Fourth. The digital platform classification of budget costs describes the logical structures of a huge database, which is an integrated complex system of these data. Methods of manipulation by modification, structural reconstruction can make transitions between the states of the database, but under conditions of integrity of the system as a whole.

Fifth. The hierarchical construction of the system of budgetary classification of expenditures, used at all levels of power hierarchy, on digital platforms can receive not only a twenty-digit grid of code, but also another more extended classification structure of costs, that they allow the capabilities of digital platforms. Despite the rather significant presence in the current classification of budget expenditures target cost items (about 2055 items), subsections (up to 94 items), types (up to 70), general government operations (up to 30), directions (up to 75 items), codes of target cost items

[4] Recommendations for building a program budget classification at the regional and local levels, ensuring the relationship of the structure and dynamics of budget expenditures with the goals and objectives of State and municipal policy. Proposals for methodological support of the organization of work with the State programs of the subjects of the Russian Federation and the application of the program classification of expenditures. Rosminfin. 2017. 92 p.

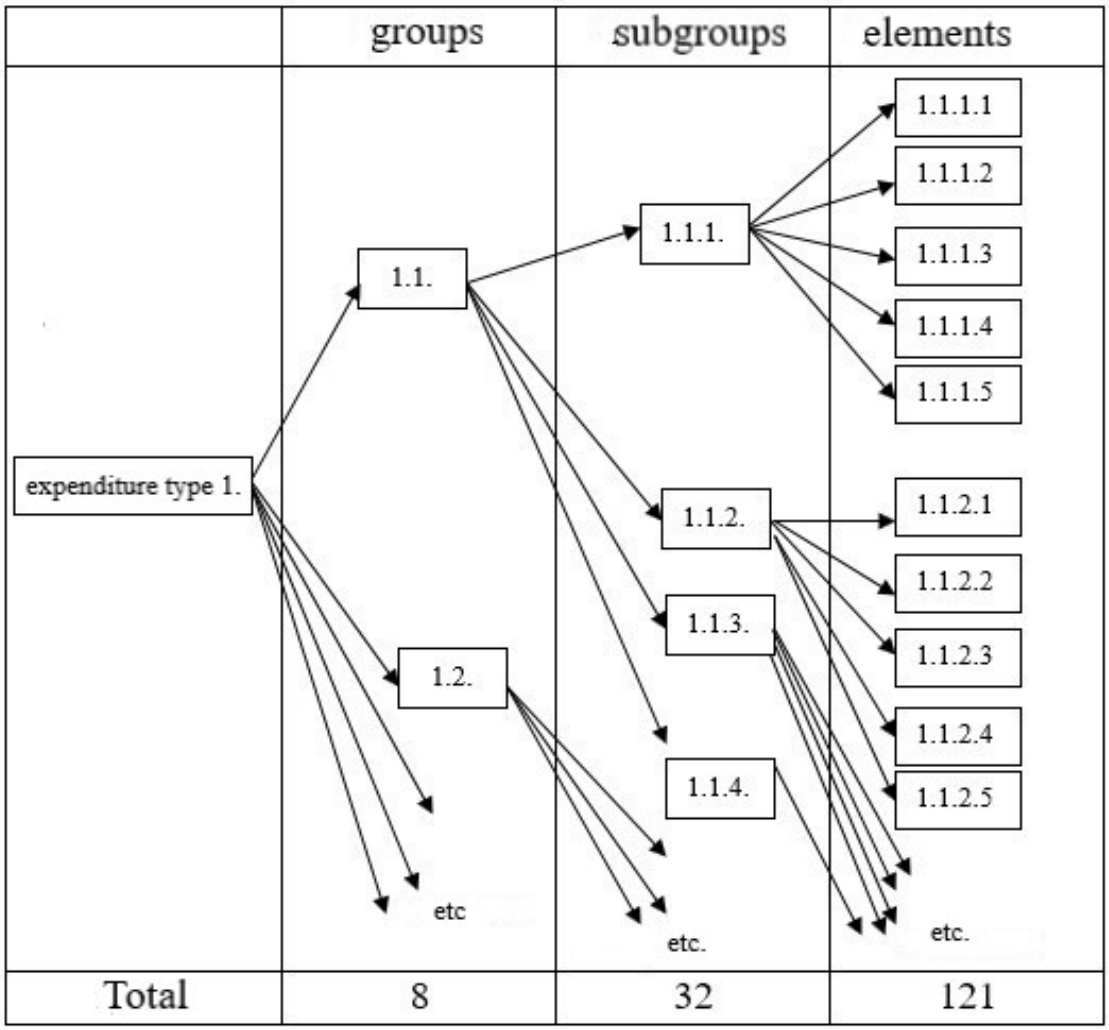

Fig. 1. **Decomposition of Types of Budget Expenditures**

Source: Worked out autoramas in material display Minfina Rossii since 08.06.2020 No. 99n. URL: https://minfin.gov.ru/ru/document/?id_4=130522-prikaz_minfina_rossii_ot_08.06.2020__99n_ob_utverzhdenii_kodov_perechnei_kodov_byudzhetnoi_klassifikatsii_rossiiskoi_federatsii_na_2021_god_na_2021_god_i_na_planovyi_period_2 (accessed on 08.09.2021).

for federal projects (up to 10 items), their structuring on digital platforms can be significantly expanded and unstructured.

Sixth. Digital platforms allow you to quickly classify and rebuild budget expenditures according to a variety of principles and factors of their possible or necessary structural transformation and construction.

Seventh. Cash treasury execution on new digital platforms can significantly accelerate all procedures of funding, monitoring and improve the quality of control over the use of budgetary resources. For example, now in the automated system "Electronic Budget", which is operated by the Ministry of Finance of the Russian Federation and which includes subsystem "Management of National Projects", about 120 000 users of allocated funds from budgets at all levels of federal and regional executive authorities have now been registered.

DECOMPOSITION OF THE COUNTRY'S BUDGET EXPENDITURE CLASSIFICATION SYSTEM

Twenty-digit budget code characterizes a huge array of a large number of digital

databases, which cannot be systematized and generalized without appropriate information and communication software products digital budget.

The budget classification is developed according to the principles of the mathematical device of the decomposition graph, which has the structure of the function tree. At the highest point of the mathematical graph is the total budget expenditure. In the consolidated budget of the Russian Federation is collected a huge database of information, which has both a vertical and a horizontal cut of huge data on the unified structure of the country's budget expenditures. Recently, codes for budget expenditures for national projects and programmes have been introduced, the positions (structure, quantity) of the budget classification target items have been significantly expanded. The budget classification of expenditures is much closer to the system of budget accounting in the budget institutions of the country, as emphasized on the website of the Federal Treasury[5] and in the paper [16].

The economic sense of the classification of budgetary expenditures consists in a gradual decomposition (disaggregation) of allocated in certain cost sections by individual components. For example, the decomposition of types of budget expenditures is presented on *Fig. 1*.

The structure of the budget classification of expenditures consists of ten components at the moment.[6] The number of codes of the budget

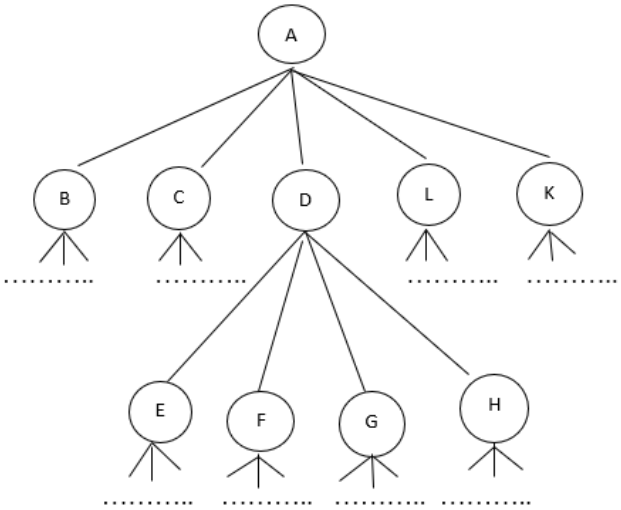

Fig. 2. **A Graph Model of the Decomposition of Budget Classification Codes of Expenditures at the GRBS Level**

Source: Developed by the authors.

classification of expenditures of the federal budget and budgets of the state extrabudgetary funds of the Russian Federation for 2018–2021 is presented in *Table 1*.

Thus, the classification of budget expenditures is represented by ten information arrays of digital databases, which include from 14 to 2 592 digital accounting codes of blocks of budget expenditures with a total value of codes, equal to 4 877. The largest number of codes is for targeted budget expenditure items (2 592) and the smallest — is for the number of budget section codes (14). Accordingly, the largest ratio of information interconnection of code arrays (the ratio of the number of codes of each array in their total value) is in the block of target objects of expenditure (0.531) and the smallest — in the array of codes for payment sections of the budget (0.003).

Schematic representation of the decomposition of the code graph of the budget classification of expenditures at the CMBF level can be considered in the form of a tree of functional and organizational direction of planning and cost accounting (*Fig. 2*).

Formalized, this model can be expressed by the following function (*F*) of dependence of

[5] Requirements for formats and method of transmitting in electronic form of budget reports of chief managers of federal budget funds, chief administrators of revenues, chief administrators of sources of funding submitted to the Federal Treasury. URL: https://roskazna.gov.ru/dokumenty/gis/dokumenty/18287/ (accessed on 04.09.2021).

[6] Order of the Ministry of Finance of Russia No. 99 from 08.06.2020 "On approval of codes (code lists) of the budget classification of the Russian Federation for 2021 (for 2021 and for the planning period 2022 and 2023)". URL: https://minfin.gov.ru/ru/document/?id_4=130522prikaz_minfina_rossii_ot_08.06.2020__99n_ob_utverzhdenii_kodov_perechnei_kodov_byudzhetnoi_klassifikatsii_rossiiskoi_federatsii_na_2021_god_na_2021_god_i_na_planovyi_period_2 (accessed on 08.09.2021).

Table 1

Structure and Number of Budget Classification Codes of Expenditures

No.	Designation	Element of the budget classification of expense codes	Element of the budget classification of expense codes
1	A	Chief manager of budget funds (CMBF)	78
2	B	Section	14
3	C	Subsection	92
4	D	Target items of expenditure (TIE)	2 592
5	E	Implementation of public regulatory payments	111
6	F	Interbudgetary transfers	274
7	G	Programme (non-programme) items of the TIE	445
8	H	Federal government functions	166
9	L	Federal projects	808
10	K	Types of costs	121

Source: Worked out autoramas in material display Minfina Rossii since 08.06.2020 No. 99n. URL: https://minfin.gov.ru/ru/document/?id_4=130522-prikaz_minfina_rossii_ot_08.06.2020__99n_ob_utverzhdenii_kodov_perechnei_kodov_byudzhetnoi_klassifikatsii_rossiiskoi_federatsii_na_2021_god_na_2021_god_i_na_planovyi_period_2 (accessed on 08.09.2021).

Table 2

Dynamics of Expenditures of the Consolidated Budget of the Russian Federation (Billion Rubles), the Number of Codes of Budget Classification of Expenditures by Sections, Subsections, Target Items, Directions and Types for 2014–2021

	2014	2015	2016	2017	2018	2019	2120	2021
Costs	27 611.7	29 741.5	31 323.7	32 395.7	34 284.7	37 382.2	38 205.7	40 000.2
CMBF	108	104	102	95	96	94	95	95
Section	14	14	14	14	14	14	14	14
Subsection	92	92	92	92	92	92	92	94
TIE	205	804	688	1292	1362	1380	2592	2403
Direction	86	107	146	733	968	902	1518	1385
Types	143	141	150	88	114	118	121	118

Source: Compiled by the authors based on materials (orders) of the Ministry of Finance and Treasury of Russia. URL: https://minfin.gov.ru/ru; https://roskazna.gov.ru (accessed on 08.09.2021).

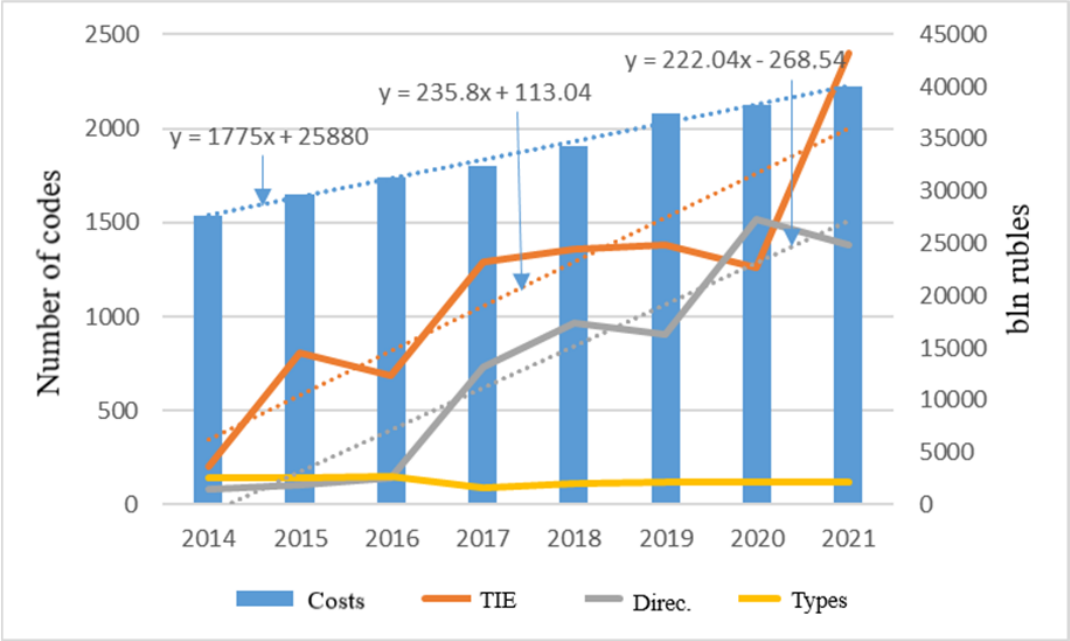

Fig. 3. **The Dynamics of Expenditures of the Consolidated Budget of the Russian Federation and the Number of a Number of Budget Classification Codes of Costs**

Source: Built by the authors based on materials (orders) of the Ministry of Finance and Treasury of Russia. URL: https://minfin.gov.ru/ru; https://roskazna.gov.ru (accessed on 08.09.2021).

the federal budget expenditure of a particular quarter or year on the budget classification of expenditures:

$$\sum (A \in 78) = F\,(B \in 14, C \in 98, D \in 2592, E \in 111, F \in 274, G \in 445, H \in 166, L \in 808, K \in 291),$$

where codes reflect total budget expenditure values for specific budget classification codes.

The system of presented functional modeling of costs allows each j-code of expenses (j = 1,...,2 592), I — that element of the budget classification (I = 1,...,10) present a specific cost item (3Ji), which can be considered and analyzed in a wide range of spectra matrix representation for planning and generalization of budget expenditures in multi-million combinations of relevant cost codes.

Presentation of the database as a large hierarchical structure of the system of codes of planning and accounting of budget expenses is at the moment the largest extensive software complex of electronic budget, which, as technological computing processes continue to be digitized, should take the form of a digital budget. The digital budget — is a form of further development of the e-budget system with new functionalities for both planning and budgeting in the context of an extensive coding system for the budget classification of costs.

REGRESSION ANALYSIS OF THE CLASSIFICATION OF BUDGET EXPENDITURES

We have made a sample according to the relevant Orders of the Ministry of Finance of Russia of the dynamics of the number of codes of the budget classification of expenditures (which can be compared) for 2014–2021 (*Table 2*).

As evidenced by the dynamics number of codes of budget classification of expenditures, which can be compared for 2014–2021, their number size as a whole increase (excluding number of codes by type and expenditure section). In general, the general trend of growth in the composition of the budget expenditure codes is particularly noticeable

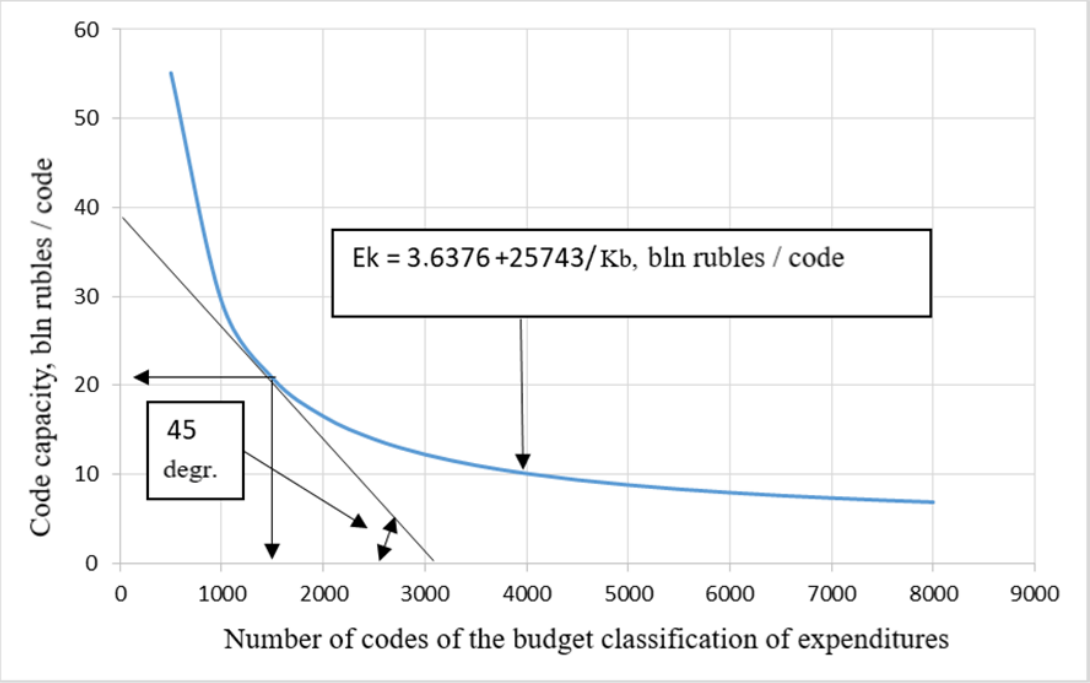

Fig. 4. **The Dependence of the Average Expenditure Intensity of the Code on the Number of Codes of the Budget Classification of Expenses**

Source: Built by the authors based on materials (orders) of the Ministry of Finance and Treasury of Russia. URL: https://minfin.gov.ru/ru; https://roskazna.gov.ru (accessed on 08.09.2021).

in the end of the 1920s and early 1930s. Average annual growth rate of expenditures of the consolidated budget of the Russian Federation for 2015–2022, according to our estimates, amounted to 105.4%. Over the same period, the increase in the number of codes for the budget classification of expenditures was as follows: expenditure directions — 159.5%; target budget expenditure items — 153.75%.

Fig. 3 presents the graphical dynamics of the considered indicators of expenditures of the consolidated budget, the number of codes of the CSR (Center for Strategic Research), directions and types of expenditures of the budget classification for 2014–2021.

On average, for 2014–2021, the annual growth of expenditures of the consolidated budget of the Russian Federation amounted to 1 775 bln rubles, the number of CSR codes — 235.8, the size of the size of the codes of expenditure directions — 222.04. A slight average annual decrease in the number of budget expenditure accounting codes occurred in terms of the number of CMBF (1.8%), the value of the type of expenditure code (0.9%).

Management budget accounting is aimed primarily at assessing the effectiveness of the use of funds in the direction of the organization of financial management of various management structures providing budget financing. The corresponding Order of the Government of the Russian Federation is directed to this effect.[7]

Analyzing the dynamics of expenditures of the consolidated budget of the Russian Federation and the change in the number of codes of the budget classification of expenditures, it is necessary to consider the relationship of these indicators. Our calculations showed that the correlation of the number of codes to the budget expenditures of the consolidated budget for 2014–2021 was:

[7] Order of the Government of the Russian Federation No. 117 from 31.01.2019 "On approval of the concept of increasing the efficiency of budget expenditures in 2019–2024". URL: http://static.government.ru/media/files/oPbFFY 1nPoRrQGx7Q7tfZrV5JGTUuTOR.pdf (accessed on 08.09.2021).

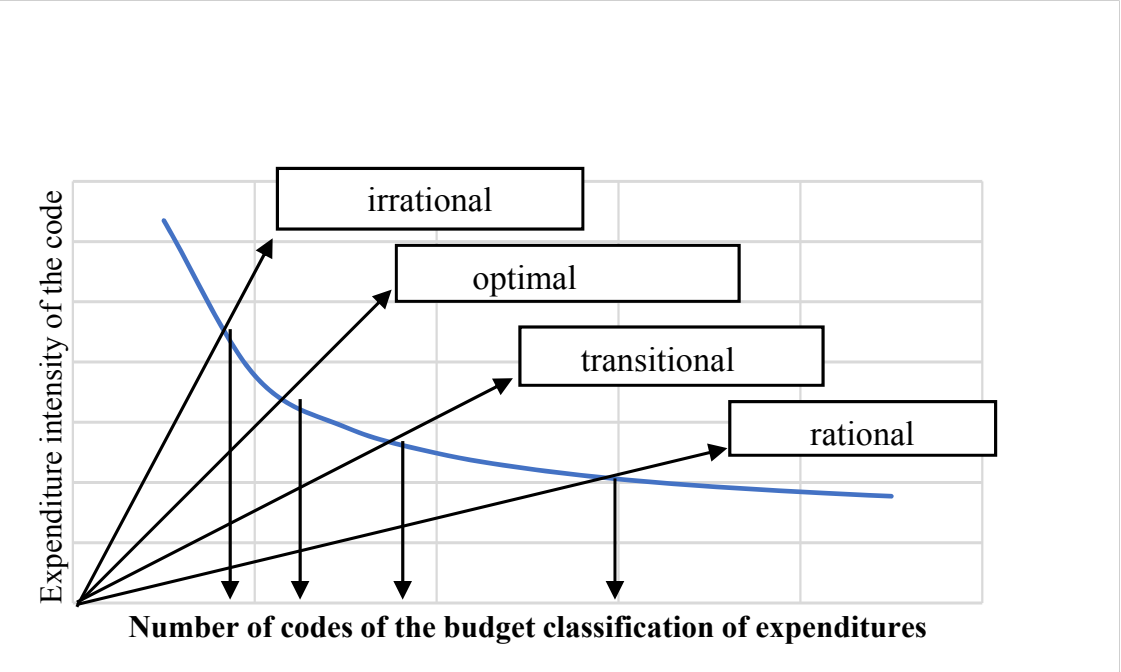

Fig. 5. **The Dependence of the Average Expenditure Intensity of the Code on the Number of Codes of the Budget Classification of Expenses**

Source: Built by the authors.

• number of CMBF codes — (–)0.861;
• number of expenditure codes — 0.459;
• number of expenditure direction codes — 0.928;
• number of CSR codes — 0.878;
• number of expenditure subsections codes — 0.72;
• number of expenditure section codes — 0.

The closest connection of expenditure trends and the growth of the number of codes of classification of budget expenditures has an increase in various areas of use of costs (0.928). The dynamics of these indicators (volume of costs and number of codes) increased on average during the analyzed period at about the same rate. The relationship between the dynamics of budget expenditures and the increase in the number of classification codes of the Russian Federation's consolidated budget objects of expenditure is somewhat lower (0.878). It is necessary to note the negative correlation between the dynamics of the number of CMBF codes and the growth of budget expenditures (–0,861), which indicates a decrease in the average number of CMBF while increasing the budget expenditures of the consolidated budget of the Russian Federation for 2014–2021.

Considering the correlation between the dynamics of budget expenditures and the number of codes of their budget classification, it is difficult to identify a formalized model of their interdependence, since the factors considered have the same nature — budget expenditures, which are signed by different codes (shelves) budget classification. By itself detailing and decomposition of budget costs without its competent use gives nothing. The more detailed the classification of costs, the greater the capacity to analyse the effectiveness of their financing and to take measures to increase the effectiveness of the achievement of goals and objectives with budgetary resources.

We calculated the amount of average expenditure intensity of the code by dividing the costs of the consolidated budget by the total volume of all the codes of the budget classification, which can be characterized as

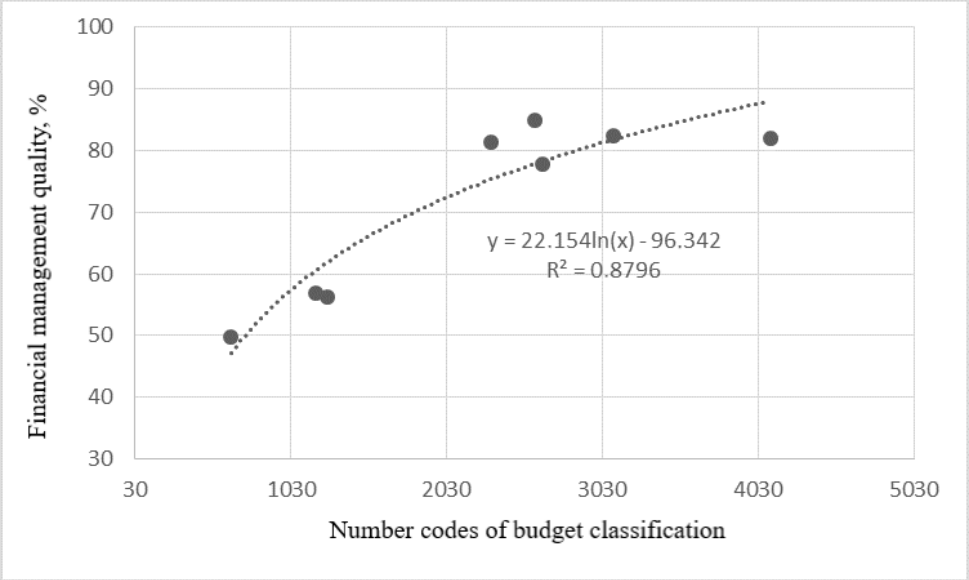

Fig. 6. **Dependence of the Quality of Financial Management of GRBS (in Terms of Budget Costs) from the Number of Codes of the Budget Classification of Expenditures for 2014–2021**

Source: Calculated and constructed by the author according to the orders and analytical tables of the quality of financial management of the GRBS of the Ministry of Finance of the Russian Federatio. URL: https://minfin.gov.ru/ru (accessed on 08.09.2021).

the average consumption of the conditional budget code by annual indicators. Based on the results of calculations, the regression dependence of conditional expenditure intensity of the average budget code (E_k) is obtained from the total sum of budget codes (K_b) by the expenditure dynamics and the total amount of the applied expenditure codes of the consolidated budget of the Russian Federation for 2014–2021:

$E_k = 3.6376 + 25\,743/K_b$, bln rubles/code.

Fig. 4 shows the graphical dependence of average conditional expenditure intensity of the conditional budget code on the total number of codes of the budget classification of expenditures. This dependence is in the form of hyperbola, where with the increase in the number of codes of classification of budget expenditures for 2014–2021, the volume of expenditure of the conditional code decreased — the number of budget expenditures taken into account on average in one classification code.

During the analyzed period of time, it can be said that the increase in the number of codes of the budget classification of the consolidated federal budget led to a decrease in the capacity of the conditional code of budget expenditures. The increase in the number of codes per thousand the volume of budget expenditures, taken into account and planned in the average conditional code, decreased on average by 25 743 mln rubles. The possible optimal ratio of the number of codes and the average resource intensity of the codes of the budget classification of expenditures can be the point of intersection of the tangent straight line to the considered hyperbola at an angle of 45 degrees to the vertical and horizontal axes on *Fig. 4*.

The increase in the conditional expenditure intensity average code (the decrease in the number of classification codes of cost accounting) below the optimal level leads to a sharp increase in this indicator, this rapidly reduces the analytical capacity to generalize the use of resources in the budget management process of the organization. Therefore, despite the existing optimum ratio of number and capacity of codes, it should strive to increase the

number of accounting classification codes of budget expenditures, which allows the present stage of development of digitization of technological budget processes in the Russian Federation.

Digital software products change the logic of establishing optimal solutions, but should not bring the system of classification of budget costs to extremely small splitting of costs in different types and directions, which will reduce the real possibilities for an effective analysis of their effectiveness. *Fig. 5* presents our proposed structure of 4 different types of number of codes depending on the value of conditional expenditure intensity of one average planning code and record of budget expenditures.

By the number of codes of the budget classification of expenditures can be distinguished, in our opinion, irrational, optimal, transitional and rational volumes of the number of codes used. State budget management in these conditions contributes to more effective planning and analysis of the use of resources of the budget system of the country. For example, the paper[8] analyses the results of the use of State information systems in the federal authorities of the countries. Every year, the Ministry of Finance of Russia conducts an analysis of the quality of financial management in all federal authorities, in the Russian regions in the process of organizing the use of budgetary resources, which is summarized in the papers [17, 18].

When conducting monitoring of quality of budget implementation on expenditures by the Ministry of Finance of Russia, such indicators are calculated, which do not directly relate to the number of forms of coding and the content of the composition of the classification of expenditures of the budget by appropriate grades and codes. But in any case, the assessment is made on the basis of an analysis of the structure of budget expenditures in different categories and codes, the change of the number and content of which contributes to a qualitative generalization of the performance of budget resources management.

We built dependence of quality of financial management of CMBF (in the part of budgetary expenses) from the number of codes of the budget classification of expenditures, based on the results of calculations of the Ministry of Finance of the Russian Federation of the average country quality of financial management in terms of the use of funds of the federal budget CMBF for 2014–2021 (on 01.10.), as shown in the *Fig.6*.

The quality of financial management of federal CMBF is closely related to the number of codes of the budget classification of expenditures (coefficient of determination — 0.8796). The logarithmic function, based on the results of the time series, shows a logical change in the quality of CMBF financial management in terms of budget expenditure management, which increases as the number of classification codes of federal budget expenditures is grows

CONCLUSION

Generalization of organization of processes of classification of budget expenses has shown that our hypothesis "the more detailed differentiation (classification) of budget expenditure, the more possibilities of competent organization and management of processes of their financing" confirmed by the results of the research. Not only digitalization of the budget system of the country, but also digital transformation of almost all branches of the economic complex of the State is being carried out, which is considered in the paper [19]. Digital possibilities of development of classification of budget expenditures of the country allow much deeper penetration into processes of formation of State resources, which contributes to increase of efficiency of their use.

[8] The Accounting Chamber counted and evaluated federal GIS. Department of Analysis. URL: https://geovestnik.ru/articles/russia/schyetnaya_palata_soschitala_i_otsenila_federalnye_gis/ (accessed on 08.09.2021).

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ORIGINAL PAPER

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Analysis of Factors Affecting the Dynamics of Residential Real Estate Prices in Russia

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ABSTRACT

In this paper, we have constructed a VAR model to identify and assess the impact of real interest rate shocks, real estate demand, oil prices, uncertainty, and aggregate business activity on residential real estate prices in Russia. The relevance of the research is due to the following: the dynamics of real estate prices determines the consumer and investment behavior of households, and serious fluctuations in real estate prices lead to adverse consequences in many areas of life, so more and more researchers are asking questions about the presence of bubbles in the real estate market, which can be dangerous to the stability of the economy. In addition, a sharp increase in the cost of housing in Russia in 2020 is an open question for researchers. Our **goal** is to determine what factors caused the rise in real estate prices in Russia in the time interval from the Q1 of 2000 to the Q2 of 2022. A VAR model with a Cholesky decomposition was used for the **evaluation**. Several specifications were considered with the inclusion of the real oil price as an exogenous variable and a set of endogenous variables: real GDP, real interest rate, uncertainty index and housing price index. The main **conclusion** of the paper is that the housing market is sensitive to identified macroeconomic shocks, and a decrease in the interest rate leads to an increase in demand and real estate prices. The estimate of the long-term elasticity of housing prices for oil prices was 0.35, the dynamics of oil prices explained a significant proportion of the variation in real estate prices, but the predominant role in housing price fluctuations is given to housing demand shocks. The housing demand shocks in Russia itself had a negligible impact on GDP.

Keywords: real estate price index; housing market; VAR models; macroeconomic shocks; real interest rate shock; historical decomposition of the real estate price index; real estate demand shock; oil price shock

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INTRODUCTION

Housing prices increased significantly in 2020 (*Fig. 1*). "The cost of residential real estate increased by 12% on average in Russia, but in some regions, prices have risen by 20 and 30%".[1]

Overall, housing price fluctuations can have huge macroeconomic effects. This is what the global economic crisis of 2008 showed when the real estate market was one of the most important channels of influence of traditional structural shocks on dynamics of macroeconomic variables. In addition, the real estate market is a significant independent source of macroeconomic instability. Events are stimulated the growth of housing market research.

In this paper the standard vector autoregression model (VAR) is used, and for the identification of shocks — Cholesky decomposition. We identified the real interest rate shock, uncertainty, aggregate supply and demand for housing, and the oil price shock as an important source of macroeconomic instability in Russia's real estate market.

The paper is structured as follows: second section provides an overview of the literature, third section — presents a description of the data, fourth section — presents empirical models and results of calculations, and fifth section — presents conclusions.

REVIEW OF THE LITERATURE

Interest rates are rightly the most important determinants of real estate prices in asset pricing, as well as the factor affecting on credit availability. The real estate price, other things being equal, can be considered as the present value of future rent payments. Then, if the real interest rate is lowered, the present value of these rent payments increases. If we abstract from depreciation and maintenance costs of real estate, then when interest rates are reduced, the real estate price should rise. In addition, the expected present value of future rent payments should be equal to the profitability of alternative investments with a comparable level of risk, according to J.M Poterba [1].

A number of works are devoted to the analysis of the contribution of real interest rates to real estate prices. S. Claessens with co-authors [2] proved pro-cyclical behavior of housing prices, and low interest rates precede the peaks of real estate prices with a few years left, that was explained in the paper of A. G. Ahearne with co-authors [3]. D. Miles and V. Monro [4] explain the rise in housing prices relative to income in the UK by a significant reduction in the real risk-free interest rate. Similar research was conducted by J. Ayuso with co-authors [5]. Using simple asset price ratios, changes in housing prices can be fully explained by changes in ex-post real interest rates. At the same time, the paper of K. N. Kuttner [6] also examines the relationship between interest rates and housing prices, but argues that the impact of interest rates on real estate prices is rather modest.

In the paper of M. Iacoviello [7] positive shock of aggregate supply statistically significantly reduces housing prices for several quarters: shock increases the return on capital, which leads to an increase in real interest rates. Then M. Iacoviello and S. Neri [8] are questioned: what sources of macroeconomic instability affect the US real estate market? Researchers identify three shocks: real estate demand shock, monetary policy (MP) and technological shock. The MP shock has a negative impact on prices, as confirmed by earlier researches of the same authors and K. Carstensen with co-authors [8–10]. In the paper of T. Y. Bian and P. Gete [11] use a similar methodology. Labor productivity shocks and savings glut play a major role in housing prices.

Evaluation of the housing market's response to the MP shock was done for K. Carstensen [10]. Authors find out that

[1] Materials of the information agency "RBC". URL: https://www.rbc.ru/society/08/04/2021/606efdb09a79472934b87a8b (accessed on 12.08.2021).

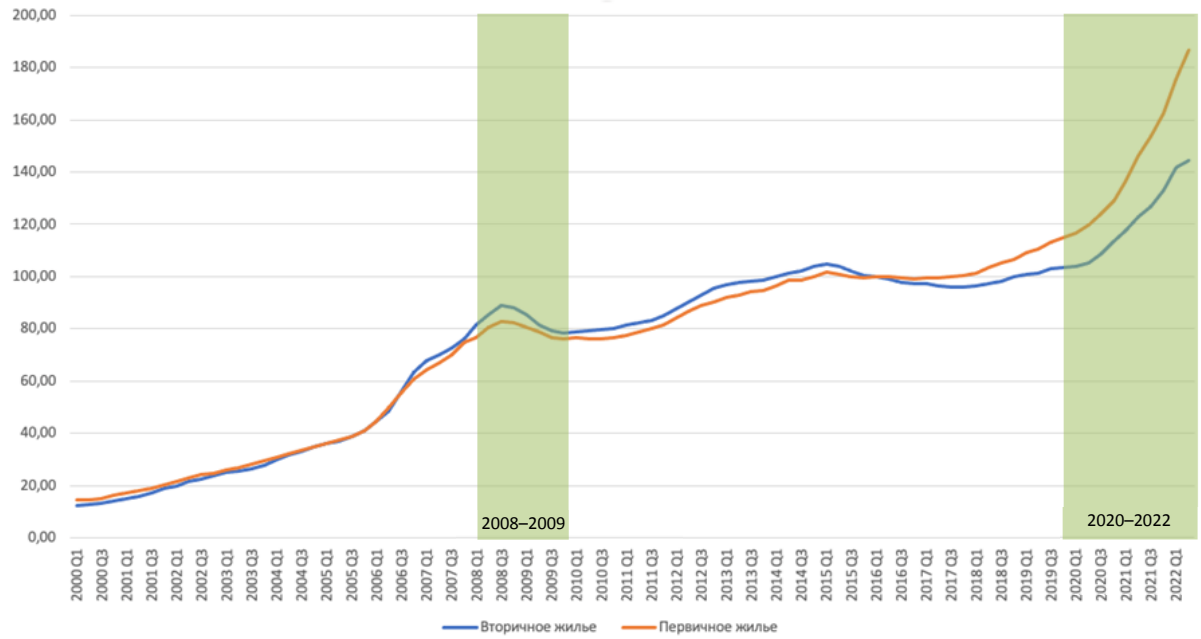


Fig. 1. **The Index of Real Estate Prices in Russia in Constant Prices of the Q1 of 2016**

Source: Unified interdepartmental information and statistical system. URL: https://www.fedstat.ru/indicator/30925 (accessed on 19.10.2022).

countries can be divided into 2 clusters relative to the degree of response to shock: countries with strong response and weak. The reaction is due to the institutional characteristics of the mortgage market. Result intersects with conclusions from article M. Iacoviello [7]. A. Nocera and M. Roma [13] considered the role of housing prices in the transmission mechanism of monetary policy: due to the high housing prices growing wealth of homeowners, which is seen as the sum of liquid financial assets.

The market reaction of housing on oil shocks differs depending on whether the country is an oil exporter or oil importer [14–16]. As for the Russian practice, the work of V.A. Salnikov and O.M. Mikheeva [17] presents a model of pricing on the real estate market of Moscow. Based on the LSM model, a significant positive impact of Urals crude prices in the housing price dynamics was found.

H. Hirata and co-authors [18] use the FAVAR model to prove the existence of synchronized housing price dynamics in 18 European countries. The R. Meeks methodology was used to highlight the specific shock of the credit market [19]. In the paper of G. Baurle and R. Scheufele [20] was estimated the impact of credit market conditions on housing prices and main macroeconomic indicators: monetary policy and housing demand shocks has a positive effect on real economic activity after the financial crisis.

Economic uncertainty directly affects the behavior of economic agents, because of precautionary motive households increase saving [21]. If interpreted the sale of residential real estate as savings, the increase in uncertainty in the economy can lead to an increase in demand for real estate and, accordingly, its prices [22, 23]. The mortgage market in Russia is lagging behind the developed countries: interest rates are significantly higher [24]. Housing affordability in Russia was analyzed in article N.B. Kosareva and T.D. Polidi [25], which note the increase in housing affordability in large urban areas. The effectiveness of State support measures for mortgage lending for housing affordability in Russia was studied in the paper of N. Ilyunkina and I. Roshchina [26]. The authors calculated that the subsidy

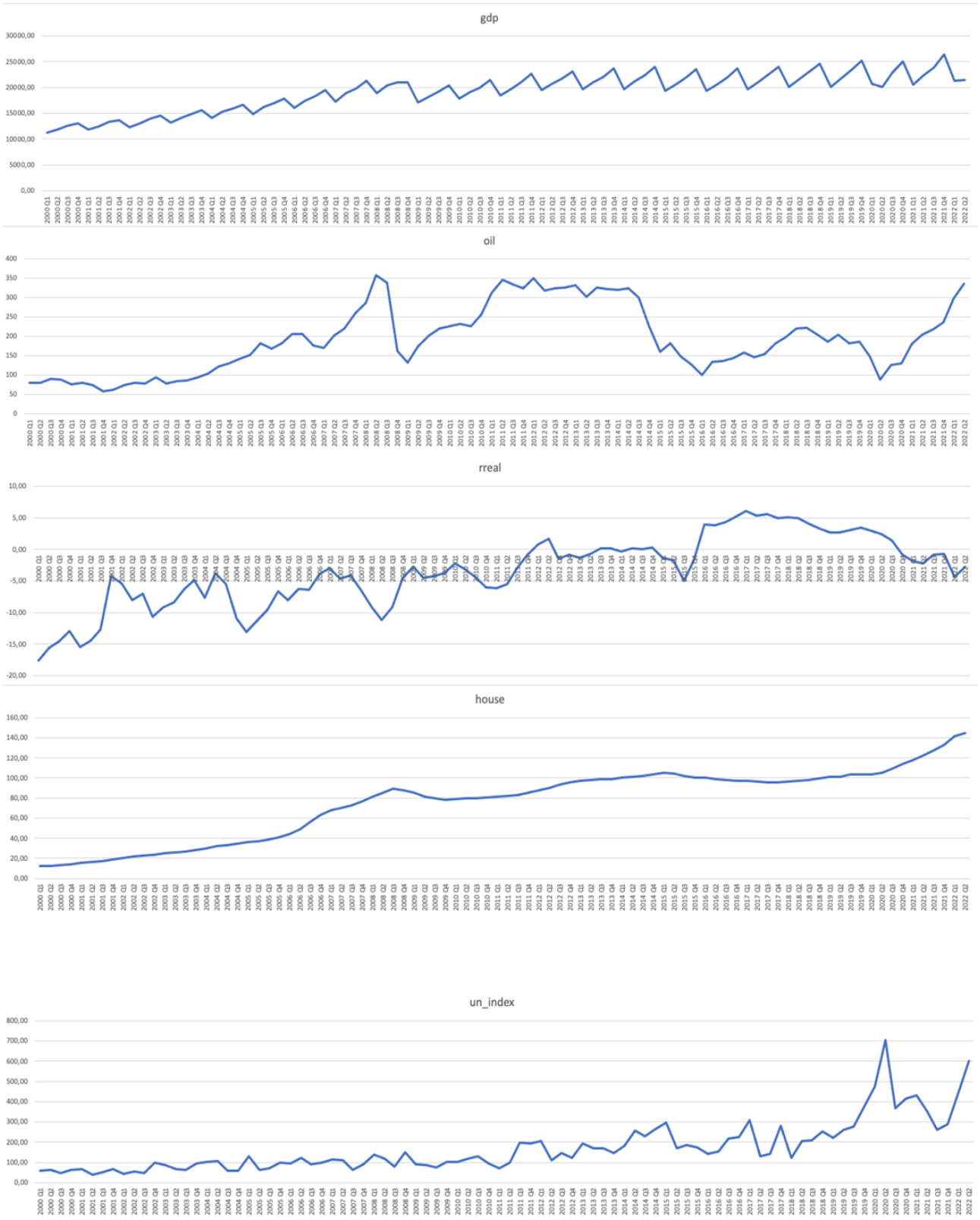


Fig. 2. **Dynamics of the Variables**

Source: Federal State Statistics Service, The Central Bank of the Russian Federation, Unified interdepartmental information and statistical system, Federal Reserve Economic Data (accessed on 19.10.2022).

Table

Selection the Number of Lags Based on the Values of Information Criteria

Number of lags	Information criteria		
	AIC	BIC	HQC
1	–1.68	–1.43	–1.58
2	–1.94*	–1.57*	–1.79*
3	–1.90	–1.40	–1.70

Source: Author's calculations.

Note: * Lowest value of each criterion.

of the mortgage rate of 3.5 p.p. leads to an increase in real estate prices by 10.5%.

DESCRIPTION OF DATA

Quarterly data from the Q1 of 2000 to the Q2 2022 were used for calculations. Several specifications are considered including the real price of oil (*oil*) as an exogenous variable and three or two endogenous variables: real GDP (*gdp*), real interest rate (*rreal*), housing price index (*house*) and uncertainty index (*un_index*) (justification for the choice of a specific indicator will be provided later). All models give results for secondary housing price index. The results for the primary housing price index are almost identical and can be provided separately on request. The real variables are expressed in 2016 prices and if cleared of seasonality by the X-13 ARIMA procedure in Gretl. *Fig. 2* shows the dynamics of the variables used.

Price index on the housing market taken as a whole in Russia for all types of apartments. It should be clarified that the index is calculated on the basis of recorded prices and is determined by the ratio of the value of a certain type of sold apartments in the prices of the reporting period to the value of apartments in the prices of the previous period. This should be taken into account as there is a difference between the actual transaction price and the offer price.[2] We used the MIACR rate minus inflation as the real interest rate. Data in the form of "quarter to the corresponding quarter of the previous year" was used as an inflation indicator. This approach allows to get seasonally differentiated rows, and therefore, there is no need to clean the received rows from seasonality in addition.

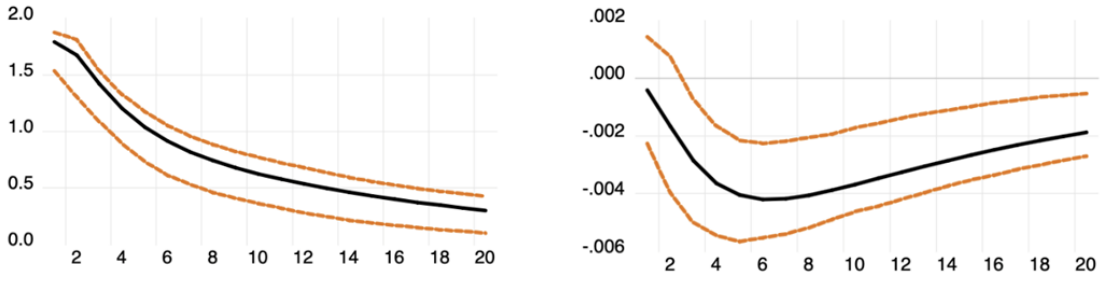
EMPIRICAL MODELS AND RESULTS OF CALCULATION

Consider the simplest VAR model including the real interest rate and the real estate price index as endogenous variables. We include Brent price as exogenous variable. We can assume that in Russia domestic macroeconomic indicators do not influence the dynamics of our exogenous variable, but it can significantly influence on our dataset of endogenous variables. The model is presented as follows:

$$y_t = \sum_{i=1}^{2} A_i y_{t-i} + \sum_{i=0}^{2} B_i oil_{t-i} + a_1 d_t + u_t,$$

where y_t — vector of endogenous model variables; A_i — matrix before the lags of endogenous variables; B_i — matrix before exogenous variables; *oilt* — oil price vector; d_t — binary variable to structural shift; *ut* — error vector. Real estate and oil price index variables used in logarithmic differences, real interest rate — in logarithmic levels. As in the paper D.A. Lomonosov with co-authors [27],

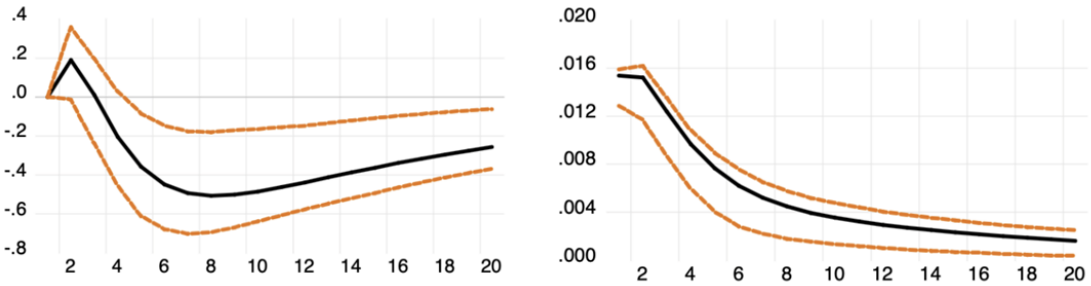
[2] Sberindex. URL: https://sberindex.ru/ru?partition=7 (accessed on 24.09.2021).



Real interest rate | Growth rate of the real estate price index

Fig. 3. **Impulse Responses to the Real Interest Rate Shock**

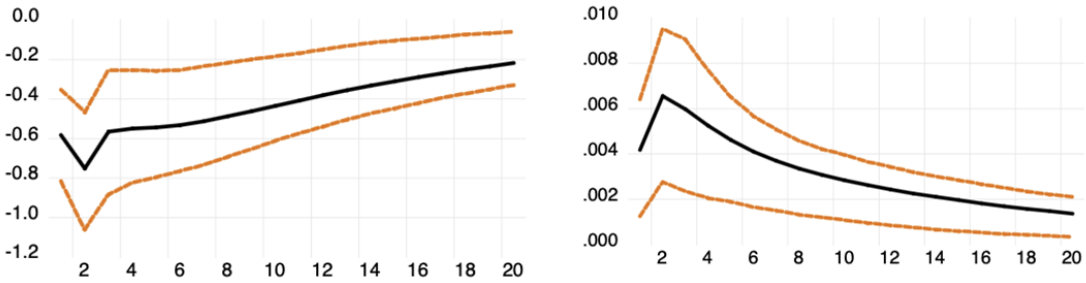
Source: Author's calculations.



Real interest rate | Growth rate of the real estate price index

Fig. 4. **Impulse Responses to Housing Demand Shock**

Source: Author's calculations



Real interest rate | Growth rate of the real estate price index

Fig. 5. **Impulse Responses to the Oil Price Shock**

Source: Author's calculations.

we take into account the structural shift in long-term growth rates during the crisis 2008. To estimate the date of the shift, we take Q3 of 2007, as well as in the paper of A.V. Polbin and A.A. Skrobotov [28].

When evaluating the model, we apply two lags of endogenous variables as well as two lags of exogenous variables together with the current value. Information criteria for choosing the optimal lag order are presented in *Table*.

To identify structural shocks, this model uses the classic Cholesky decomposition, in which we can order the effects of shocks by exogeneity. Order of variables: oil price, real interest rate and real estate price index. *Figure 3–5* presents the impulse responses of real estate prices and real interest rates to the corresponding shocks with 68% confidence intervals derived from the bootstrap.

Real estate price index declines in response to real interest rate positive shock. The

reaction rate of real estate price index growth is significant for the whole time period under consideration and fades 1.5 years after the shock, reaching the bottom by the Q5. This sensitivity of the housing market to interest rates can be interpreted as follows: as households are limited in borrowing — the amount of credit available, the increased availability of credit due to lower interest rates will lead to higher housing prices due to increased demand. During the positive shock of real interest rates, the situation is reversed. Also, the growth (decrease) of the interest rate will lead to a decrease (increase) of the present value of rent payments and, accordingly, to negative (positive) pressure on real estate prices.

Fig. 5 presents the impulse response to the oil price shock. In response to the positive shock of oil prices, the real estate price index is rising significantly and peaking in the Q1–Q3, the impact of the shock is significantly fading after 20 quarters. This effect of the shock is consistent with the literature review and confirms the sensitivity of the housing market to the oil products market.

To calculate real estate price multiplier for oil prices, we need accumulated impulse responses to the price index growth rate of the oil price shock (*Fig. 6*).

Based on the calculations — if the oil price increases by 17%, corresponding to

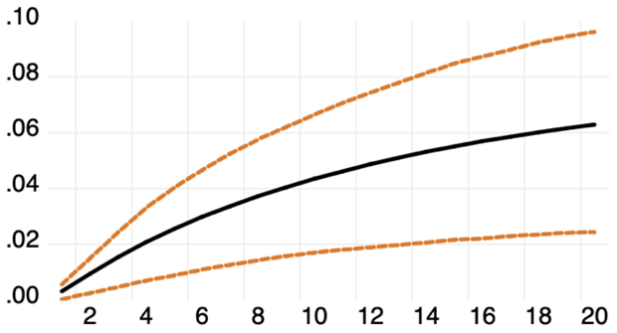


Fig. 6. **Accumulated Impulse Response of the Real Estate Price Index to the Oil Price Shock**

Source: Author's calculations.

one standard deviation, the real estate value increases by 6%, i.e. the elasticity of real estate prices is 0.35. When comparing with the elasticities of other indicators, real estate price elasticity at oil prices is slightly higher than the same indicator for consumption and investment — 0.3 and 0.25 respectively [29].

Next, consider the forecast error variance decomposition (FEVD). Results are shown in *Fig. 7*. The oil price shock explains 5 to 18% of the variance of the forecast error for the real estate price index, while the share explained by the shock of the real interest rate is gradually rising from 0 to 8%, the contribution of real interest rate shocks — is limited.

Real estate prices, as can be expected, in historical retrospect were highly susceptible

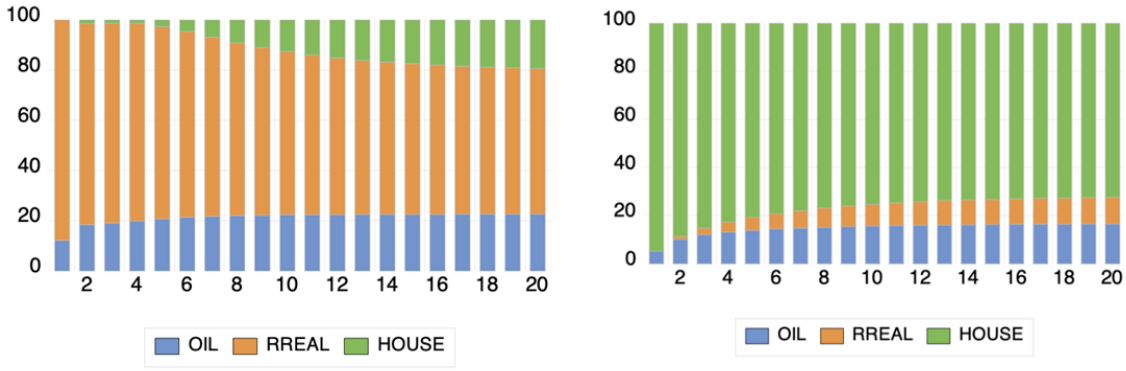


Fig. 7. **Forecast Error Variance Decomposition**

Source: Author's calculations.

Note: The vertical line is the percentage of the explained variance; the horizontal line is the quarters.

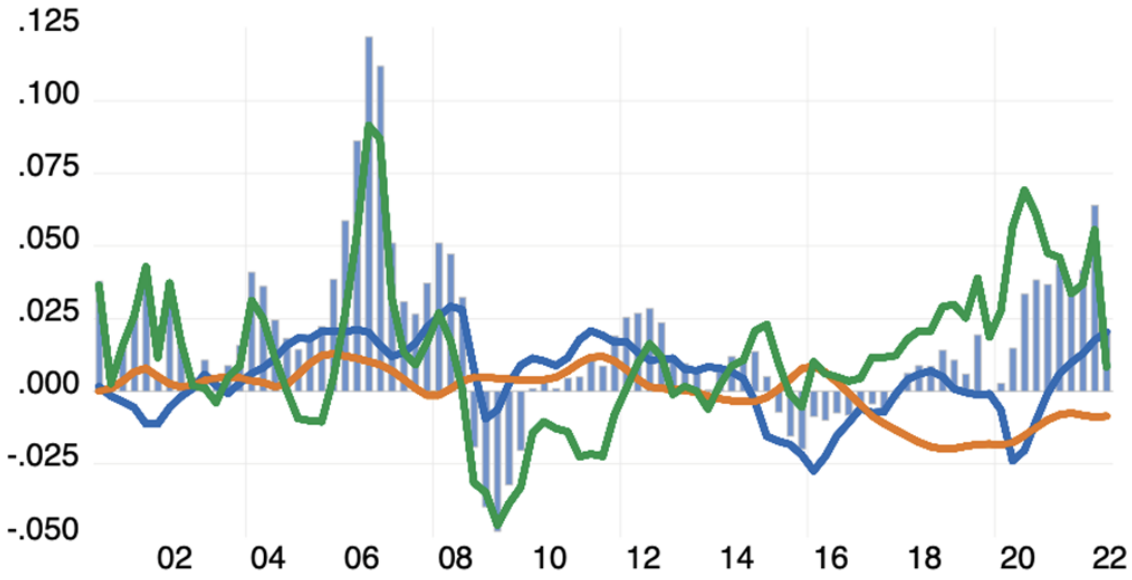


Fig. 8. **Historical Decomposition of the Real Estate Price Index**

Source: Author's calculations.

Note: Blue vertical columns is the deviation of the true value of the time series from its unconditional average; blue line — oil price shock; green line — housing demand shock; orange line — real interest rate shock.

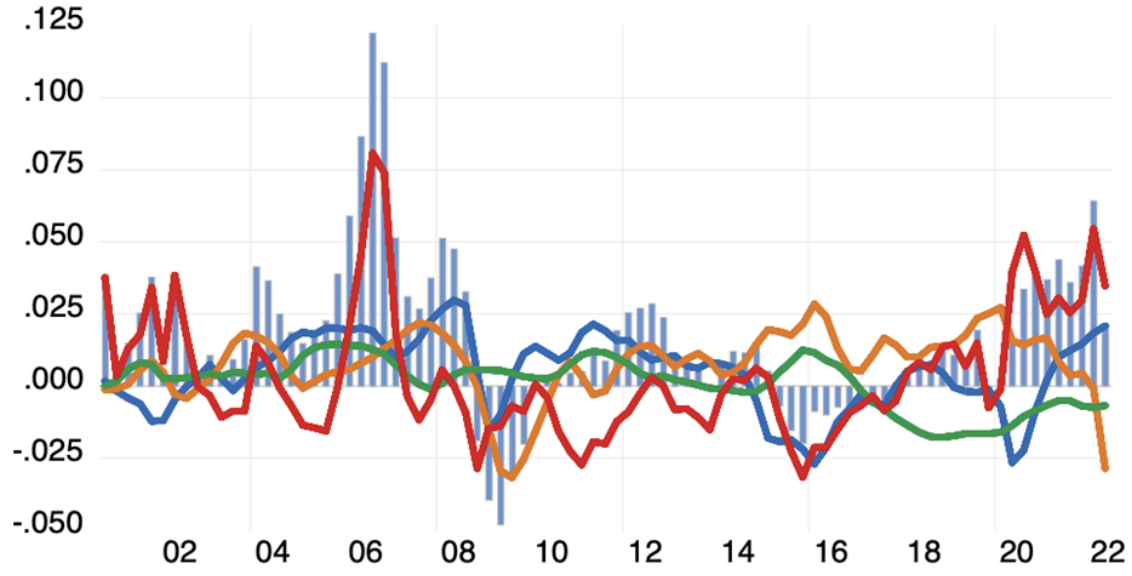


Fig. 9. **Historical Decomposition of the Real Estate Price Index**

Source: Author's calculations.

Note: Blue vertical columns is the deviation of the true value of the time series from its unconditional average; blue line — oil price shock; orange line — aggregate supply shock; green line — real interest rate shock; red line — housing demand shock.

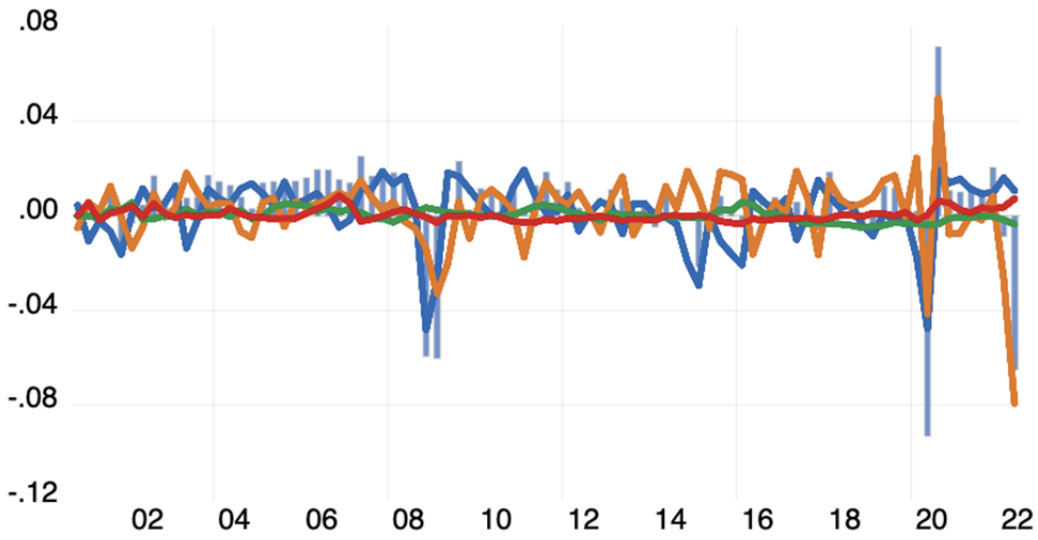


Fig. 10. **Historical Decomposition of GDP**

Source: Author's calculations.

Note: Blue vertical columns is the deviation of the true value of the time series from its unconditional average; blue line — oil price shock; orange line — aggregate supply shock; green line — real interest rate shock; red line — housing demand shock.

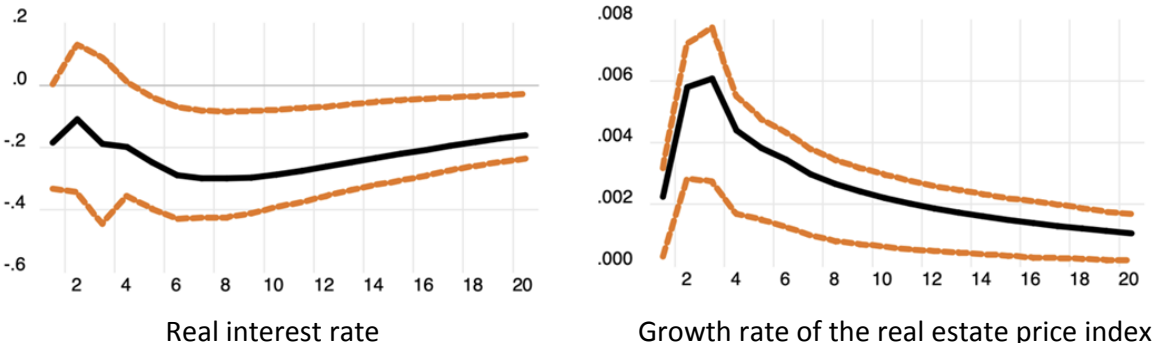
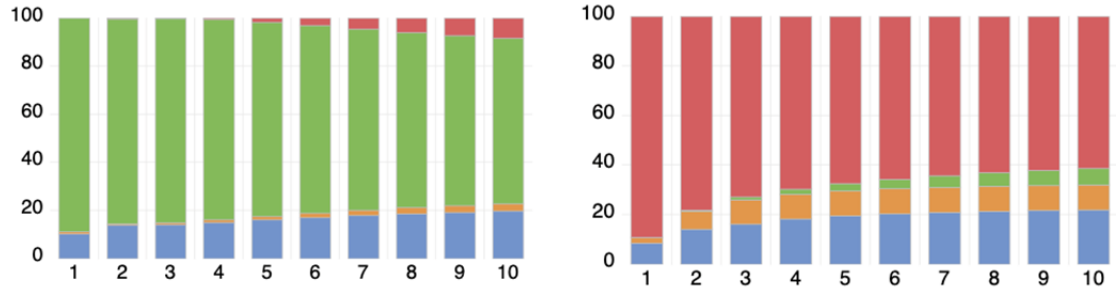


Fig. 11. **Impulse Responses to the Uncertainty Shock**

Source: Author's calculations.

to oil price shocks almost all the considered time interval (*Fig. 8*).

The situation changed in 2017–2019: oil prices stabilized and ceased to have an impact on real estate prices. By itself, the shock of the real interest rate affects only insignificant on the dynamics of the indicator of interest. However, it should be noted that this shock has a mildly positive impact before the crisis of 2014–2015, but with the onset of the crisis after the increase in interest rates by the Bank of Russia its impact is already on the negative, reaching the bottom in the Q2 of 2018. In the pre-crisis period 2006–2007, the growth of well-being of the population and the development of the financial market led to increased demand in the mortgage market due to increased availability of credit, and, accordingly, to the growth of demand in the real estate market. Sharp increase in prices for real estate in 2020 is explained by the real estate demand shock. The increase in demand could be due to the increased demand for meters as part of the development of remote work, due to the precautionary motive in which households faced with great uncertainty in the development of the financial market, in the inflation trend, decided to protect savings by investing in real estate, due to the



Real interest rate | Growth rate of the real estate price index

Fig. 12. **Forecast Error Variance Decomposition**

Source: Author's calculations.

Note: The vertical line is the percentage of the explained variance; the horizontal line is the quarters. Colors: red — housing demand shock; green — real interest rate shock; orange — uncertainty shock; blue — oil price shock.

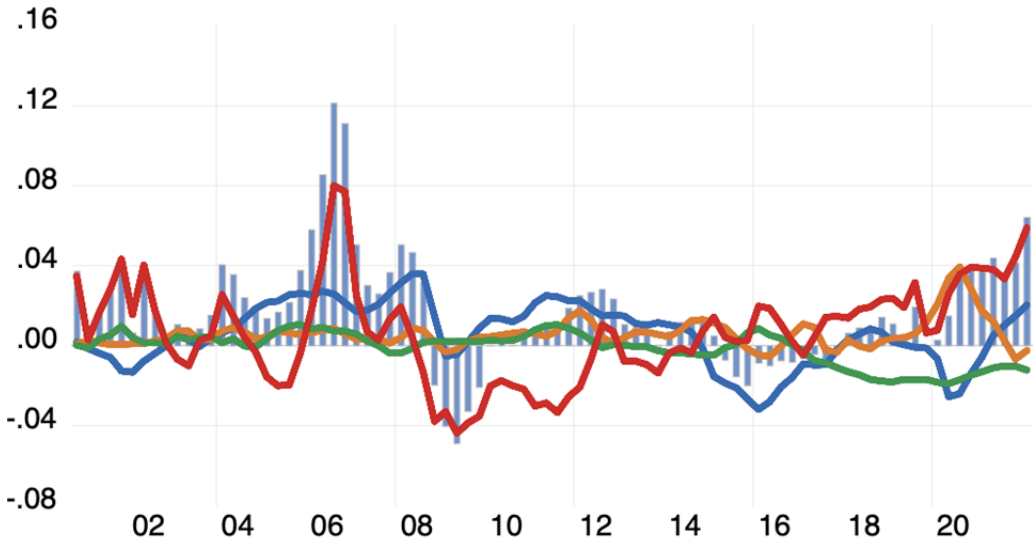


Fig. 13. **Historical Decomposition of the Real Estate Price Index**

Source: Author's calculations.

Note: Blue vertical columns is the deviation of the true value of the time series from its unconditional average; blue line — oil price shock; green line — real interest rate shock; orange line — uncertainty shock; red line — housing demand shock.

expansion of preferential mortgage. At the same time, loose monetary policy, along with relatively high inflation, allowed to reduce the previous negative contribution of shocks of the real interest rate to zero. The rise in prices between 2020–2022 was mainly due to the oil price shock, which had an increasing impact. At the same time, the shock of housing demand and the shock of the real interest rate contributed to the "cooling" of the real estate market. Multidirectional movement of factors did not help stabilize and balance the price growth.

In the second specification we add real GDP as a significant income factor to the vector of endogenous variables.

Historical decomposition of the real estate price index is presented in *Fig. 9*, and for GDP — in *Fig. 10*.

Fig. 10 shows that in Russia the housing demand shock (red line) has no significant impact on the dynamics of GDP except for the first three quarters of 2007, before the global economic crisis of 2008, and the first quarters of 2020.

We use the Economic Policy Uncertainty Index for Russia as an uncertainty index. This index consists of three components: the first component — is the normalized volume index of news articles discussing economic policy uncertainty; the second component — the level of uncertainty regarding the Tax Code; the third component — variance between individual expert forecasts (in more detail[3]). Other uncertainty indices (World Uncertainty Index, Geopolitical Risk Index, CBOE Volatility Index: VIX) did not show significant results in the modelling process, so it was decided to focus on the first — Economic Policy Uncertainty Index (*un_index*).

Fig. 11 presents impulse responses to real estate prices and real interest rates for uncertainty shocks.

In response to the positive shock of uncertainty, the real estate price index rises significantly and peaks in Q3.

Results of error variance forecast decomposition (*Fig. 12*) show that uncertainty shock explains up to 10% variance.

On a graph with historical decomposition (*Fig. 13*) the shock of uncertainty describes a significant increase in the real estate price index since 2020. So, due to the increasing uncertainty due to the epidemiological crisis, economic agents have significantly increased their savings due to the precautionary motive that was sent for the purchase of residential real estate, which can be classified as one of the safe assets (especially in comparison with stocks), which, with a low elastic supply in the housing market, led to a serious rise in prices.

CONCLUSION

In this paper, we have identified and assessed the impact of housing demand shocks, oil prices and aggregate business activity on residential real estate prices in Russia. For this, the standard vector autoregression model (VAR) was used, and the Cholesky decomposition was used to identify shocks.

Based on the impulse functions of the response, a significant impact of the shocks we identified was found both in the short and long term. This behavior of the real estate market is explained by the sensitivity of the market to shocks of this type. Also, the results of the historical decomposition confirm the importance of the variables chosen by us. The sharp rise in real estate prices in 2020 is due to a real estate demand shock. Expansion of demand could be due to increased demand on meters as part of remote work development or due to precautionary motive. The long-term elasticity of housing prices at oil prices was estimated at 0.35, which is reasonable, as the resulting elasticity is slightly higher than for consumption and investment.

One of the limitations of this paper is the lack of consideration of the date of introduction of the program of preferential mortgage in Russia. Other econometric approaches to assessment should be used to identify causal relationships of the effects of this measure.

[3] URL: https://www.policyuncertainty.com/methodology.html (accessed on 19.10.2022).

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