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Forecast of the Impact of the Railway Container Transportation Market on the GDP of the Russian Federation

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ABSTRACT

The relevance and practical significance of the is caused by pervasive impact of container transportation on the economy of the Russian Federation, which is reflected in the State strategy for the development of the transport industry. Expansion of the network of multimodal transport and logistics hubs for handling container cargo should increase their capacity, ensure the growth of transit cargo and the inflow of private Russian and foreign investments in rail transport. The purpose of the research is to develop a forecast for the rail container transportation market in the Russian Federation and estimate its impact on GDP using mathematical and statistical tools based on publicly available information base. The research methodology included the following stages: industry analysis, identification of trends and their assessment; development of a regression model for market forecasting, taking into account the identified factors and information available in the public domain; assessment of the impacts of factors on GDP; taking into account the development risks of the rail container transportation market. Industry analysis, a systematic approach and graphical methods were used to refine the methodology for forecasting the container transportation market by rail in the Russian Federation. The article shows that the key factors influencing the forecast of the development of the rail container transportation market are: advantages over other modes of transport in speed, quality, convenience and cost of cargo delivery; growth of containerization cargo base; transit prospects for developed and developing countries. Based on the data of Rosstat and JSC "RZD", the regression model was built for the dependence of the volume of the Russian Federation's GDP on the dynamics of the rail container transportation market, which allowed to predict the increase of GDP by 2025 compared to 2022 by 20.4% due to the growth of the rail container market, in in particular, due to imports by 55.2%, due to exports by 77.8%, and transit through the Russian Federation by 101.3%. The practical significance of the study is to assess of industry trends and risks in the short and medium-term implementation of the development strategy for the transport industry of the Russian Federation, which allows to substantiate the investment attractiveness of the industry.

Keywords: forecast; impact on GDP; rail container trasportation; industry analysis; investments; regression model

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INTRODUCTION

In the global market, the share of container transportation is quite high, especially between the USA, Europe and Asia. Today, cargo delivery is mainly by sea, with shortages ranging from 45 days or more, as well as significant disruptions, such as in March 2021 in the Suez Canal. In April 2022, Container Trade Statistics (CTS) estimated the global demand for container transport at 4.3 mln TEU, which is 4% less than the year before, and only 1.5% higher than the level of April "pre-pandemic" in 2019.[1] The growth of the cargo base and containerization, i.e. the switch of cargo to containerized transport from other modes of transport and railway rolling stock, are the key determinants of the dynamics of the rail container transportation market. The advantages, and thus the prospects, of the rail market in developed and developing countries are due to the acceleration of the time and cargo's delivery quality by rail, as well as the multimodality of transport, by containerization of the goods carried. Containerization allows to effectively carry out the process of transportation, loading and unloading, storage of goods, providing a significant advantage over carriage in wagons.

Since the beginning of 2022, due to the geopolitical and economic situation, the container transportation market has also undergone significant changes. So, first a partial and then a complete stop of cargo traffic with Finland, the Baltic countries and some European countries required a response in the form of a change of standard delivery routes, a reorientation of goods "to the East" (in particular, Russia-China) and geographical expansion of shipments. In addition, the suspension of the activities of large container carriers such as Maersk, MSC and CMA CGM, the suspension of transit traffic led to a short-term shortage of containers in the Russian Federation. According to JSC "RZD", the decrease in transit traffic between China and Europe in the future may lead to a fall in transit container traffic on the results of 2022 by 25%.[2] In general, the situation in the container transport market today depends to a greater extent on the sanctions restrictions of the outside world and the adaptability of Russian operators and carriers in the area of 1520.

The aim of our study was to develop a forecast of the rail container transportation market in the Russian Federation using industry analysis and mathematical and statistical tools based on publicly available information base. The practical significance of the results is due to the significant impact of container transportation on the economy of the Russian Federation, and the State strategy for the development of the transportation industry, aimed at the creation and loading of a network of multimodal transport and logistics hubs for the processing of containerized cargos, which will increase the average commercial speed of the movement of goods on railway transportation and, in turn, will lead to an increase in transit cargo and the inflow of private Russian and foreign investments. Local businesses will benefit from faster delivery times, local logistics companies will be able to optimize their own costs, increase asset turnover and reduce delivery time to end users.

The author's approach to forecasting the rail container market is based on the hypothesis that the rail container market in the Russian Federation will continue to grow despite the pandemic, as it has a number of progressive opportunities and prospects for trade among countries. Advantages over other modes of transport are speed, quality, convenience and cost of delivery.

Perspective directions, models and methods of forecasting development of various branches of economy are considered

[1] InfraNews. URL: https://infranews.ru/logistika/containeri/59734-spros-na-kontejnernye-perevozki-zamedlyaetsya-cts/ (accessed on 20.10.2022).

[2] RBC. URL: https://www.rbc.ru/business/03/10/2022/633ae33e9a79475367f13340 (accessed on 20.10.2022).

in the works A. A. Shirova, B. N. Porfiryeva, V. V. Ivantera, D. E. Sorokina, M. N. Uzyakova, M. A. Fedotova and other scientists [1–4]. In order to find the most appropriate approaches to forecasting the volume of the rail container transportation market in the Russian Federation, we have analysed the tools used by Russian and foreign scientists. Among these are studies by A. Stuart and M. Kendell, which suggested a variable approach to forecasting future values, and gave a detailed description of the general theory of regression and the methods of constructing multiple linear regression and estimating the correlation of the analyzed factors [5–7]; R. Fisher's methods for comparing general variances of two independent samples, described in his work "Statistical methods for researcher workers"[3]; paradigm of industry analysis J. S. Bain [8]; methodology for forecasting industry risks using coefficients based on standard deviation, that proposed by A. Damodaran.[4]

During the research, we have also taken into account the work on forecasting of cargo transportation of Russian and foreign authors: Y. Wang, X. Chen, Y. Han, S. Guo [9], which considered the methodology for estimating cargo and passenger transportation by elasticity coefficients and the impact of the results on China's gross domestic product; V. Lukinsky [10], evaluating the condition of the cargo base and infrastructure in the Russian Federation and proposing an analytical platform for cargo management in multi-level terminal logistics systems; A. N. Sakhanova, Y. Zh. Akhmer [11], describing the forecasting methodology using time-series econometric models. For the purposes of this research, were also of interest the following articles by scientists A. I. Orlov [12], E. Yu. Samysheva [13], I. L. Beilin [14], considering the use of econometric methods and digital modelling in forecasting economic processes. We used regression analysis to develop forecasts of container rail transportation in the Russian Federation: A. A. Sazonov [15], A. G. Kunitsyna, L. A. Vinskovskaya [16], O. V. Moskvichev, E. E. Moskvicheva, D. V. Vasiliev [17], A. R. Kurtikova [18].

As a result of the review, we concluded that existing traffic forecasting methodologies are generally based on counterparty data and order volumes, which are only applicable at the company level.

Having studied the available data of Rosstat[5] and JSC "RZD"[6] to assess the prospects of container transportation development in the Russian Federation, the authors selected regression modeling based on the forecast of import, export and transit as an effective indicator — GDP growth of the Russian Federation (in billion rubles) due to the comparable growth in the volume of rail container transportation.

Thus, to realize the purpose of our research and confirmation of the hypothesis, industry analysis, identification of factors and risks of development of the market of rail container transportation, justification of statistically significant indicators of exports, imports and transit of goods, estimation of their impact on gross domestic product by regression model was used.

RESEARCH METHODOLOGY

Our research consisted in developing a forecast of the rail container transportation market in the Russian Federation in the post-COVID-2019 and the current geopolitical situation using industry analysis and mathematics and statistical tools based on regular publicly available information and reliable sources. The research was based on the data of official statistics of Rosstat and JSC "RZD" for 2018–

[3] URL: https://www.scribd.com/document/58873576/Fisher-R-a-1925-Statistical-Methods-for-Research-Workers?language_settings_changed=English (accessed on 25.10.2022).

[4] Website A. Damodaran. URL: http://pages.stern.nyu.edu/~adamodar/. (accessed on 25.10.2022).

[5] Rosstat official website. URL: https://rosstat.gov.ru/ (accessed on 25.10.2022).

[6] JSC "RZD" official website. URL: https://www.rzd.ru/ (accessed on 25.10.2022).

2022, our mathematical calculations, as well as analytical scientific materials from open sources. A model of multiple linear regression has been built, on the basis of which the short-term forecast of growth of the volume of rail container transportation market up to 2025 has been made.

The method of forming the forecast of the market of rail container transportation in the Russian Federation in the post-COVID-2019 and the current geopolitical situation consists of several stages: industry analysis, trend identification and assessment; development of a regression model for market forecasting based on identified factors and publicly available information; assessing the impact on GDP; taking into account the development risks of the rail container transportation market. Industry analysis, system approach and graphical methods used to refine the methodology of forecasting the market of containerized transport by rail in the Russian Federation.

The study is based on an understanding of trends in the development of the container transportation market in rail transport of the Russian Federation, justification of forecast values, identification of current problems and consideration of perspective directions of development of the container transportation market [19–21]. When constructing the equation of multiple linear regression as a dependent factor Y is the volume of GDP of the Russian Federation, which reflects the market value of all goods and services. Import, export and transit of container transportation by rail are selected as factors that influence on GDP.

The built regression model was used for the short-term forecast of the market of rail container transportation in the Russian Federation up to 2025.

It should be noted that, as part of the research, the authors have found that there are risks that are difficult to predict and could have a significant impact on changes in volume rail container traffic, such as, for example, the destruction of railroad tracks as a result of a natural disaster, the introduction of a new package of sanctions by unfriendly countries, the reduction of public and private investment in railway infrastructure in the Russian Federation. To take into account difficult-to-predict risks, an expert method has been proposed, which will allow to rank these risks by the degree of their critical importance. Their accounting in the forecast can be realized as a risk adjustment based on an expert risk matrix.

TRENDS, FACTORS AND RISKS OF THE DEVELOPMENT OF THE RAIL CONTAINER TRANSPORTATION MARKET

The completed analysis proves that the rail container transportation market has grown steadily over the past five years, despite certain difficulties that arose in 2022. The geopolitical situation in the beginning of 2022 corrected optimistic forecasts of shippers, but, according to experts, in 2022 we can get into the so-called "zero dynamics": partial loss of European market compensated by geography of delivery to Asian countries. Experts note that the demand for containerized goods, regardless of external situations, has a number of advantages over carriage in wagons. First of all, there are no requirements for the type of cargo, as well as the ability to carry out loading and unloading operations in ports, in sorting stations, container terminals and storage without unnecessary costs for additional equipment [22].

Speed — is an important factor in the transport of goods. For comparison: it will take about 30 days to move cargo overland from Asian ports to European ports. If the transport is carried out through the Suez Canal, the delivery time can reach 45 days. And the transit of containerized goods by rail through the territory of the Russian Federation currently leaves 12 days, and by 2024 will be reduced to 7 days.

In 2018, by the Decree of the President of the Russian Federation No. 204 from 07.05.2018 approved the "Integrated plan for the modernization and expansion of backbone infrastructure" until 2024, the main thrust of which — is the modernization and development of transport infrastructure, namely — modernization of railway infrastructure, creation of a backbone network of multimodal transport and logistics hubs and transport corridors of the Russian Federation, such as "West — East", "North —South", "Europe — Western China". This became one of the drivers of the growth of the container transportation market in Russia.

In 2018, the container transportation market grew by 14.3% compared to the previous year[7] mainly due to the growth of international transport. In addition, in the freight transport market there has been an upward trend of purchasing covered wagons against the background of their reduction in the cargo base. At the same time, according to research by IPNM (the Institute of problems of natural monopolies), contractors increasingly prefer to use containers instead of covered wagons, as they are more attractive in terms of tariffication and multimodality.

2019 year was marked by a gradual recovery from the financial crisis, an attempt to stabilize the exchange rate of the ruble in the currency market, as well as the growth of selected macroeconomic indicators, while the growth dynamics of the economy are low. For container transportation, the environment was much more favourable: increase of transhipment port capacity, realization of the first stages of the program of development of the Eastern polygon, increase of capacity of Baikal-Amur and Trans-Siberian railway, etc. As a result, Russia's container market rose by 9%, or 5.2 million twenty-foot equivalent unit (TEU). Growth was mainly driven by land transport, transit and containerization of supply chains.

Despite restrictions in early 2020 due to pandemic and border closures between countries, according to CTS,[8] global container market contraction was less than 1%. In general, 2020, despite the COVID-19 and problems in many industries in different countries, demonstrated the growth of container transportation in the Russian Federation and around the world. For the Russian Federation in 2020, despite the global crisis associated with COVID-19, signaled the growth of the container traffic by 11.5%, or up to 5.8 million TEU. In the first place, this happened due to the switch of cargo flow from sea transport to rail, mainly in the direction of Asia — Europe — Asia, including direction "Silk Road". Overland transit through the Far East and containerization of domestic transport in the country also developed. In addition, this growth is supported by a sharp increase in imports from China to the EU of medical products. As a result, in 2020 the growth rate of the volume of transport in the transit direction Asia — Europe — Asia through Russia reached a record 52%. A total of 750 thous. TEU were transported.

The first half of 2022 slowed down the positive trend of growth of freight traffic in Russia as a whole. According to estimates of some experts, the Russian container transport market is expected to fall by 13–18% at the end of the year, the world — by 2%.[9] As noted above, this is primarily due to the disruption of the usual logistics chains, the need to build new routes, many foreign companies that were the largest shippers on the Russian railway network left the market, and there were some difficulties in making payments to banks abroad.

[7] According to EY data. URL: https://ru.investinrussia.com/data/file/ey-transportation-services-2019-rus.pdf (accessed on 25.02.2022).

[8] RZD-partner. URL: https://www.rzd-partner.ru/logistics/news/mirovoy-spros-na-konteynernye-perevozki-v-iyule-byl-na-urovne-proshlogo-goda/ (accessed on 25.10.2022).

[9] Forbes. URL: https://www.forbes.ru/biznes/476277-fesco-ocenila-padenie-rynka-kontejnernyh-perevozok-v-rossii-v-13–18-po-itogam-goda (accessed on 25.10.2022).

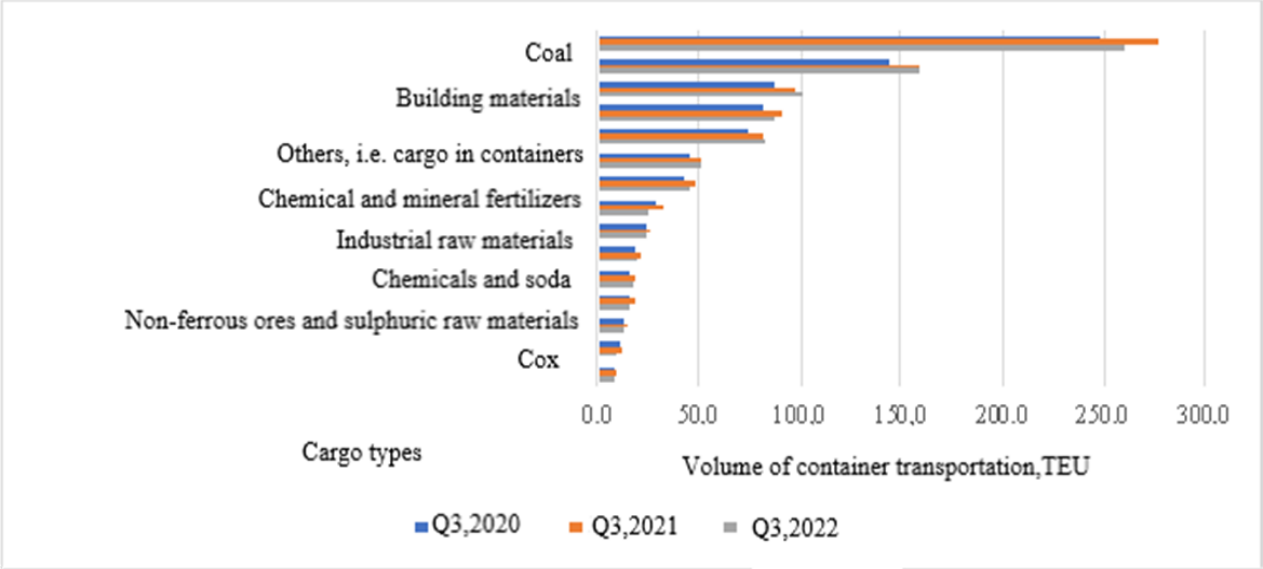

Fig. 1. **Dynamics of the volumes of container freight transportation by rail in the Russian Federation by type of cargo in the Q3 of 2020–2022, TEU**

Source: compiled by the authors.

However, there are certain risks of slowing down the growth of containerized transportation without necessary subsidies for container shipments, pricing policies and tariffication of individual maritime and railway operators, Late implementation and modernization of infrastructure projects (the complicated situation with the shipments from the Eastern polygon, the prospect of electrification of the Baikal-Amur Mainline just indicates the need for preventive research of current problems). In the Q3 of 2022, the volume of traffic decreased by 3.7%, or 34.7 million TEU, compared to the same period in 2021.

On *Fig.1* presents the dynamics of volumes of container freight transportation by rail in the Russian Federation by types of cargo for the Q3 of 2020–2022.

Negative developments for all types of freight in containers by rail, except transportation of oil and petroleum products, construction and other cargoes. The decrease in traffic was due to the withdrawal of foreign companies and investors and the imposition of sanctions by unfriendly countries, which resulted in the suspension of transport on conventional logistics routes.

EXPORT, IMPORT AND TRANSIT OF GOODS, ESTIMATION OF THEIR IMPACT ON THE VOLUME OF GDP BY THE REGRESSION MODEL OF FORECASTING

To construct the regression model, we used the results of industry analysis, assessment of trends and factors influencing the level of rail container transportation in the Russian Federation. The GDP of the Russian Federation, influenced by the activities of the rail container industry, was selected as an indicator. As independent factors — indicators of import, export and transit of container transport by rail on the railway network [26, 27].

Based on the existing data on the volume of the rail container transportation market for 2018–2022, as well as on the trends of the container market, we have made the equation of multiple linear regression using the MS Excel and the "Data Analysis" package with a view to forecasting rail container traffic for the period until 2025.

Using MS Excel tools, statistically significant factors have been determined, which have the most influence on the

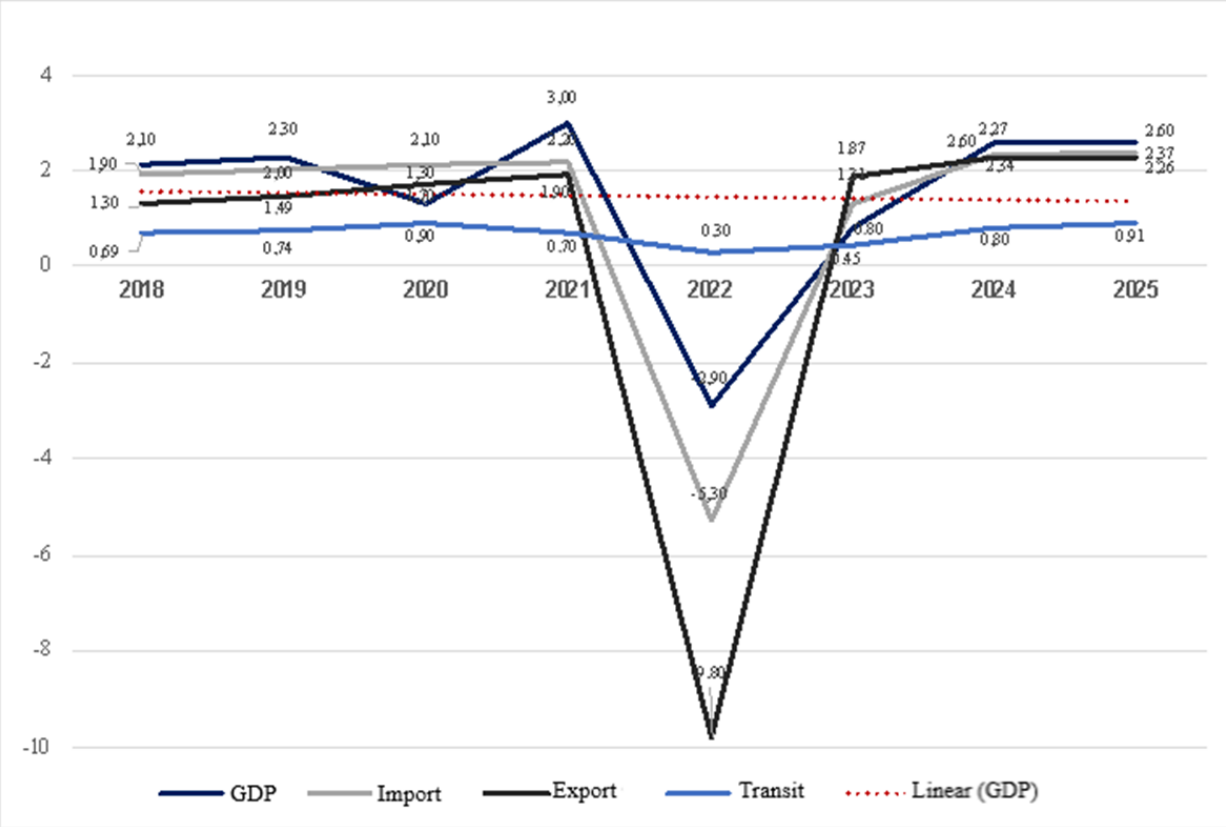

Fig. 2. **Actual and forecast data on the volume of imports, exports and transit of rail container transportation in the Russian Federation, TEU**

Source: compiled by the authors.

volume of GDP in the Russian Federation — the volume of import, export and transit. Domestic transportation has no significant impact on the country's GDP. These intermediate results lead to the conclusion that the Russian Federation plays the role of a global distribution hub: the State, due to the convenience of its geographical location, as well as the availability of quality rail infrastructure plays a key role in the global supply chain [19]. At the same time, despite the decline of certain indicators in the 9 months of 2022 due to the current geopolitical situation, according to various experts, in a few years the industry will return to the initial growth trend.

As a result, the multiple linear regression equation characterizing the dependence of the volume of GDP of the Russian Federation on the dynamics of the rail container transportation market is as follows:

$$Y = -6,47 + 8,05x_1 - 2,03x_2 - 6,2x_3, \quad (1)$$

where Y — GDP of the Russian Federation;

x_1 — volume of rail container transportation imports in the Russian Federation;

x_2 — volume of rail container transportation exports in the Russian Federation;

x_3 — volume of rail container transportation transits in the Russian Federation.

The statistical significance of this model is confirmed by the calculated Fisher' criterion (F_{fact} = 11.6), which exceeds its theoretical value (F_{table} = 0.21), and value R ~ 0.98 [26]. Using statistics on the volume of import, export and transit of rail container transportation, we make a forecast these factors up to 2025 (*Fig. 2*).

Thus, as a result of our research and graphical representation of the values of factors it is possible to conclude about "drawdown" on the basis of the results of 2022 the cargo transportation in general. At

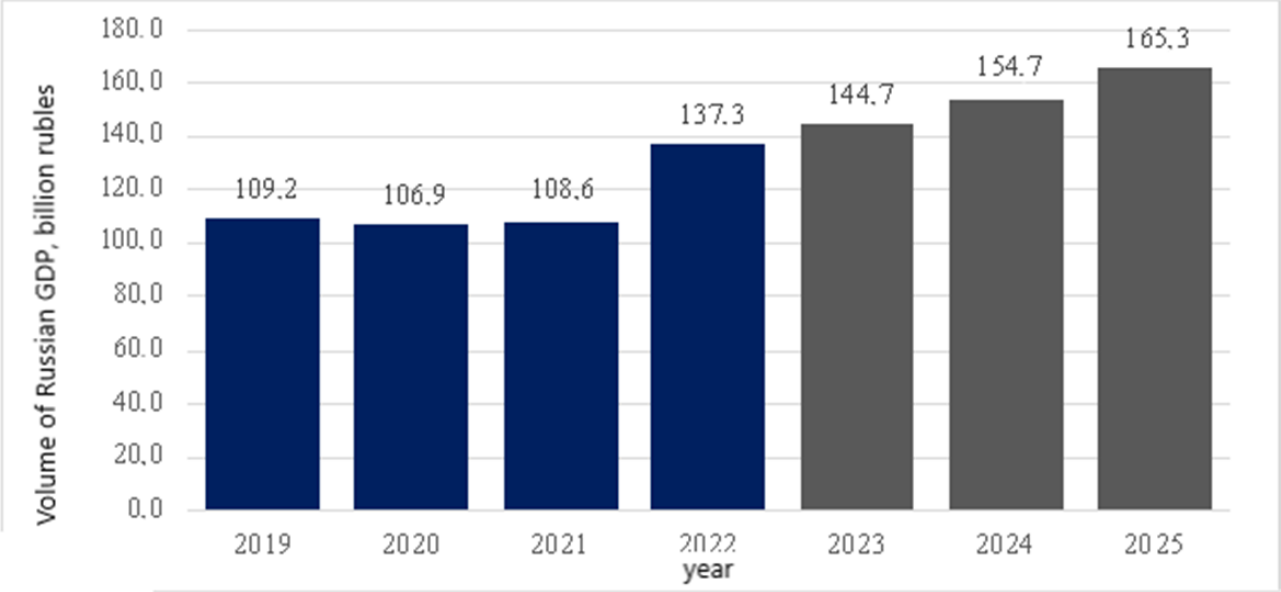

Fig. 3. **Actual and forecast values of GDP in the Russian Federation, bln rub.**

Source: compiled by the authors.

the same time, by 2023, the growth trend is expected to resume for imports (+55.2% in 2025 against 2022), exports (+77.8% in 2025 against 2022) and transit (+101.3% in 2025 against 2022).

On *Fig. 3* presented a forecast of the GDP of the Russian Federation for the period 2023–2025, taking into account the influence of the volumes of rail container transportation.

Based on the forecasted data, the Russian Federation's GDP by 2025 will be 165.3 billion rubles (+20.4% against 2022), which is a significant increase, given the instability in the foreign and domestic market.

INTERPRETATION OF RESULTS, ASSUMPTIONS AND RISKS

Based on the results of the industry analysis and forecast, we have concluded that container transportation will grow by 2025 based on the dynamics of import, export and transit of goods, despite the current difficulties of building new logistics chains, introduction package of sanctions against the Russian Federation, as well as the withdrawal of large foreign companies and investors from the Russian market. In addition, consideration should be given to the possibility of amendments due to factors not considered in the model, such as the increase in shipping container, in particular due to port development plans in the Far East and Sakhalin. In addition, risk groups may influence the outcome of the forecast, with which the rail container transportation market may be faced.

Among the difficult-to-predict risks are also political ones (change in the direction of development of cargo transportation in the country, possible introduction of new sanctions by unfriendly countries), regulations (tightening of the rules for the transportation of different types of cargo, higher tariffs for the transportation of goods in containers), natural disasters (railway accidents due to a natural disaster can lead to a significant disruption of supplies), investment (lack of sufficient financing for the transport and logistics industry, departure of foreign investors), which in general may lead to stagnation of the cargo transportation market. Risk adjustment to the forecast of rail container traffic and GDP of the Russian Federation based on the expert risk matrix can be used to take into account the difficult-to-predict risks to understand the degree of impact and the level of possible damage.

According to experts, the most significant are investment risks and force majeure risk [27]. In order to reduce the significant financial losses resulting from the non-delivery of containerized goods, it is necessary to ensure a sufficient presence of private investors in the railway infrastructure of the transport and logistics industry.

CONCLUSION

The research made it possible to substantiate trends in the development of the rail container transportation market in the Russian Federation, based on the following forecasts:

- the decline in the growth rate of cargo transportation in 2022 is due to foreign factors, but Russian cargo carrier and operators were able to adapt to the difficult geopolitical and economic situation, this allowed partially to level the drop and find suppliers in the world market new customers and new delivery routes;
- the growth of rail container transportation in the Russian Federation in 2025 compared to 2022 due to imports by 55.2%, exports— by 77.8% and transit — by 101.3%;
- the growth of the Russian Federation' GDP by 2022 relative to 2020 by 20.4% due to the growth of rail container transportation in the Russian Federation, by building new transport and logistics routes (reorientation of goods "to the East").

The key factors underpinning these forecasts are: increase speed of cargo handling in containers through the establishment of a backbone network of multimodal transport and logistics hubs in the Russian Federation; transition to a three-stage model of tariffication for a container train depending on the route, speed and technical characteristics; increase competition among container operators; containerization up to 90% of bulk cargo; digitalization of documentation during the ordering and delivering of goods.

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Green Finance Instruments as a Factor of Increasing Industrial Waste Utilization in Russia

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ABSTRACT

Influenced by the governmental policy of national economy decarbonization and greening fundamentally new institution of green finance is currently developing in Russia. One of the key areas for the development of green finance is industrial waste disposal. The **aim** of the paper is to determine the efficiency of green financing of industrial waste utilization projects in Russia. The **methodological basis** of the paper consists of domestic and foreign scientific articles in the field of green financing and waste disposal, regulatory legal acts of the Russian Federation, as well as Rosstat data on the volume of industrial waste disposal. As a **research method**, the authors applied an analytical approach to systemize green finance concept definitions, and analyzed foreign experience of using green financial instruments in the industrial waste management industry. The article represents the **content analysis** of the Russian taxonomy of green and adaptation projects, as well as an assessment of the industrial waste utilization volumes that can potentially be achieved due to the implementation of projects within the framework of taxonomy areas. The **results** of the analysis show that through the implementation of green and adaptation projects, it is possible to additionally dispose of about 91 million tons of industrial waste, or 2.5% of the total volume of waste generated. Such a low recycling rate is a result of the limited amount of industrial waste types, the utilization of which is included in the taxonomy. It is necessary to expand the list of industrial waste, the disposal of which can be recognized as an independent project or a criterion for the implementation of projects within the framework of the taxonomy.

Keywords: green economy; green finance instruments; industrial waste; waste disposal

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INTRODUCTION

Today in Russia one can observe the formation of a fundamentally new institution of green finance. This trend is primarily associated with the increased attention of state policy to decarbonization and greening of the national economy [1]. Thus, in July 2020, Methodological recommendations for the development of investment activities in the field of green finance in the Russian Federation[1] and criteria (taxonomy) for the implementation of green and adaptation projects[2] were published. В ноябре 2021 г. In November 2021, the Bank of Russia also published a Glossary of terms in the field of sustainable development, which contains the main concepts related to the sustainable development agenda.[3]

Among one of the most relevant areas of green financing in Russia, it is necessary to highlight the processing of industrial waste. About 7 billion tons of production and consumption waste are generated annually in the country. At the same time, less than half of the generated volume is utilized. According to the Industry Development Strategy for the Processing, Utilization, and Treatment of Production and Consumption Waste for the period up to 2030, by the end of 2030, 70% of all waste generated in the country should be disposed of.[4] The world's experience shows that the transformation of the waste management system cannot be carried out without targeted support measures.[5]

Due to the relevance of waste management tasks, the purpose of this article is to substantiate the effectiveness of green financing for industrial waste management projects in Russia. The resource base of the study was domestic and international scientific articles in the field of green financing and waste management, regulatory legal acts of the Russian Federation, as well as Rosstat data.

LITERATURE REVIEW

Numerous attempts have been made in the academic literature to define the concept of green finance. Many authors agree that green finance involves investing in projects aimed at improving the state of the environment and combating climate change [2–4]. Summarizing the definitions of various researchers, N. Lindenberg came to the conclusion that the concept of "green finance" consists of a combination of three components [5] (*Fig. 1*):

1) private green investments: investments aimed at organizing the production of goods and services with low / zero anthropogenic impact, as well as in projects to prevent, minimize and compensate for environmental damage;

2) measures of state support: state stimulation of projects to reduce harm to the environment, provision of benefits, reduction of tax rates for organizations engaged in activities to reduce the anthropogenic footprint;

3) greening the components of the financial system: the creation of green funds and the development of green financial instruments, such as green bonds, green loans, etc.

[1] VEB.RF. Guidelines for the development of investment activities in green finance in the Russian Federation. 2020. URL: https://veb.ru/files/?file=1cc7ffec701762260d130988dafca0cf.pdf (accessed on 01.10.2021).

[2] Decree of the Government of the Russian Federation as of September 21, 2021 No. 1587 "On approval of the criteria for sustainable (including green) development projects in the Russian Federation and requirements for the verification system for sustainable (including green) development projects in the Russian Federation". 2021. URL: http://static.government.ru/media/files/3hAvrl8rMjp19BApLG2cchmt35YBPH8z.pdf (accessed on 01.10.2021).

[3] Bank of Russia. Sustainable Development Glossary. 2020. URL: https://cbr.ru/develop/ur/faq/?fbclid=IwAR 0iGY 1xeYDW0JE-Q9Cz_2ter3sfJ-y8r-3VaA86NIppOuMlAqZ-sB 2gn1k (accessed on 01.10.2021).

[4] Ministry of Industry and Trade of Russia. Industry Development Strategy for the Processing, Utilization, and Treatment of Production and Consumption Waste for the period up to 2030. 2018. URL: http://static.government.ru/media/files/y8PMkQGZLfbY 7jhn6QMruaKoferAowzJ.pdf (accessed on 06.08.2021).

[5] OECD. Waste Management and the Circular Economy in Selected OECD Countries: Evidence from Environmental Performance Reviews, OECD Environmental Performance Reviews, OECD Publishing. Paris. 2019. URL: DOI: 10.1787/9789264309395-en

It is important to note that the components that make up the concept of green finance are interrelated. Thus, an increase in government support is an incentive for increased green investment from private investors. This, in turn, affects the development of green instruments in the financial system.

The key difference between green finance and traditional finance is to achieve a positive effect on the environment, in addition to providing a return on investment.[6] Traditional financing involves only obtaining financial profit, taking into account possible financial risks [6]. Green finance, in addition, includes an environmental component, in which, together with financial benefits, positive environmental effects are achieved.[6] Therefore, it is often defined as part of sustainable financing, in which adherence to the principles of ESG is mandatory.[7]

At the same time, green finance instruments do not differ in their structure from traditional ones. Any traditional financial instrument can be used as a green instrument, provided that it is aimed at implementing green projects.[8] The main green finance instruments today are green loans and green bonds [7]. The main difference between the two is that green lending is a banking instrument, while green bonds are exchange-traded.

To date, most empirical studies of the impact of green finance instruments have examined the impact on reducing the carbon footprint of national economies and enterprises [8, 9]. M. S. Meo and Abd Karim M. Z. using the example of 10 countries,[9] leading the world in terms of the level of development of the green finance market, came to the conclusion that there is a negative correlation between green finance and greenhouse gas emissions — as the volume of green finance increases, CO_2 eq emissions decrease. [9]. Using quantile regression and data from 2008 to 2019 (monthly), the authors found that for all the countries studied, an increase in green finance leads to a decrease in greenhouse gas emissions. The strongest correlation between the two variables was found in the US and Sweden, and the weakest in New Zealand and Norway. According to the study, green finance is the best financial strategy for reducing greenhouse gas emissions.

C. Tolliver et al. calculated that for the period from 2008 to 2017, due to the issuance of green bonds by the world's largest financial institutions, the reduction of greenhouse gas emissions amounted to 108 million tons [8]. Considering the fact that total greenhouse gas emissions during this period amounted to 341

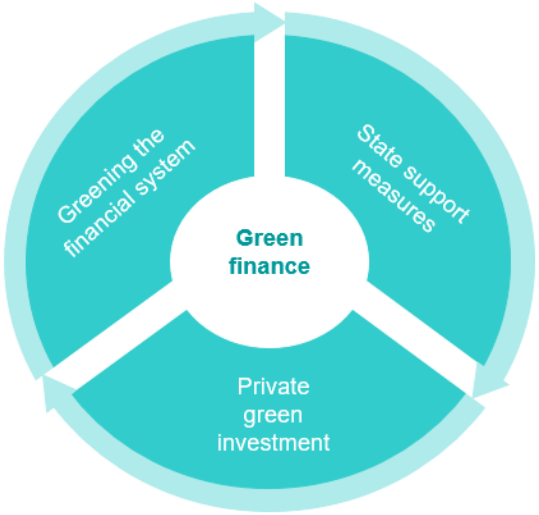

Fig. 1. **Components of the green finance concept**

Source: compiled by the authors based on [5].

[6] Asian Development Bank. Green Finance, Explained. Development Asia. 2018. URL: https://development.asia/explainer/green-finance-explained.

[7] ESG (Environmental, Social, Governance) principles — the principles of the company's activities based on environmental protection, the creation of favorable social conditions, a conscientious relationship with employees and customers, and proper corporate governance; IMF (International Monetary Fund). Global Financial Stability Report Lower for Longer. 2019. URL: https://www.imf.org/en/Publications/GFSR/Issues/2019/10/01/global-financial-stability-report-october-2019#Chapter6.

[8] Working group on ecology and nature management of the Expert Council under the Government of the Russian Federation. Russian Green Bank concept. 2017. URL: https://nangs.org›news›association›download (accessed on 07.09.2021).

[9] Canada, Denmark, Hong Kong, Japan, New Zealand, Norway, Sweden, Switzerland, UK, and USA.

billion tons,[10] the activities financed by green bonds managed to reduce emissions by 3%.

A summary list of definitions of the green finance concept is presented in *Table 1*.

INTERNATIONAL PRACTICES

Currently, the global financial community does not have generic rules and standards for classifying financial instruments and projects as "green". In this regard, many international organizations and countries issue their own classifiers and taxonomies to define green economic activities. The most famous of them:

- Climate Bonds Taxonomy;
- EU Taxonomy;
- China's Green Bond Endorsed Project Catalogue (hereinafter referred to as the "PRC Taxonomy").

In each of the named taxonomies, financing of waste disposal and recycling projects is singled out as one of the most relevant areas. For example, the *Climate Bonds Taxonomy*, developed by the international non-profit organization *Climate Bond Initiative*, lists assets and projects aimed at recycling, reusing, and other waste management methods.[11] The *EU Taxonomy* defines the following criteria for green waste management projects[12]:

- use of waste as secondary energy resources;
- recovery of materials from non-hazardous waste.
- The main areas of green financing in terms of waste management, according to the PRC Taxonomy, are:
- production of equipment for obtaining technogenic materials through waste processing;
- complex utilization of industrial waste;
- creation of technoparks.

As noted earlier, green bonds and loans are the two most popular green finance vehicles today. In the world over the past decade, there has been a stable trend towards an increase in the volume of circulation of green bonds and green loans. Green bonds, however, are the more common instrument.

In 2013, the volume of issuance of both financial instruments was approximately the same and did not exceed $ 15 billion (*Fig. 2*). Over 7 years, the volume of green bond issuance increased by more than 20 times, amounting to $ 305.3 billion by the end of 2020.[13] The volume of issued green loans at the same time increased only 7 times and amounted to $ 80.3 billion.[14]

Today, the world market leaders in the issuance of green bonds are the United States, China and European countries (*Fig. 3*). In 2019, the US accounted for 20% of all green bonds issued globally, worth more than $ 50 billion. The second place belongs to China ($ 31.5 billion), the third — France ($ 30 billion). The volume of green finance in Russia remains insignificant compared to the world, which is associated with the low level of development of the green finance market in the country.

In 2019, the global volume of green financing in the industry of industrial and consumer waste processing amounted to $ 6.8 billion, or about 4% of the total volume of issued green bonds [10] (*Fig. 4*). In most European countries (France, UK, Sweden, etc.), the issue of green bonds is more typical for business representatives, and in

[10] Based on Statista URL: https://www.statista.com/statistics/264699/worldwide-co2-emissions/ (accessed on 10.11.2021).

[11] Climate Bonds Initiative. Climate Bonds Taxonomy. 2021. URL: https://www.climatebonds.net/files/files/CBI_Taxonomy_Tables-2June21.pdf.

[12] EU Technical Expert Group on Sustainable Finance. Taxonomy: Final report of the Technical Expert Group on Sustainable Finance. 2020. URL: https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy_en.pdf.

[13] Argus Media. Green bond issuance surges in 2020. 2021. URL: https://www.argusmedia.com/en/news/2178514-green-bond-issuance-surges-in-2020#:~: text=The%20%24305.3bn%20in%20green, data%20from%20Bloomberg%20BNEF%20showed (accessed on 12.2021).

[14] Bloomberg Green. The Sustainable Debt Market Is All Grown Up. 2021. URL: https://www.bloomberg.com/news/articles/2021–01–14/the-sustainable-debt-market-is-all-grown-up (accessed on 10.12.2021).

Table 1

Consolidated list of green finance concept definitions by international organizations, national institutions and various research papers

Author	Definition
International organizations	
G20[a] Study Group	Green finance is an investment that provides the following environmental benefits: reduction of pollution of the atmosphere, water, and land; reduction of greenhouse gas emissions; increase of energy efficiency when using existing natural resources; climate change mitigation and adaptation
OECD[b]	Green finance aims to achieve green economic growth driven by reduced pollution and greenhouse gas emissions, reduced waste, and more efficient use of natural resources
IMF[c]	Green finance is part of sustainable finance, incorporating ESG principles into business decision-making, economic development, and investment strategies
European Commission[d]	Green finance is a component of sustainable finance that supports economic growth while reducing environmental pressures, taking into account social and governance aspects
National institutions	
People's Bank of China[e]	Green finance is financial services provided for economic activities that: contributes to the improvement of the environment; favors the efficient use of natural resources; mitigates the effects of climate change
GIZ[f]	Green finance is a strategic approach to engage the financial sector in the transition to a low-carbon and resource-efficient economy, as well as climate change adaptation challenges
Chartered Banker Institute[j]	Green finance is any financial initiative, process, product, or service designed to protect the environment or to manage its impact on finance and investment
Research papers	
S. Khosla et al. [2]	Green finance is invested in projects and initiatives aimed at: sustainable development; ecological products; fight against industrial pollution, water disposal; protection of biodiversity; prevention of the consequences of climate change
U. Volz et al. [3]	Green finance includes all forms of investment and lending that have an impact on the environment and enhance environmental sustainability
M.B. Ghoul [4]	Green finance is the link between the financial industry, the environment, and economic growth
N. Lindenberg [5]	Green finance is a combination of green investments, public policies, and components of the financial system

Source: compiled by the authors based on the literature review.

Notes: [a] Green Finance Study Group. G20 green finance synthesis report. 2016. URL: https://unepinquiry.org/wp-content/uploads/2016/09/Synthesis_Report_Full_EN.pdf.; [b] OECD. Green Finance and Investment. Developing Sustainable Finance Definitions and Taxonomies. OECD Publications. 2020. URL: https://www.oecd-ilibrary.org/fr/environment/green-finance-and-investment_24090344; [c] IMF (International Monetary Fund). Global Financial Stability Report Lower for Longer. 2019. URL: https://www.imf.org/en/Publications/GFSR/Issues/2019/10/01/global-financial-stability-report-october-2019#Chapter6; [d] European Commission. Overview of sustainable finance. 2021. URL: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/overview-sustainable-finance_en; [e] The People`s Bank of China. Guidelines for Establishing the Green Financial System. 2021. URL: http://www.pbc.gov.cn/english/130721/3133045/index.html; [f] GIZ. Green Finance An Innovative Approach to Fostering Sustainable Economic Development and Adaptation to Climate Change. 2011. URL: https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/Green_finance_GIZ.pdf; [j] Chartered Banker Institute. The Green Qualifications Workbook. file:///C:/Users/YVNikitushkina/Downloads/The%20Green%20Qualifications%20Workbook%20-%20Chapter%201%20(1).pdf.

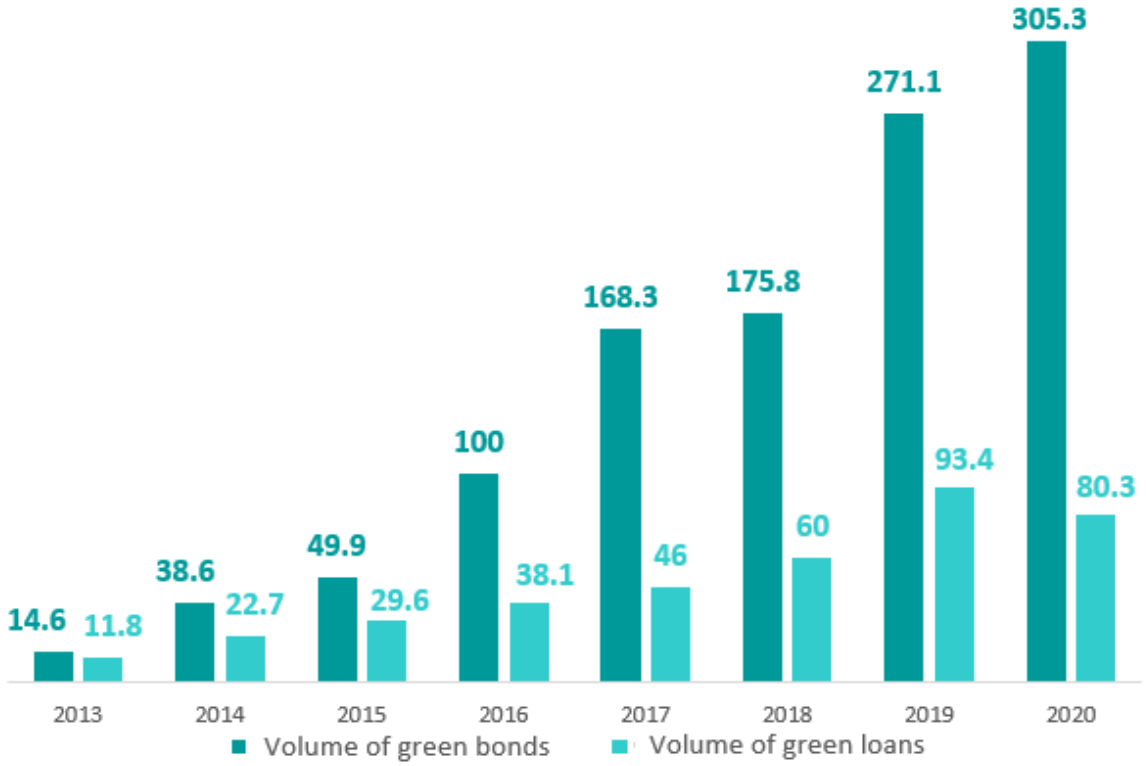

Fig. 2. **The volume of green bonds and green loans issuance in the world, 2013–2020, USD billion**

Source: compiled by the authors based on Investinfra. URL: https://investinfra.ru/novosti/v-2019-godu-mirovoj-obem-emissii-zelenyx-obligaczij-dostig-rekordnogo-pokazatelya-v-$255-mlrd.html (accessed on 09.06.2021).

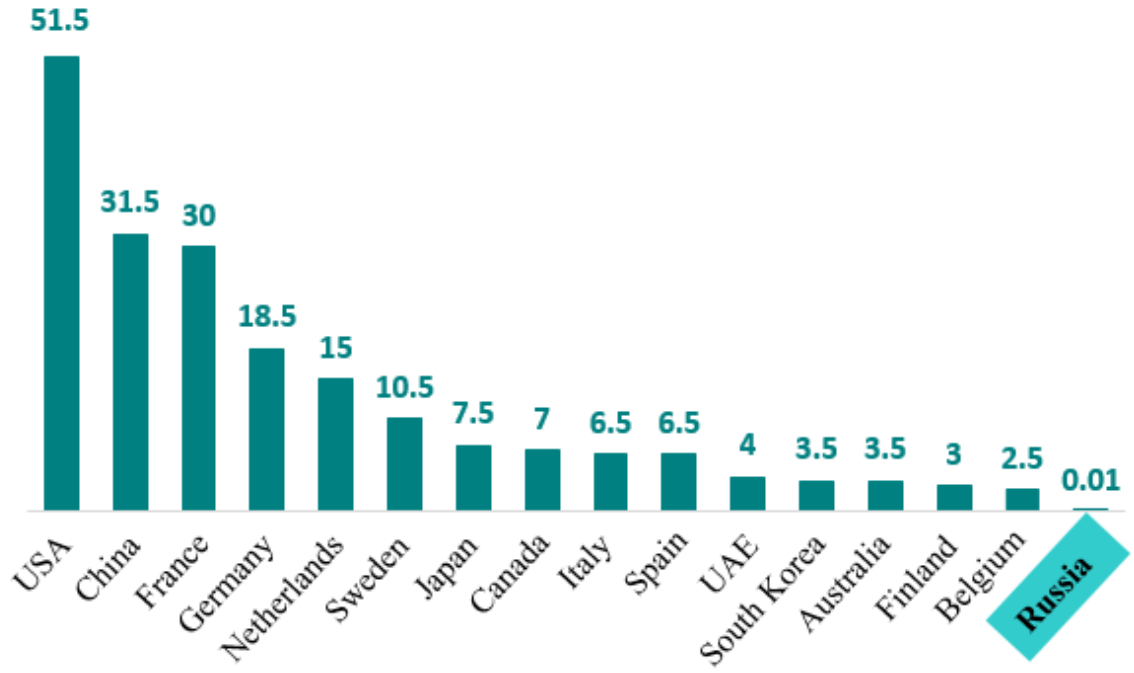

Fig. 3. **Comparison of Russia and 15 countries with the largest green bond issuance in 2019, USD billion**

Source: compiled by the authors based on Investinfra and database Statista.com. URL: https://investinfra.ru/novosti/v-2019-godu-mirovoj-obem-emissii-zelenyx-obligaczij-dostig-rekordnogo-pokazatelya-v-$ 255-mlrd.html; URL: https://www.statista.com/statistics/512030/share-of-green-bond-market-value-globally-by-major-country/ (accessed on 09.06.2021).

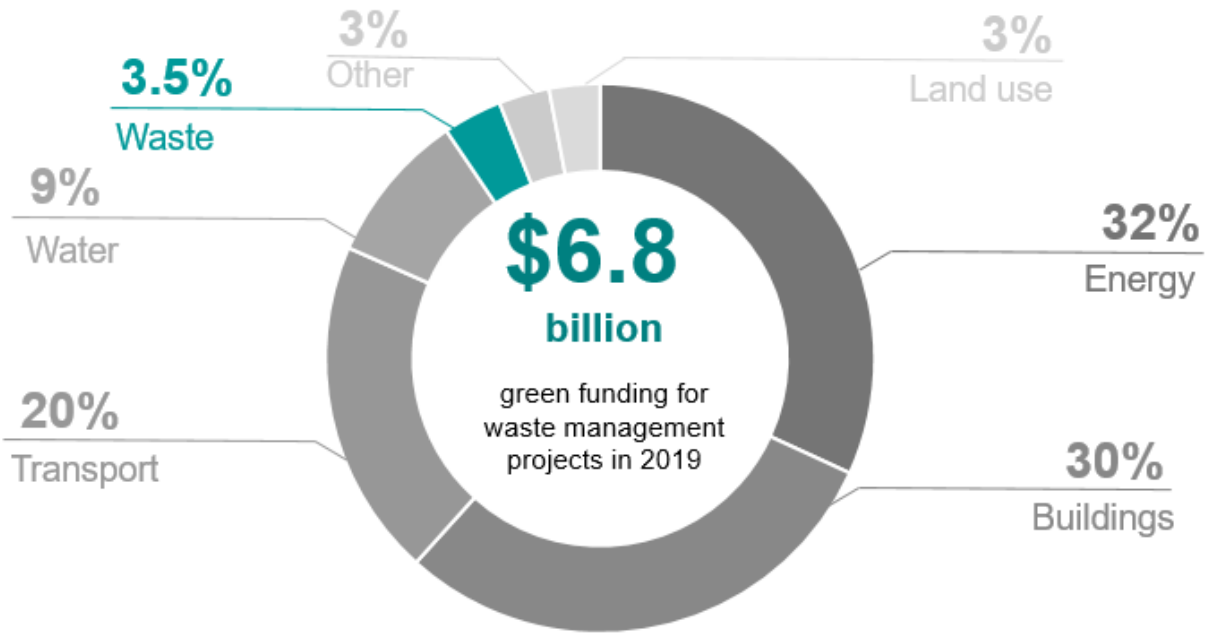

Fig. 4. **Distribution of issued green bonds by sector in 2019**

Source: compiled by the authors based on [11].

the USA and China — for the state. At the same time, it should be noted that most of the ongoing projects relate to solving the problems of utilization of municipal solid waste (MSW) generated as a result of consumption by the population, and not industrial waste.

CONTENT ANALYSIS OF THE RUSSIAN TAXONOMY OF GREEN AND ADAPTATION PROJECTS

In Russia, today the green financing system is in its emerging phase, while the state is actively developing this area. In September 2021, a Decree of the Government of the Russian Federation dated September 21, 2021 No. 1587 "On approval of the criteria for sustainable (including green) development projects in the Russian Federation and the requirements for the verification system for sustainable (including green) development projects in the Russian Federation",[15] which is the regulatory framework for launching the national system for financing green projects and initiatives in the field of sustainable development. Within the framework of this document, criteria for green and adaptation projects (taxonomies) have been developed, according to which companies will be able to attract concessional financing.[16]

The key difference between the two types of projects lies in the guidelines (directions) in the field of sustainable development and ecology, which they must comply with. Green projects must comply with the goals and directions in the field of climate and sustainable development specified in international documents.[17] Adaptation projects, in turn,

[15] Decree of the Government of the Russian Federation dated September 21, 2021 No. 1587 "On approval of the criteria for sustainable (including green) development projects in the Russian Federation and the requirements for the verification system for sustainable (including green) development projects in the Russian Federation. 2021. URL: http://static.government.ru/media/files/3hAvrl8rMjp19BApLG2cchmt35YBPH8z.pdf (accessed on 01.10.2021).

[16] Decree of the Government of the Russian Federation dated September 21, 2021 No. 1587 "On approval of the criteria for sustainable (including green) development projects in the Russian Federation and the requirements for the verification system for sustainable (including green) development projects in the Russian Federation. 2021. URL: http://static.government.ru/media/files/3hAvrl8rMjp19BApLG2cchmt35YBPH8z.pdf (accessed on 01.10.2021).

[17] Russian Government. The government has approved green financing criteria. 2021. URL: http://government.ru/news/43320/ (accessed on 09.11.2021).

Area	Green projects	Adaptation projects
Waste management* *with municipal solid waste (MSW)	✓	✓
Energy	✓	✓
Construction	✓	✗
Industry	✓	✓
Transport and industrial technology	✓	✓
Water supply and sanitation	✓	✗
Natural landscapes, rivers, reservoirs, and biodiversity	✓	✗
Agriculture	✓	✓
Sustainable Infrastructure	✗	✓

✓ Implementation of projects is possible within the area

✗ Implementation of projects is not possible within the area

Fig. 5. **List of areas for the implementation of green and adaptation projects**

Source: compiled by the authors based on the Decree of the Government of the Russian Federation as of September 21, 2021 No. 1587 "On approval of the criteria for sustainable (including green) development projects in the Russian Federation and requirements for the verification system for sustainable (including green) development projects in the Russian Federation". 2021. URL: http://static.government.ru/media/files/3hAvrl8rMjp19BApLG2cchmt35YBPH8z.pdf (accessed on 01.10.2021).

must comply with Russian priorities in the field of environmental protection. The main directions for the implementation of green and adaptation projects are shown in *Fig. 5*.

Waste management in the Russian taxonomy is singled out as a separate area for project implementation. At the same time, this direction implies only the processing of municipal solid waste (MSW). Utilization of industrial waste in this direction is not provided. The use of industrial waste is provided for within the taxonomy industry areas:

- "Power industry": ash and slag waste from thermal power plants (TPPs);
- "Industry": steel slag and glass cullet;
- "Agriculture": phosphogypsum.

In the direction of production sector and energy, both green and adaptation projects for the disposal of industrial waste can be implemented. As part of waste management, only green recycling projects can be implemented. In agriculture, industrial waste disposal projects can be implemented as adaptation projects.

Only the utilization of ash and slag waste can be recognized as an independent green project, subject to a number of criteria. Utilization of phosphogypsum, steel slag and glass cullet is not recognized as an independent project within the framework of the taxonomy, but is used only as a criterion for the project's compliance with the green or adaptation category.

Ash and slag waste are traditionally a coal combustion by-product at thermal power plants (hereinafter CCP-ASW). Within the

framework of the Russian taxonomy, the construction industry and other industries of industrial production are designated as a priority area for the disposal of CCP-ASW. A key criterion for qualifying eligible projects as "green" is verification of environmental and climate impacts by the reviewing party.

In addition to the fact that projects for the disposal of CCP-ASW can qualify for preferential green financing, the availability of systems and technologies for processing these wastes becomes one of the criteria for the implementation of complex projects within the taxonomy. Utilization of the received CCP-ASW is a key criterion for the recognition of green projects in the direction of waste disposal with energy production. The presence of equipment or installations for the processing of CCP-ASW into secondary material resources is mandatory for adaptation projects implemented in the direction "Cogeneration facilities — new or existing facilities". An optional criterion for recognizing the production of rare and rare earth metals as adaptation projects is the use of technologies for extracting rare earth metals from ash and slag waste.[18]

Steel slag is a waste generated during the smelting of metals from ores. Utilization of this type of waste is an additional criterion for the recognition of green projects for the production of steel and aluminum in modernized and newly built industries. Utilization of sludge from the processing of bauxite and nepheline ores, formed during the production of aluminum, is not provided for by the taxonomy. As an additional criterion, the utilization of steel slag is also used to recognize the following projects as adaptation projects:

- production of iron and steel;
- production of copper;
- production of nickel and cobalt;
- production of lead, zinc. and cadmium.

Glass cullet is a waste generated during the production and processing of glass products. Utilizing glass cullet in the production process is a mandatory criterion for recognizing glass production projects as adaptation projects. Other prerequisites are compliance with resource and energy efficiency indicators and the use of advanced technologies in accordance with ITS 5–2015.[19]

Phosphogypsum is a waste from the production of phosphate fertilizers. This type of waste can be utilized as a part of the implementation of adaptation projects for the chemical reclamation of acidic and saline agricultural lands. The only criterion, in this case, is the restoration of the neutral acid-base balance of the soil solution pH = 6.5–7.0 due to the neutralization of salts and acids accumulating in the soil with the appropriate chemical ameliorant (phosphogypsum or lime).

It is also worth noting that one of the additional criteria for recognizing cement production projects as "green" is the replacement of 10% or more of natural raw materials with waste from various industries. However, within the framework of the Russian taxonomy, specific types of waste that can be used for cement production are not explicitly indicated. It has been repeatedly confirmed in the scientific literature that industrial waste, common for domestic enterprises, is widely used in the construction industry as a substitute for traditional natural resources, in particular:

- CCP-ASW [12];
- foundry sand (waste of metallurgical production) [13];
- phosphogypsum (waste from the production of phosphate fertilizers) [14].

A summary of green and adaptation projects where industrial waste utilization can be applied, is presented in *Fig. 6*.

[18] Ash and slag waste is a hydraulic structure designed for the accumulation / placement of ash and slag from thermal power plants.

[19] Information and technical guide on the best available technologies "Glass production" (ITS 5–2015).

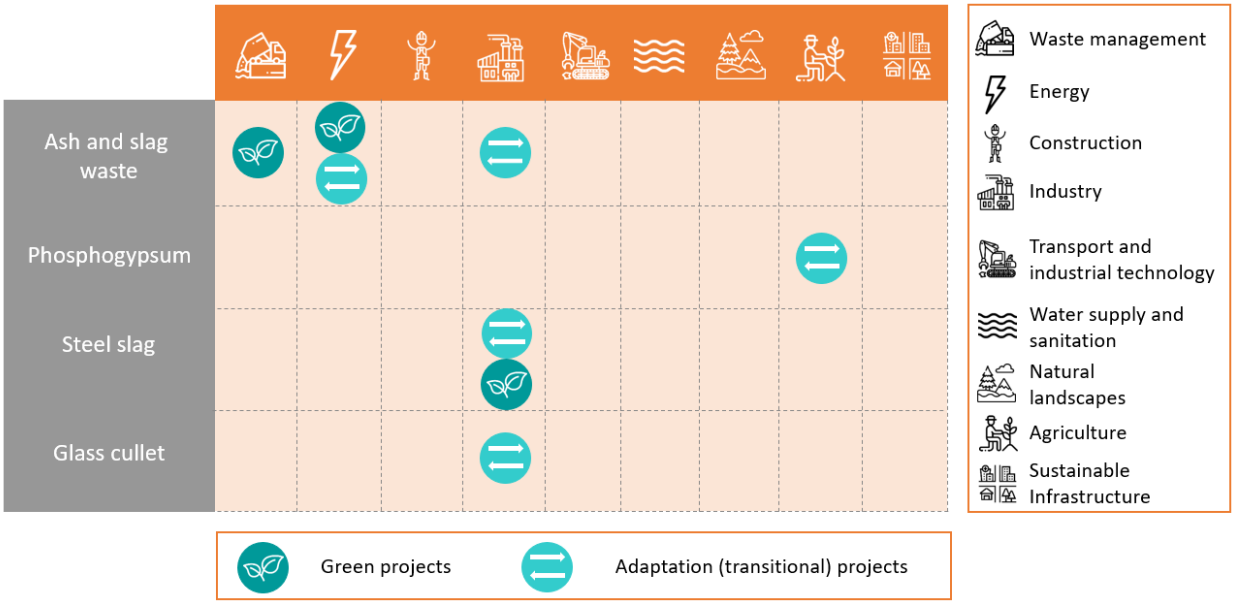

Fig. 6. **Consolidated list of areas for green and adaptation projects where industrial waste utilization can be applied**

Source: compiled by the authors based on the Decree of the Government of the Russian Federation as of September 21, 2021 No. 1587 "On approval of the criteria for sustainable (including green) development projects in the Russian Federation and requirements for the verification system for sustainable (including green) development projects in the Russian Federation". 2021. URL: http://static.government.ru/media/files/3hAvrl8rMjp19BApLG2cchmt35YBPH8z.pdf (accessed on 01.10.2021).

Next, we estimated the volumes of industrial waste utilization that can be covered by the projects indicated in the taxonomy. To do this, the volumes of non-utilizable industrial waste were compared by type of economic activity (OKVED2) and by type of waste within the taxonomy. Based on the data obtained, the percentage of industrial waste that could potentially be disposed of in the process of implementing green and adaptation projects was calculated. The evaluation results are given in *Table 2*.

According to Rosstat, in 2020, 3.5 billion tons of production and consumption waste,[20] or about 50% of the total amount of waste generated, could not be utilized. The percentage of industrial waste that could potentially be utilized in the process of implementing green and adaptation projects was calculated using the formula:

$$x = \frac{\sum_{i=1}^{n} Q_{gen\_taxon\_i} - \sum_{i=1}^{n} Q_{util\_taxon\_i}}{\sum_{i=1}^{n} Q_{gen\_rosst\_i} - \sum_{i=1}^{n} Q_{util\_rosst\_i}} * 100\%,$$

where $Q_{gen\_taxon\_i}$ — the amount of waste generated by the i-th type of waste within the taxonomy directions per year;

$Q_{util\_taxon\_i}$ — the amount of utilized waste by the i-th type of waste within the taxonomy directions per year;

$Q_{gen\_rosst\_i}$ — the amount of waste generated by the i-th type of waste in the framework of economic activity according to OKVED2;

$Q_{util\_rosst\_i}$ — the amount of utilized waste by the i-th type of waste within the framework of economic activity according to OKVED2.

As a result, out of 3.5 billion tons of non-utilized waste within the framework of taxonomy projects, an additional 91 million tons, or no more than 2.5% of the total non-utilized industrial waste in the country, can be utilized. At the same time, it should be noted that 90% of non-utilized waste is overburden. The share of non-utilized non-overburden

[20] Based on Rosstat data. URL: https://rosstat.gov.ru/folder/11194 (accessed on 24.10.2021).

Table 2

Estimation of industrial waste utilization volumes (by types and sources of formation), which can potentially be achieved through the implementation of green and adaptation projects

Rosstat data for 2020			Taxonomy content analysis		Share of utilized waste that can be achieved through taxonomy	
Type of economic activity (OKVED2)	Types of waste generated as a result of economic activities	Volume of non-utilized waste by type of economic activity (thousand tons)	Area of implementation of utilization projects / type of waste	Volume of non-utilized waste by type specified in the taxonomy (thousand tons per year)	by type of waste, %	in industry as a whole, %
Agriculture, forestry, hunting, fishing, and fish farming	Phosphogypsum	11,439.5	Agriculture / phosphogypsum	3,430.00 [15]	30	30
	Wood waste				0	
	Grain waste, etc.				0	
Extractive industry						
Coal mining	Overburden and host rock, crush screenings	2,032,608.6	Not applicable	0	0	0
Extraction of crude oil and natural gas		5,636.0		0	0	
Mining of metal ores		1,051,756.0		0	0	
Extraction of other minerals		304,259.6		0	0	
Provision of mining services		2248.1		0	0	

Table 2 (continued)

Rosstat data for 2020			Taxonomy content analysis		Share of utilized waste that can be achieved through taxonomy	
Type of economic activity (OKVED2)	**Types of waste generated as a result of economic activities**	**Volume of non-utilized waste by type of economic activity (thousand tons)**	**Area of implementation of utilization projects / type of waste**	**Volume of non-utilized waste by type specified in the taxonomy (thousand tons per year)**	**by type of waste, %**	**in industry as a whole, %**
Manufacturing industry						
Manufacture of other non-metallic mineral products	Glass cullet	1963.1	Industry/ Glass cullet	1060.21 [16]	54	36
	Sludges and sediments of charge preparation systems.				0	
	Sludge and sludge from dust and gas collection and wastewater treatment systems				0	
	Suspensions for glass grinding and polishing systems				0	
Manufacture of basic metals	Steel slag	70,421.7	Industry / Steel slag	70,421.7 [17]	100	
	Foundry sand			Not available	–	
Other manufacturing industries (excluding the production of other non-metallic mineral products and metallurgical production)	Red mud	127,839.9	Not applicable	0	0	
	Acid sediment mine drainage			0	0	
	Crushed limestone			0	0	
	Jarosite sediment			0	0	
	PCB waste			0	0	
Resource supply industry						
Provision of electricity, gas, and steam; air conditioning	CCP-ASW	15,925.5	Energy / CCP-ASW	15,925.50 [15]	100	100
Water supply; water disposal, organization of the collection and waste management, pollution control activities	Sludge from rainwater treatment plants	–47,530.9	Not applicable	0	0	
	Quartz sand			0	0	
	Hydroanthracite			0	0	
TOTAL		3,576,567.1		90,837.41		2.54

Sources: compiled by the authors based on Rosstat database and research papers [15–17]. URL: https://rosstat.gov.ru/folder/11194 (accessed on 24.10.2021).

waste accounts for about 200 million tons of annually generated. The use of the taxonomy mechanism in full creates the potential for the placement of an additional 45% of industrial waste (excluding overburden) from the annually accumulated waste. This is the maximum limit.

At the same time, within the framework of certain types of waste, thanks to taxonomy, up to 100% of the generated industrial waste can be utilized, as is the case with CCP-ASW and steel slag. In the main industries producing waste, 100% utilization can only be achieved in the power industry. From 30 to 36% of the generated waste can be further used in agriculture and production. The mining industry, which generates half of the country's annual waste, is currently not considered in the taxonomy as industrial waste disposal.

CONCLUSION

Green finance today is a relevant concept, as it is a link between the financial sector and the implementation of projects aimed at protecting the environment. In the context of the greening and decarbonization of the national economy, the development of the green finance system in Russia today is of great importance for the implementation of strategic goals on the federal scale.

In order to increase the volume of industrial waste utilization in Russia, it is necessary to create additional incentives to attract concessional financing. In the current version of the Russian taxonomy of green and adaptation projects, the list of industrial waste is limited to four types. Thus, the potential for utilization through green and adaptation projects remains low. At the same time, in the current version of the taxonomy, only the utilization of CCP-ASW can be recognized as a separate (independent) direction for the implementation of green projects, provided that the criteria are met. In this regard, it is necessary to make additions to the taxonomy in terms of recognizing the utilization of other types of industrial waste as an independent project (similar to the utilization projects of the CCP-ASW).

Within the scope of "Industry", for example, the processing of sands for use in industry and construction can be recognized as an independent project. As part of the "Agriculture" direction, the list of independent projects must be supplemented with the utilization of phosphogypsum for use in industry, construction and agriculture.

The list of criteria for recognizing projects as green or adaptable should also be supplemented with the utilization of other types of industrial waste (in addition to CCP-ASW, steel slag, and glass cullet). In the list of criteria for recognizing a project for the production of mineral fertilizers as green, in particular, it is necessary to include the utilization of waste generated as a result of production (for example, phosphogypsum).

Expansion of the list of industrial waste management projects in the taxonomy will be an additional incentive to intensify activities in this direction, and will also help optimize the waste management system in the country.

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Bigtech-Companies Ecosystems Prospects in the Payment Sector

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ABSTRACT

The **relevance** of the article is determined by solving the problems of expansion of BigTech-companies' activities in the field of payments, which take place at present. The **aim** of the article to identify perspective directions of interaction of ecosystems with credit institutions in the payment sector. The authors used the following **methods:** system-functional, system-structural, statistical analysis and synthesis. The research analyzed current approaches to the definition of ecosystems and digital platforms and proposed the authorial interpretation; identified the main advantages associated with the participation of ecosystems in financial and payment intermediation; reviewed the models of provision of financial and payment services by ecosystems and identified the regulatory framework of their activities in foreign countries; proposed criteria for assigning a company to an ecosystem in Russia and marked out prospects of ecosystem activities in the payment sector. It is concluded that an ecosystem is a new institutional unit that has advantages in comparison with traditional financial institutions: the presence of a global customer base, the possibility of rapid implementation of network effects, the lack of excessive regulatory burden. Objective criteria that allow to assign a company to an ecosystem are: general and specific criteria that take into account the country characteristics of doing business, the level of development of the financial market, information technology, etc. Regulation of activities of ecosystems of the BigTech-companies allows to minimize basic, global and country risks by improving financial regulation and antimonopoly legislation, developing of unified standards and requirements for cross-border activities of ecosystems of BigTech-companies. The main scenarios of interaction between traditional financial institutions and ecosystems in the Russian financial and payment markets are: preservation of the dominance of traditional financial institutions; cooperation between banks and ecosystems; competition between banks and ecosystems; transition to a financial ecosystem dominance scenario.

Keywords: ecosystems; digital platforms; technology companies; BigTech-companies; credit institutions; financial services; payment instruments; payment services

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INTRODUCTION

In recent years, technological changes related to the introduction of breakthrough technologies in the field of big data, cloud technologies, distributed ledgers, artificial intelligence, the Internet of things, etc. are contribute to the overall process of transition to platform business models and formation of ecosystem by large technology companies. Features of the platform business model, which uses both technological and behavioral innovations, lead to qualitative restructuring of business processes, contribute to productivity growth, creation of new value objects/goods/services, the emergence of new payment instruments and payment mechanisms on a platform basis.

Many large technology companies (further — Bigtech-companies) and some transnational banks concentrate large amounts of data to realize network effects. They also have sufficient financial resources to implement both financial and non-financial innovations that allow them to use the key advantages of new business models compared to traditional business models of credit organizations. As a result, the digital platforms of individual producers are often integrated into the ecosystems of largest technology companies, which become centers for managerial, technological and financial decisions.

Currently, the ecosystems of Bigtech-companies provide users with access to a wide range of products and services in information technology, e-commerce, finance, etc. Thus, in the financial sphere, two main areas of ecosystem activity can be identified — payment

sector and other financial services (savings, investment, insurance, etc.). The object of our research is the activity of ecosystems of Bigtech-companies in the payment sector.

The topical issues of the development of ecosystem activities in the sector of payments are:

• development of criteria for assigning a company to an ecosystem;

• analysis of possible models for ecosystem payments;

• determination of the place and role of technology and Bigtech-companies in the payment sphere as a competitor of banks and other payment service providers, etc.

Thus, due to the development of their own payment instruments, the ecosystems of Bigtech-companies can become large players in the market of payment services. On the one hand, this will allow them to increase their autonomy from traditional payment intermediaries — banks and non-bank payment service providers by increasing the margin of their business. On the other hand, through economies of scale, the ecosystems of Bigtech-companies can affect the entire payment landscape, significantly changing the role of various payment intermediaries in the global payment services market in general and in individual countries in particular.

The aim of the research is to identify perspective directions of interaction of ecosystems of technological companies with credit institutions in the payment sector. To achieve this aim, the following tasks were solved:

• analysis of current approaches to defining ecosystems and digital platforms and their author's interpretation;

• identification of key benefits and risks of ecosystem participation in financial and payment intermediation;

• analysis of the main models of the provision of financial and payment services by ecosystems;

• identification of the regulatory framework and its activities in foreign countries;

• proposal of criteria for assigning a company to an ecosystem in Russia;

• identification of ecosystem perspectives in the payment sector.

REVIEW OF THE LITERATURE

Currently, research on ecosystems and digital platforms is mainly presented in the works of international financial institutions, publications of foreign authors, as well as in reports of central banks, including the Bank of Russia. Ecosystems are more popular than digital platforms. There are few works focusing on digital platforms.

In scientific works an "ecosystem" is most commonly defined using a descriptive approach. Thus, in the annual economic report of the Bank for International Settlements[1] the definition of "ecosystem" is reduced to the identification of its key elements and features, which include: advanced data analytics, network externalities and related activities. In a number of researches, ecosystem elements are considered in relation to their interrelationships and interdependencies [1, 2]. At the same time, the authors do not identify objective criteria for assigning companies to an ecosystem, which is a prerequisite for regulating their activities.

The European Banking Association (EBA)[2] report gave a rather detailed analysis of the nature of digital platforms and their functioning features. The study considers various approaches to business modeling of digital platforms and identifies the risks of their functioning. "Digital platform" in this publication is interpreted as a link between financial institutions, firms and customers to create value of their interaction. A similar approach has been adopted by the economists of the Bank for International Settlements [3]. And in a study by the European Insurance and Occupational Pensions Authority

[1] Big tech in finance: opportunities and risks. Bank for International Settlements. 2019. URL: https://www.bis.org/publ/ arpdf/ar2019e3.html (accessed on 01.09.2022).

[2] Report on the use digital platforms in the UE. Banking and payment sector. European Banking Authority. 2021. URL: https://www.eba.europa.eu/sites/default/ documents/files/document_library/Publications/Reports/2021/1019865/EBA% 20Digital%20platforms%20report%20-%20210921.pdf (accessed on 01.09.2022).

(EIOPA),[3] the term "platform" is used as technical infrastructure.

A separate direction of the research is modeling the options of interaction between traditional players of the financial market — banks, non-bank credit institutions, etc. — and new players — the ecosystems of technology companies and digital platforms of non-credit organizations. Thus, the Financial Stability Board (FSB)[4] examines the most likely scenarios of interaction between them: direct competition, partnership, mediation, etc. In turn, the authors of the annual economic report of the Bank for International Settlements[5] justify the idea that in the future, Bigtech-companies and credit institutions will compete in the financial market. Dutch economists L. Spek and S. Phijffer indicate that partnership and mediation are the most likely options for interaction between Bigtech-companies and financial institutions [1].

Assessment of the benefits of the penetration of Bigtech-companies into the financial industry is discussed separately in the reports of the Financial Stability Board.[6] The Board reports analyze the benefits from the end-user and client experience. In contrast, the European Commission research[7] identified the main advantages of penetration for Bigtech-companies. The studies by international organizations do not normally analyze the benefits of Bigtech-companies entering the financial market for the state, business and its players.

A sufficient number of publications are devoted to identifying, assessing and minimizing the risks that arise when ecosystems enter the financial market. Possible risks are detailed in the researches of the Bank for International Settlements [4] and the Financial Stability Board.[8] Thus, the leading economists of the Bank for International Settlements in their work "Regulation of Bigtech-companies in finance" divide the risks into two groups: traditional and innovative risks that have arisen due to the increasing activity of Bigtech-companies in the financial market [5]. At the same time, the publications lack analysis of risks from the point of view of the triad of involved entities "State-business-consumer".

It should be noted that all the works devoted to the topic of minimization of risks associated with the activities of the Bigtech-companies in the financial market focus on adaptation of the existing financial regulation to the new realities. In this case, regulation is considered by the authors in terms of attributing it to a certain risk group (traditional or innovative risks) or to a certain object of regulation (a company or its financial services activities). The first approach is reflected in the report of the Financial Stability Institute (FSI) [6]. The second — in the studies of the Fintech Task Force of the European Parliament and the publications of the economists of the Bank for International Settlements [2, 7]. Thus, the economists of the Financial Stability Institute note that risk monitoring and identification should focus on economic functions and operations and/or services provided by the

[3] Request to EBA, EIOPA and ESMA for technical advice on digital finance and related issues. URL: https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/210202-call-advice-esas-digital-finance_en.pdf (accessed on 01.09.2022).

[4] BigTech in finance: market developments and potential financial stability implications. Financial Stability Board. 2019. URL: https://www.fsb.org/wp-content/uploads/P091219–1.pdf (accessed on 01.09.2022).

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company, but regulation and supervision — directly on the company as an economic unit. The authors of the papers discussed above thought that there is a need for international standards on financial regulation (especially in the payment sector) of Bigtech-companies to prevent the risk of fragmentation of the regulatory framework depending on jurisdiction [2, 7].

In Russia, the concept of ecosystem has become used relatively recently, and the work of domestic authors in this field is based on foreign research. Fundamental research which is devoted to the role of ecosystems and digital platforms in the financial sector, including the payment sphere, as well as to the regulation of their activities in Russia is non-present. At the same time, the publications of the Bank of Russia (in particular, the reports "Ecosystems: approaches to regulation",[9] "Management of risks of participation of banks in ecosystems and investments in immobilized assets" [10]) focus more on the study of operating practices and the proposal of a regulatory regime for Russian and foreign ecosystems in the Russian financial market, and less — on the research of issues related to the regulation of the activities of Bigtech-companies' ecosystems in the payment sector.

INTERPRETATION OF ECOSYSTEMS AND DIGITAL PLATFORMS

At present, in the vast majority of countries, the concepts of "ecosystem" and "digital platform" are not enshrined in law. In this regard, there are differences in the interpretation of these concepts at the level of both international financial institutions and national central banks and separate research economists.

According to the European Insurance and Occupational Pensions Authority,[11] a digital platform is the technical infrastructure needed by several participants to connect and interact with each other, and for the creation and exchange of values. According to the research by the European Banking Association,[12] the digital platform allows at least one financial institution directly (or indirectly, using a regulated or unregulated intermediary) sell to customers and/or sign a contract with clients for financial products and services within a separate jurisdiction or single economic zone. The term "platform" can be used in a broad and narrow sense.

In a narrow sense, the mobile banking application can be described as a platform, as well as the online interface of the payment institution, focused on the client. In a broad sense, the digital platform creates values for interaction between one or more financial institutions (and possibly other firms) and customers.[13] At the same time, in a study of the international consulting company Deloitte[14] similar interpretation is given to the term

[9] Ecosystems: approaches to regulation. Report for public consultation. 2021. URL: https://www.cbr.ru/Content/Document/File/119960/Consultation_Paper_02042021.pdf (accessed on 01.09.2022).

[10] Management of risks of participation of banks in ecosystems and investments in immobilized assets. Report for public consultation. 2021. URL: http://www.cbr.ru/Content/Document/File/123688/Consultation_Paper_23062021.pdf (accessed on 01.09.2022).

[11] Request to EBA, EIOPA and ESMA for technical advice on digital finance and related issues. URL: https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/210202-call-advice-esas-digital-finance_en.pdf (accessed on 01.09.2022).

[12] Report on the use digital platforms in the UE. Banking and payment sector. European Banking Authority. 2021. URL: https://www.eba.europa.eu/sites/default/documents/files/document_library/Publications/Reports/2021/1019865/EBA% 20Digital%20platforms%20report%20-%20210921.pdf (accessed on 01.09.2022); Request to EBA, EIOPA and ESMA for technical advice on digital finance and related issues. URL: https://ec.europa.eu/info/sites/default/ files/business_economy_euro/banking_and_finance/documents/210202-call-advice-esas-digital-finance_en.pdf (accessed on 01.09.2022).

[13] New forms of interaction are emerging between financial institutions (credit institutions, payment institutions, e-money institutions, etc.) and non-financial organizations. Source: Report on the use digital platforms in the UE. Banking and payment sector. European Banking Authority. 2021. URL: https://www.eba.europa.eu/sites/default/documents/files/document_library/Publications/Reports/2021/1019865/EBA% 20Digital%20platforms%20report%20-%20210921.pdf (accessed on 01.09.2022).

[14] Realizing the digital promise. Transformation in an ecosystem of regulators, BigTech, FinTech and more. Deloitte. Institute of International Finance. URL: https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Financial-Services/gx-realizing-the-digital-promise-transformation-in-an-ecosystem.pdf (accessed on 01.09.2022).

"ecosystem". Thus, a broad approach to the platform's interpretation leads to blurring the lines between the individual concepts of "digital platform" and "ecosystem".

In our opinion, it is more reasonable to attempt to disclose the concept of "ecosystem" through a set of key elements and features that companies need to have in order to be included in this category. Key elements/features to be highlighted are:

1) advanced data analytics;
2) network externalities;
3) interrelated activities.

The sum of these key elements forms the so-called DNA ("data-network-activities") loop. In this case, loop elements generate a self-reinforcing cycle according to Metklaf's law, in which the utility of the network for its members has a quadratic dependence on the number of network members [8]. Thus, more data creates stronger network effects that generate more activity, leading to further data growth.

The Bank of Russia reflected its interpretation of the concept of "ecosystem" in the Strategy of development of the National Payment System for 2021–2023.[15] Thus, according to the Bank of Russia, an ecosystem is a set of services, including platform, one group of companies or companies and partners, allowing users to obtain a wide range of products and services, satisfying the vast majority of customer's daily needs, in a single, seamless integrated process. In this case, producers of products and services are able to directly or indirectly use the aggregate data available in the ecosystem on customers and their consumer behavior. Later, the Bank of Russia in the Report of Public Consultation "Ecosystems: approaches to management"[16] tried to reveal the essence of an ecosystem and its elements and clarified that an ecosystem may include closed and open platforms. One of the main disadvantages of the research is the lack of an objective criterion for assigning a company to an ecosystem.

Our research shows that the concept of "ecosystem" is broader than that of a digital platform. An ecosystem may include several digital platforms, but may also evolve on a single platform. However, the existence of an ecosystem without a digital platform is currently difficult to imagine, as there is currently no alternative technical and institutional framework for interconnecting services within an ecosystem and seamless switching between them. At the same time, a digital platform may exist outside an ecosystem. In the process of evolution, a digital platform can (but does not necessarily) be transformed into an ecosystem. Where a digital platform is converted to an ecosystem or an ecosystem is built on a single digital platform, the definitions remain separate and should not be identified. In this regard, a digital platform is likely to describe a company's technical infrastructure, while an ecosystem reflects the functionality and relationships of elements[17] within a company and/or between companies implemented on a technical basis.

In our research, we will use a broad definition of a digital platform, but clearly differentiate between platforms and ecosystems. By digital platform we will understand technical and organizational infrastructure, that allows a financial institution(s) directly or through an intermediary/intermediaries sell to customers and/or contract with customers to provide financial products and services, including offering payment services and instruments. The exception to the broad definition of a digital platform, in our opinion, is:

1) online banking tools and mobile banking applications used by a financial institution to provide financial services in a fully digital way;
2) crowdfunding platforms;
3) platforms used for P2P lending.

[15] Strategy of development of the National Payment System for 2021–2023. URL: https://www.cbr.ru/ Content/Document/File/120210/strategy_nps_2021–2023.pdf (accessed on 10.09.2022).

[16] "Ecosystems: approaches to management". Report of Public Consultation. 2021. URL: https://www.cbr.ru/Content/Document/File/119960/Consultation_Paper_02042021.pdf (accessed on 10.09.2022).

[17] Key elements include: advanced data analytics; network externalities; related activities.

These tools and/or platforms are generally either covered by existing regulation or require special regulatory regime.

An ecosystem will be understood by us as a new institutional unit that includes a network of financial and non-financial services provided on a platform basis by a group of companies that together create an integrated business environment generating new values for its customers. At the same time, from the Russian practice perspective, an ecosystem is understood as an ecosystem of a technology company, from the foreign experience perspective — an ecosystem of a Bigtech-company, due to the absence of large technology companies on the Russian market, comparable in capitalization and scope with the foreign ones.

Also in our research, we will not divide ecosystems into business ecosystems, banking ecosystems and other,[18] since no matter what a company's main activities are, they should all be subject to the company's criteria for assignment to an ecosystem and regulated in this way.

Ecosystems have a number of advantages over traditional financial institutions in providing financial and payment services to both end-users (households) and small and medium-sized businesses and the State. Thus, in terms of end users (households), the main advantages of using ecosystems are:

- low financial services cost achieved through the availability of own financial services and additional margins from the total presented activities within an ecosystem;
- high speed of financial services provided by interoperability of ecosystem services and seamless switching between them, online access to products and services presented on a single digital platform, a minimum set of data and documents required to identify and obtain services;
- providing individual offers of financial products due to high technological capabilities in the fields of artificial intelligence, Internet of things, big data, etc.;
- increasing the availability of financial services in areas with poor financial infrastructure and increasing the involvement of economic agents who do not have the full package of documents needed to appeal to the traditional financial institutions.

For small and medium-sized businesses, the following ecosystem benefits can be highlighted:

- affordable loans both in terms of cost of borrowing and credit/ credit line application procedures and receipt of funds;
- access to the platform of a large technology company that contributes to the growth of business.

It should be noted that the prerequisite for obtaining credit for small and medium-sized companies within an ecosystem is their operation on the platform of a Bigtech-company, which has a lot of data on the borrower and, through credit scoring and machine learning methods, prevents the risks associated with non-return of funds and loss of profit.

Bigtech-lending became particularly popular during the COVID-19 pandemic, as it allowed companies to compensate for the decline in transactions caused by the pandemic by about 20% [11]. On a global scale, the volume of loans issued by Bigtech-companies in 2020, increased by 40% and amounted to more than 700 bln USD [12]. The largest markets for Bigtech-lending in 2020–2021 were China, the USA, the UK, etc. [13].

The main advantage of ecosystems in providing financial services for the State is also the possibility of obtaining credit resources from a Bigtech-company, especially during economic and financial crises. For example, during the COVID-19 pandemic in some jurisdictions, Bigtech-companies participated in government credit schemes [14, 15].

The above benefits of ecosystems for economic agents are based on the specific characteristics of large technology firms as opposed to traditional financial institutions (*Table 1*).

As can be seen from *Table 1*, the main characteristics of ecosystems which differ from

[18] Several authors divide ecosystems into groups and consider each group separately. For example, the work on business ecosystems [9], banking ecosystems — publication [10] etc.

the ones of the traditional credit organizations such as banks are: global customer base; network effects; nanotechnology; less regulation. However, due to less regulation, ecosystems pay less attention to confidentiality and protection of personal data than traditional financial institutions, which have a lot of experience and knowledge in regulation and risk management. In this regard, the entry of ecosystems into the financial market raises risks for both ecosystems and end-users, businesses and the State.

PAYMENT INSTRUMENTS AND ECOSYSTEM SERVICES, LEGAL BASIS FOR THEIR PROVISION OF PAYMENT SERVICES

Currently, the largest ecosystems in the world are considered to be American companies Google, Apple, Meta, Amazon and Chinese companies Alibaba and Tencent.[19] The main sphere of activity of these companies is information technology, retail, social networks, etc. rather than financial services. However, these Bigtech-companies due to the wide use of digital platforms, the use of advanced information technology, the steady expansion of customer audience, more investment, as well as being integrated into related industries in recent years, have become significant in the financial and payment markets. Every year the share of financial services offered by large technology companies is increasing. According to the analysis by the economists of the Bank for International Settlements, more than 10% of the revenue of Bigtech-companies comes from the activities of the financial sector [4].

Table 2 presents the main activities of ecosystems of Bigtech-companies in the financial sphere.

As can be seen from *Table 2*, at present the main activities of large technology companies in the financial market are: opening deposits, lending, making payments, crowdfunding, asset management, insurance. While Chinese technology companies (Alibaba, Tencent) are represented by their services in all major areas of the financial market, American companies focus on payments. This is primarily due to the different models for embedding financial services in the non-financial sector, which will be discussed below.

The payment market is the only segment of the financial sphere in which all the Bigtech-companies considered by us are represented. This segment organically fits into almost any commercial activity and is critical for the creation of a client's "full cycle" within an ecosystem. It was payments that began the penetration of ecosystems into the financial sphere. Currently, in some jurisdictions, the share of payments by Bigtech-companies is significant [16]. For example, in China, Bigtech-companies account for 94.4 and 93.8% of payments in online and mobile payments respectively [17].

The provision of financial services, including the payment ones, by ecosystems is not possible under the traditional credit organization scheme because none of the above-mentioned Big-tech companies possess the traditional financial license in any national market (banking, brokerage, insurance, etc.) [18]. The following models for integrating payment services into the modern platform solutions of Bigtech corporate ecosystems can be identified:

1) partnership with classic financial market participants;

2) creation of a digital bank within its own settlement and payment system;

3) add-on to the existing retail payment system;

4) implementation of autonomous financial and payment services through issuance their own virtual currencies, such as global stablecoins, and development of decentralized financial

[19] These companies are the largest, based on the volume of capitalization and the size of the customer base: Apple — 2600 bln dollars, 1500 mln people, Amazon — 1264 bln dollars, 310 mln people, Google — 1551 bln dollars, 3.3 bln people, Meta — 606 bln dollars, 3.6 bln people, Tencent — 471 mln dollars, 1.27 bln people, Alibaba — 277 mln dollars, 1.28 bln people (the amount of capitalization — as at 04.05.2022, the customer base — as at 01.01.2022). Source: companiesmarketcap.com, company websites, 04.05.2022.

Table 1

Comparative characteristics of banks and BigTech-companies ecosystems activities in the financial and payment spheres

Factors	Characteristics	Banks	Ecosystems
End users' confidence	Size	+	+
	Brand awareness	+	+
	Customer loyalty	+	–
Financial sustainability factors	Investment potential	+	+
	Cheap financing	+	+
	Global customer base	–*	+
	Network effects	–	+
Operational activities and regulation	Nanotechnology	–	+
	Cross subsidization	+	+
	Overregulation	+	–

Source: compiled by the authors.

Note: * for most banks except large transnational banks.

Table 2

Main activities of BigTech-companies ecosystems in the financial sphere

BigTech-company	Main activities	Activities in the financial sphere*					
		Banking**	Lending	Payments	Crowdfunding	Asset management	Insurance
Google	Internet, advertising	–	–	+	–	–	–
Apple	Technology, software	–	–	+	–	–	–
Meta	Social media, advertising	–	–	+	–	–	–
Amazon	E-commerce, online retail	–	+	+	+	–	–
Alibaba	E-commerce, online retail	+	+	+	+	+	+
Tencent	Technology, games and messaging	+	+	+	+	+	+

Source: compiled by the authors.

Note: * financial services may be provided through the ecosystem and/or in partnership with financial institutions outside the ecosystem group in at least one jurisdiction; ** the main type of banking in most countries is the acceptance of deposits.

instruments, such as payment tokens for meta-projects within metauniverses.

Within the first model, based on a partnership with classic financial market participants, Bigtech-company Apple is observed to operate. An example of the company's payment instruments is the Apple Card, produced by Apple in partnership with Goldman Sachs Bank (USA). Implemented within the framework of this model, cooperation between financial institutions and Bigtech-companies benefits both sides. Bigtech-companies provide modern technology, big data processing capabilities, extensive customer base and marketing solutions. They also have single-sign on options and a set of preferences from integrated services. In addition, large technology companies are more flexible and subject to less regulation. In turn, financial institutions provide Bigtech-companies with the necessary infrastructure and traditional banking services.

Within the second model, Bigtech-companies create their own digital bank. Alibaba Group and Tencent and their digital banks MyBank[20] and WeBank, respectively, are examples of such a model of Big-tech companies. The features of digital banks are: integration into social networks; seamless multichannel; possibility of digital payments, etc. The use of this model by Chinese companies can be the basis for penetration of ecosystems into all segments of the financial sphere.

In the third model, Bigtech-companies create a kind of add-on to the existing retail payment system. Such Bigtech-companies as Google and Apple operate within the framework of this module. Examples of payment instruments of these Bigtech-companies are payment services Google Pay and Apple Pay respectively. For example, Google Pay and Apple Pay allow consumers to link a bank card to mobile or wearable devices (smartphone, tablet, watch, bracelet, etc.) working on Android and iOS operating systems respectively, and pay for goods and services online and offline.[21]

Within the fourth model, large technology companies produce their own virtual currencies and other decentralized financial instruments. At present, there is a tendency of the client's attachment to a company not only through "subscriptions" services, loyalty programs with the accrual of points, etc. but also using its own accounting units (the company's private virtual currency), which can be used both within and outside the ecosystem. The virtual currency of a company can be payment tokens used as an internal settlement tool in the ecosystem only of the company-issuer or the so-called stablecoins,[22] which can have universal circulation [19–21]. In both cases, such virtual currencies are produced using new emission and accounting technologies, such as distributed ledger technology or blockchains, which are most commonly used by large technology companies rather than traditional lending institutions. For example, a large-scale project to issue the global stablecoin (Diem currency) in 2020–2022 was prepared by Meta. If this company had issued its own currency, it would have been the first global private currency for retail payments by the Bigtech-company's ecosystem. Investment banks and other financial sector organizations such as JPMorgan Bank, Signature Bank, UBS, Deutsche Bank, Santander and others are also interested in the issuance of global stablecoins, and are trying to integrate new payment instruments into their ecosystems [21].

In most jurisdictions providing payment services on the basis of the payment services and tools used by Bigtech-companies requires a special permission (license, entry into the registry, etc.). Thus, in the USA and the EU countries, not being a credit organization, it is necessary to obtain the status of a payment

[20] Formally, MyBank is owned by Ant Financial (a subsidiary of Alibaba Group).

[21] For this type of payments used NFC technology (Near Field Communication) — a technology of wireless data transmission of a small range, which allows the exchange of data between devices located at a distance of about 10 cm.

[22] Steablecoins are a kind of virtual currencies that: 1) are released by clearly identified issuers on the blockchain in the form of negotiable digital monetary obligations or certificates of deposit; 2) support the exchange rate stability by tying to base low volatility or through algorithmic technologies; 3) can be used as a means of exchange and/or a means of payment, as well as a means of saving from persons other than the issuer. See details in: [20–22].

institution in order to engage in payment activities. Therefore, ecosystems in these jurisdictions create subsidiaries that obtain licenses for payment activities. In the USA, ecosystems operate under a license from a money transmitter service provider (money transmitter license),[23] that is required in each State, and licensing requirements may vary among States. In the EU countries, ecosystems operate on the basis of a payment service provider's license (payment license). It may be a payment institution licence[24] or an e-money institution licence,[25] except for Apple.

In China, the situation is different from that of the EU and the USA. Currently, foreign Bigtech-companies are not directly represented by their services in the Chinese financial market due to the regulatory restrictions. Chinese Bigtech-companies are required to have three licenses to operate in the national financial market: banking licence; payments licence and credit licence.

In Russia, to carry out payment activities, Bigtech-companies are required permission from the Bank of Russia and entry into the register of payment application suppliers and/or the register of foreign payment service providers. In February 2022, Bank of Russia registries included such Bigtech-companies as Apple, Google, Alibaba, Tencent, but only Google (Google Pay) and Apple (Apple Pay) provided payment services in the Russian market. These payment services included applications for business, trade/service enterprises and consumers and operated on the principle of add-ons to the existing retail payment system. Such an add-on allowed consumers to link a bank card to mobile and wearable devices and pay for goods and services either online or offline.

Introduction of payment services of ecosystems of Bigtech-companies[26] in Russia has allowed to provide end consumers with a wider range of payment methods, which in most cases proved to be more convenient, fast and safe in comparison with payments by bank cards.[27] In turn, for trade and service enterprises there was a need (due to maintaining competitive advantages) to provide the opportunity for customers to use the full range of payment methods (using both payment instruments and payment services). Connection of foreign payment services required a large-scale modernization of sales points in terms of connection and configuration of terminals of contactless payment, integration of payment services into applications and websites. It should be noted that before the appearance of foreign payment services contactless payments in Russia were available only through the use of a small number of cards with an NFC-chip,[28] and the infrastructure for the implementation of contactless payments in Russia was poorly developed. At the same time, the introduction of

[23] License of money transfer service provider allows to provide services on issue of payment instruments, money transfers, cashing of cheques, currency exchange, etc. The license is issued by a local state and a special bureau in the US Treasury — Financial Crimes Network (Money services business definition). URL: https://www.fincen.gov/index.php/money-services-business-definition (accessed on 01.08.2022). For example, in Texas, a license is issued by the Department of Banking. The minimum amount of company's share capital — 100 thous. USD. License fee is 2.5 thous. USD, guarantee fee — not less than 300 thous. USD (Requirements for Money services businesses). URL: https://www.dob.texas.gov/money-services-businesses (accessed on 10.08.2022).

[24] License of payment institution allows to provide acquiring and processing services. Source: Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015L2366 (accessed on 01.09.2022).

[25] License of the Institute of electronic money allows to provide services on issue of payment instruments, initiation of payments, acquiring and processing services, to carry out direct debits and credit transfers. Source: Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015L2366 (accessed on 01.09.2022).

[26] Apple Pay launched in Russia 4 October 2016, Google Pay — 23 May 2017.

[27] Convenience is ensured by the fact that bank cards are stored in the mobile phone application, and for payment it is necessary only to unlock the phone or enter a security code and bring it to the payment terminal. Payment is instantaneous, no PIN is required. When making a payment, payment data are transmitted via a secure protocol using a unique transaction code, which guarantees the safety of bank account data and card. Also, when paying online there is no need to enter bank account data and card.

[28] Total issued contactless cards (with NFC chip) in 2015 amounted to about 7 million units (2.9% of the total amount of bank cards in circulation in Russia), according to the Bank of Russia.

foreign payment services caused the intention among the leading Russian banks to instantly ensure that trading acquiring networks support contactless transactions, which was caused by high expectations associated with attracting high-yield users. The introduction of Apple Pay and Google Pay can be considered one of the main impulses for the distribution of POS-terminals for contactless payments and the growth rate of contactless settlements in the late 2010s in Russia.

At the same time, the emergence of payment services of foreign ecosystems on the Russian market stimulated the development of national payment services based on similar information technologies. In order to prevent the risks of the Russian payment market being dominated by foreign payment service providers, QR-code payments were introduced, implemented on the platform of the Fast Payment System of the Bank of Russia, national payment services, implemented on the basis of JSC "NSPK" (SBPay, MirPay), payment services of ecosystems of Russian companies[29] (SberPay, VK Pay etc.).[30] Thus, two main trends were observed on the Russian payment market in 2020–2022: 1) competition between the payment services of the foreign ecosystems and those of the Russian technology companies ecosystems; 2) competition between the payment services of ecosystems and the payment instruments of traditional financial institutions.

Since March 2022, the activity of foreign Bigtech-companies in the country was suspended due to the sanctions restrictions imposed by the governments of the developed countries and individual companies against Russia. Therefore, payment functionalities provided earlier by foreign Bigtech-companies have been naturally substituted by the payment instruments of the Russian financial institutions and national payment services implemented on the basis of JSC "NSPK".

The payment services of the Russian ecosystems and technology companies were also actively created and promoted. For example, there are such payment services as Tinkoff Pay,[31] GazpromPay[32] etc. However, the competitive environment in the Russian payment market has not yet developed. Transactions made with the use of the payment services of the Russian ecosystems and technology companies occupy 10% of the total volume of non-cash transactions, the share in 90% accounts for transactions, committed using of state payment services and traditional payment instruments.[33]

Currently, payments using the NFC-technology in the "SBPay"[34] application are being tested on the basis of JSC "NSPK". In the case of a large-scale implementation of the service among banks, this payment method can be a substitute for the global payment services Apple Pay and Google Pay, as from the point of view of the end user the algorithm of using the service is similar: it is necessary to bring the smartphone to the POS-terminal and confirm the payment.[35]

However, competition in the financial and payment systems can be expected to increase in the coming years, on the one hand, between the payment instruments of traditional financial institutions and the payment services of ecosystems, and on the other hand, between

[29] According to the Bank of Russia Russian ecosystems are: Sber, VK (Mail Group), Tinkoff, MTS, VTB, Yandex. Source: Ecosystems: approaches to regulation. Report for public consultation. 2021. URL: https://www.cbr.ru/Content/Document/File/119960/Consultation_Paper_02042021.pdf (accessed on 10.09.2022).

[30] Strategy of development of the National Payment System for 2021–2023. URL: https://www.cbr.ru/Content/Document/File/120210/strategy_nps_2021–2023.pdf (accessed on 10.09.2022).

[31] Payment service Tinkoff Pay. URL: https://www.tinkoff.ru/tinkoff-pay/ (accessed on 01.08.2022).

[32] Payment service Gazprom Pay. URL: https://www.gazprombank.ru/ personal/payment-service/gazprom-pay/ (accessed on 01.08.2022).

[33] How Russians pay after Apple Pay and Google Pay. Report by YKassa. URL: https://plusworld.ru/daily/platezhnyj-biznes/kak-platyat-rossiyane-posle-uhoda-apple-pay-i-google-pay/ (accessed on 01.08.2022).

[34] SBPay — mobile application for payment of goods and services in retail stores and the Internet within the framework of the Fast Payment System of the Bank of Russia.

[35] Strategy of development of the National Payment System for 2021–2023. URL: https://www.cbr.ru/Content/Document/File/120210/strategy_nps_2021–2023.pdf (accessed on 10.09.2022).

them and the new payment instruments (stablecoins and digital currencies), which can be produced both within and outside the ecosystems of the Bigtech-companies.[36] At the same time, there is not necessarily competition between ecosystems and traditional financial institutions for the provision of traditional payment instruments (payment services) as other ways of interaction between these companies and institutions might bring about far more benefits to companies and financial institutions as well as to end-users.

CRITERIA FOR ASSIGNING COMPANIES TO AN ECOSYSTEM IN RUSSIA

As mentioned at the beginning of this research, technology companies are considered as ecosystems in Russia due to the absence of Bigtech-companies. While not every technology company is an ecosystem, some companies have only some elements of ecosystems. For example, a company may be an ecosystem in one country but will not be considered an ecosystem in another country. This may be due to the features of the development of financial and payment markets, different degrees of introduction of new financial technologies, etc. and be conditioned by specific national regulatory framework.

In our opinion, two groups of criteria can be identified: general (qualitative) and specific (quantitative). The general criteria are relevant for analyzing a company of any country, the specific criteria — only of a particular country, taking into account the characteristics of doing business, the level of development of the financial market, IT-sphere, etc. *Table 3* presents the general and specific criteria that we propose to use to assign a company to an ecosystem in Russia.

As can be seen from *Table 3*, the first general criterion a company must have to be assigned to an ecosystem,— is functioning in the B 2C segment, i.e. a company must primarily provide goods and services to end users (customers) — individuals.

The second general criterion is the goal of a company. In the case of an ecosystem, one of the main objectives of the company's activities should be to maximize the overall network effect derived from the operation of each service within the ecosystem, which generates profits for the company. In other words, a company should aim to maximize the number of end users and suppliers of goods and services, and should be prepared for long-term investments and, short-term financial losses to provide unique technological solutions for segmented customers.

The next criterion is the level of technological development of a company. Although this criterion is included in the general criteria, it may have some country differences due to the overall level of technological development in the country and the level of investment in advanced technologies.

The fourth general criterion is the provision of payment services as a key element of systemic integration. In our opinion, a Bigtech-company cannot be recognized as an ecosystem, but only as having some elements of an ecosystem if the company does not provide payment services on its own. Otherwise, a company cannot provide closed-loop services without involving payment intermediaries located outside the ecosystem perimeter, i.e. the company cannot function as an ecosystem within a closed business cycle.

The fifth criterion for assigning a company to an ecosystem is its presence in several market segments. As noted above, technological effectiveness and the availability of payment services are criteria required for assigning a company to the ecosystem. Hence, a company should be represented at least in the financial sphere, as well as in the field of information technology. However, the main ecosystem activities may not be related to any of the above. So, we distinguish three options of a company's presence in several market segments (*Table 4*).

As shown in *Table 4*, a company's presence in three or more different areas of activity is required to be assigned to an ecosystem.

[36] We expect the return of selected foreign ecosystems to the Russian payment market after the termination of military action in Ukraine and the partial lifting of economic sanctions by developed countries.

Table 3

Criteria for assigning a company to an ecosystem

General (qualitative) criteria	Specific (quantitative) criteria
Functioning in the B2C segment	Capitalization volume
The goal of the activity – is to maximize the overall network effect, which generates profit of the company	Customer base size
Technology of business (use of artificial intelligence technologies, Internet of things, Big Data, blockchain, open API* etc.)	Number of services provided within the ecosystem in the financial and non-financial spheres
Provision of payment services as a key element of system integration	Number of companies connected to the platform
Presence in several market segments	Share of profit from main field of activity
Seamless switching between services within the ecosystem / digital platform availability	

Source: compiled by the authors.

Note: * Application programming interface (application software interface) – a set of tools and functions in the form of an interface for creating new applications, through which one program will interact with another.

Table 4

Options for a company's presence in multiple market segments

	1 option	2 option	3 option
Main field of a company's activity	Finance	Information technology	Retail, social media, etc.
Required fields of a company's activity	Information technology	Finance	Information technology and finance
Additional fields of a company's activity	Retail, social media, etc.	Retail, social media, etc.	

Source: compiled by the authors.

The last common criterion is the seamless switching between services within an ecosystem / the availability of a digital platform. These criteria can be called substitutional, as seamless switching between services within an ecosystem is ensured by the company's possession of a single digital platform. A single interface allows end-users to obtain the required services without leaving the digital platform perimeter and without having additional labor costs, in particular for making payments and other financial transactions.

The authors consider the following to be specific (quantitative) criteria: capitalization of a company, customer base size, number of services provided within an ecosystem, financial and non-financial spheres, number of companies connected to an ecosystem platform, share of profit from the main field of activity. Quantitative values for each of the criteria are reflected in *Table 5*.

In order for a technology company to be recognized as an ecosystem in Russia, it is necessary to comply with all the quantitative values reflected in *Table 5*. If you analyze the companies in Russia positioning themselves as ecosystems [Sber,[37] VK (Mail Group),[38] Tinkoff,[39]

[37] Annual Report of PJSC "Sberbank" for 2020. URL: https://www.sberbank.com/common/img/uploaded/_new_ site/com/gosa2021/yr-sber-ar20-eng.pdf (accessed on 01.08.2022).

[38] Annual Report of Mail Group for 2020. URL: https://corp.imgsmail.ru/ media/files/mail.rugrouparfy2020.pdf (accessed on 01.08.2022).

[39] Annual Report of JSC "Tinkoff" for 2020. URL: https://www.annualreports.com/HostedData/Annual Reports/PDF/LSE_TCSLI_2020.pdf (accessed on 01.08.2022).

Table 5

Specific (quantitative) criteria for assigning a company to an ecosystem in Russia

Quantitative criteria	Value*
Capitalization of a company	Not less than 5 bln USD
Customer base size	Not less than 10 mln people
Number of services provided within an ecosystem, financial and non-financial spheres	Not less than 10
Number of companies connected to an ecosystem platform	Not less than 5
Share of profit from the main field of activity	Not more than 98%

Source: compiled by the authors.

Note: * the values of quantitative criteria are determined on the basis of foreign experience of functioning of Bigtech-companies ecosystems, taking into account Russian practice.

MTS,[40] VTB,[41] Yandex[42]], according to the criteria set by us, all the companies comply with the ecosystem criteria.

MAIN SCENARIOS AND RISKS OF INTERACTION OF ECOSYSTEMS AND CREDIT INSTITUTIONS IN THE PROVISION OF FINANCIAL AND PAYMENT SERVICES IN RUSSIA

Based on the above research we have identified four main scenarios of interaction of traditional financial institutions (banks) and ecosystems of Russian technology companies and foreign Bigtech-companies on the Russian market (*Table 6*).

As can be seen from *Table 6*, we propose to identify four scenarios of interaction between financial institutions and ecosystems of technology companies and Bigtech-companies. In the first scenario, traditional financial institutions play a key role in customer relations and the provision of payment instruments, financial products and services. At the same time, technology companies within Russian and foreign ecosystems cooperate with banks in terms of innovative solutions, technological services and infrastructure to provide payment and other services (development of cloud computing, advanced Big Data analytics, etc.). The advantage of this scenario is the sustainability of business models of traditional financial institutions, their effective interaction with consumers and the provision of financial and payment services. The main disadvantage is the lack of competition for innovation among financial institutions.

In the second scenario, technology companies within Russian and foreign ecosystems interact with customers, offer payment instruments, financial products and services on their own behalf, while banks provide infrastructure for payments. The advantage of this scenario is that ecosystems offer innovative solutions for the provision of financial and payment products and services. The main disadvantage can be seen as the increasing risks due to the entry of ecosystems into the financial market and the implementation of uncharacteristic activities.

In the third scenario, both the ecosystems of technology companies and traditional financial institutions offer payment instruments, financial products and services. The advantage of this scenario is that there is competition for the consumer between banks and ecosystems

[40] Annual Report of "MTS" for 2020. URL: https://s22.q4cdn.com/ 722839827/files/doc_downloads/2020/MTS-2020–20-F.pdf (accessed on 01.08.2022).

[41] Annual Report of VTB Bank (PJSC) for 2020. URL: https://www.annualreports.com/HostedData/AnnualReports/ PDF/vtb-bank_2020.pdf (accessed on 01.08.2022).

[42] Annual Report of "Yandex" for 2020. URL: https://ir-docs.s3.yandex.net/main/Yandex%2020-F%202020.pdf (accessed on 01.08.2022).

Table 6

Scenarios of interaction among banks and ecosystems of BigTech-companies and technology companies in Russia

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Market participants				
Traditional financial institutions (banks)	They provide PIs, financial products and services	They provide infrastructure for payments and financial services	They provide PIs, financial products and services on an equal basis with ecosystems	–
Ecosystems of technology companies and Bigtech-companies	They provide innovative solutions for payment and financial services; PM — opportunity to receive direct income	They provide PIs, financial products and services; PM — the possibility of broadening the activities	They provide PIs, financial products and services on an equal basis with banks; PM — the possibility of broadening the activities	They provide PIs, financial products and services
Consumers*	They are clients of banks and they trust them	They are clients of ecosystems but they trust banks	They are clients of banks or ecosystems depending on the degree of trust	They are clients of ecosystems and they trust them
Government	It performs regulatory and control functions, provides PS and is ready to replace the entire market **	It performs regulatory and control functions, provides PS		
Market factors				
Competition	Among banks, among ecosystems		Between banks and ecosystems	Between ecosystems
Possible risks (basic, global, country)	Lack of competition for innovation among banks	High barriers to ecosystem change, reduced financial stability of banks, replacement of Russian PS by foreign suppliers***, risks associated with consumer protection, reduced quality of services and financial security, financial crimes, etc.		
		–	Financial market fragmentation	Emergence of cash surrogates
Minimization of risks	–	Ecosystem management, licensing of their activities or other legal basis		

Source: compiled by the authors.

Note: * "to be a client" means to conclude a contractual relationship with this institution for the provision of services and their payment, "trust" means the client's consent to the provision of services and their payment, and confidence in the safety of funds, confidentiality of data and security of operations; ** Replacement of payment services of foreign ecosystems with state payment services is currently observed; *** here authors make particular assumptions about return of foreign ecosystems of Bigtech-companies in the medium or long term. PI — payment instruments, PM — payment market, PS — payment services.

that have their own online banks, insurance companies and asset management companies. At the same time, technology companies and Bigtech-companies are trying to retain customers by setting high barriers to switching [for example, providing incompatible with other payment systems and non-convertible payment instruments (own digital currencies)], which is the disadvantage of this scenario. Also, traditional financial institutions are losing financial stability due to the transition of part of the payment business to financial services of ecosystems, accompanied by the fragmentation of the financial market.

In the fourth scenario, payment instruments, financial products and services are provided by ecosystems. As a result, traditional financial institutions are losing their role in the payment market. This scenario is unlikely in the short to medium term because banks have many years of experience and skills to interact effectively with consumers in providing financial and payment services to them. However, this scenario can be implemented over a long period of time. This scenario is made possible by the fact that many technology companies and Bigtech-companies — social networks, mobile operators, retail companies — become much "closer" to their customers every year, unlike banks due to the growing number of daily transactions. The advantage of this scenario is that when customers interact with ecosystems, they generally do not have the interoperability and seamlessness problems that exist with banks. The disadvantages of this scenario are: the increasing risks in terms of consumer protection, reduced quality of services and financial security, growth of financial crimes; emergence of cash surrogates; reduced financial sustainability of traditional financial institutions, etc.

In scenarios where an ecosystem is a participant in the financial and payment markets,[43] implementation of the basic, global and country risks is possible.[44] Basic risks (risks associated with consumer protection, reduced quality of services and financial security, financial crimes, etc.) can be minimized at the level of individual countries, taking into account international experience in regulating the financial activities of large technology companies. For example, in Europe, Directive 2015/2366 (PSD 2)[45] imposes strict requirements on payment service providers for the initiation and processing of electronic payments and consumer protection. In the U.S., in addition to the license of a money transfer service provider, Bigtech-companies must obtain a FinCEN (Financial Crimes Network) license to provide financial and payment services, aimed at combating money laundering. Compliance with the conditions is monitored by the Internal Revenue Service (US Treasury Bureau).[46]

Global risks (risks associated with disruption of financial stability, decrease in the effectiveness of monetary policy, disruption of the stability of the international monetary system, etc.) characterize the cross-border operations of Bigtech-companies, in particular the issuance and operation of global stablecoins with digital assets. Minimizing such risks requires joint efforts by countries under the auspices of international financial organizations (International Monetary Fund, World Bank, Organization for Economic Cooperation and Development, Bank for International Settlements, Financial Stability Board, G20 countries, etc.) to develop common standards and requirements for cross-border activities of technology companies in the financial and payment spheres.

Country risks depend on the state policy, the level of economic and financial development, other specific characteristics of individual subjects and should be regulated at the State level. For example, until recently there were

[43] Scenarios 2, 3, 4 according to Table 6.

[44] Risk division conditional, based on the author's classification.

[45] Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015L2366 (accessed on 01.09.2022).

[46] Money services business (MSB) registration. URL: https://www.fincen.gov/ money-services-business-msb-registration (accessed on 01.09.2022).

no domestic ecosystems in Russia that could compete with foreign Bigtech-companies' ecosystems. So, the capitalization of the Sberbank ecosystem in 2021[47] amounted to 100 bln dollars, with the 110 mln people customer base,[48] while the capitalization of the Apple ecosystem was at 2 600 bln dollars, with the 1 500 mln customer base .[49] On this basis, there were risks associated with the replacement of the Russian services by foreign suppliers and the dominance of foreign Bigtech-companies. Currently, this risk is offset by the temporary withdrawal of western Bigtech-companies' ecosystems from the Russian market. Nevertheless, in the medium and long term, western companies may return, so this risk should not be neglected.

There are also no such participants on the Russian payment market as the European payment institutions,[50] which prevents the development of competition between companies that are non-financial, but capable of providing financial or payment services. Accordingly, for consumers there are high barriers to switching among technology companies. In addition, in Russia there is no regulation in the provision of financial and payment services by the entities that do not have a bank license, which also creates risks of reducing competition in the supply of financial and payment services on the Russian market.

Minimizing the basic risks of ecosystems penetration into the Russian financial and payment market requires a comprehensive multi-level approach to regulating the activities of the ecosystems of technology companies both at the national and at the international level, based on improved financial regulation, antitrust legislation and data privacy regulation. In this case, specific commitments and constraints to the ecosystems of technology companies can be embedded both at the institutional level of a company and at the operational level of its activities. Obligations and limitations at the institutional level should include requirements for a company with a certain license or charter (for example, under current licenses, Bigtech-companies must comply with the consumer protection regulations and AML/CFT procedures (anti-money laundering and combating the financing of terrorism). At the same time, obligations and restrictions at the operational level of a company must contain requirements that must be met by all companies offering specific services (payment, investment, financial, consulting services, etc.).

In the case of ecosystems that issue payment instruments denominated in their own units of account (stablecoins or payment tokens), minimizing financial risks is a complex issue because of the cross-border nature of payment instruments. While some countries, such as the USA and the EU, are aiming to develop specific legislation to regulate the activities of and operations with stablecoins issuers, by contrast, China and Russia, seek to ban such activities and the use of stablecoins in payments [22]. In this regard, there is a need to develop international traffic regulation of the so-called global/significant stablecoins of Bigtech-companies in order to eliminate regulatory cross-country arbitration and prevent the risks of undermining financial stability, uninterrupted operation of payment systems, loss of monetary sovereignty, etc.

To minimize country risks in Russia, legislation is needed to ensure that non-financial companies operate as financial and payment service providers and promote competition among them. When providing non-financial companies with extensive financial and payment instruments, it is appropriate to legislate the obligation for such companies to obtain a license

[47] The volume of capitalization as at 04.05.2022, customer base — as at 01.01.2022.

[48] Market capitalization of PJSC "Sberbank". URL: https://companiesmarketcap.com/sberbank/marketcap/ (accessed on 04.05.2022); Reference information of PJSC "Sberbank". URL: https://mainfin.ru/bank/sberbank (accessed on 04.05.2022).

[49] Apple's market capitalization. URL: https://companiesmarketcap.com/apple/marketcap/ (accessed on 04.05.2022); Apple statistics. URL: https://www.businessofapps.com/data/apple-statistics/ (accessed on 01.07.2022).

[50] Payment institutions include non-bank payment service providers (payment institutions), account information services provider (AISP) and payment initiation service provider (PISP).

to carry out financial transactions (banking license, insurance license, etc.) or obtain the status as a non-bank payment service provider (NPSP), similar to payment institutions in the EU countries. Introduction of the NPSP institution in Russia is provided by the Strategy of Development of the National Payment System for 2021–2023.[51] Two types of suppliers are planned: NPSPs of the first type will only engage in the initiation of transfers requested by clients, and their net assets should be at least 5 million rubles; NPSPs of the second type, in addition to initiating transfers requested by clients, also provide for payments along with opening e-wallets. At the same time, they must have net assets of at least 50 million rubles.[52]

CONCLUSION

Currently there is no unified interpretation of the concepts of "digital platform" and "ecosystem". A number of researches equate these concepts because they are studied separately, outside the analysis of the causal relationships that lead to their emergence and subsequent development. Our research shows that the term "ecosystem" is broader than the term "digital platform". An ecosystem cannot exist without a digital platform, while a digital platform may exist outside an ecosystem. An ecosystem can be defined as a new institutional unit that includes a network of financial and non-financial services provided on a platform basis by a company or group of companies that together create an integrated business environment generating new values for its customers.

Ecosystems as new institutional units have a number of advantages over traditional financial institutions in the provision of financial services for both end-users and small and medium-sized businesses, and for the State due to the global customer base, implementation of network effects, less regulation, etc. At the same time, the entry of ecosystems into the financial market raises financial risks both for the ecosystems themselves and for other market participants, as a result of less rigid monitoring and supervision by financial regulators.

The provision of financial and payment services in the ecosystems of Bigtech-companies can be based on the following models:

a) partnerships with classic financial market participants;

b) creation of a digital bank within its own settlement and payment system;

c) add-ons to the existing retail payment system;

d) implementation of autonomous financial and payment services through issuance of their own virtual currencies and development of decentralized financial instruments within the metauniverses.

Regulation of the activities of Bigtech-companies at the global and state level allows to minimize the main types of financial risks at the global and local level through:

a) improvement of financial regulation, antimonopoly legislation and data privacy regulation;

b) development of common standards and requirements for transboundary activities of Bigtech-companies in general and global/significant stablecoin turnover in particular;

c) making necessary amendments to State legislation, including consumer protection.

Identification of objective criteria that make it possible to assign a technology company to an ecosystem institution is a prerequisite for ecosystem management. Such criteria may be general (qualitative) and specific (quantitative) criteria. The general criteria are relevant for assessing the assignment of a company to an ecosystem in any country, while the specific criteria — of a particular country only, as they take into account the characteristics of doing business, the level of development of the financial market, information technology, etc.

Successful development of ecosystems in Russia requires flexible regulation of their

[51] Strategy of development of the National Payment System for 2021–2023. URL: https://www.cbr.ru/Content/Document/File/120210/strategy_nps_2021–2023.pdf (accessed on 01.09.2022).

[52] Regulation of the institution of non-bank payment service providers: proposals of the Bank of Russia. URL: https://www.cbr.ru/press/event/?id =12619 (accessed on 01.08.2022).

activities, allowing to increase competition in the financial and payment services market by legislating the obligation to license financial transactions by ecosystems (banking license, insurance license, etc.) or to become a non-bank payment service provider (NPSP), similar to the payment institutions in the EU countries.

The conducted research concluded that the main scenarios of interaction of traditional financial institutions and ecosystems of technology companies and Bigtech-companies in the Russian financial and payment markets are:

a) maintaining domination of traditional financial institutions;

b) cooperation of traditional financial institutions and ecosystems;

c) competition between traditional financial institutions and ecosystems;

d) transition to dominance of ecosystems in the financial market.

Among certain scenarios of interaction of traditional financial institutions and ecosystems in the short term, the first scenario seems most likely to be implemented in Russia, since it provides for the minimum necessary institutional and regulatory changes. At the same time, in the medium and long term, the second and third scenarios are more promising as they improve the quality and availability of payment and other financial services. In general, the scenarios of interaction of traditional financial institutions and ecosystems in Russia and foreign countries match, but the prospects and implementation time of each scenario vary among countries.

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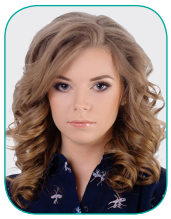

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Challenges and Threats of the Digital Economy to the Sustainability of the National Banking System

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ABSTRACT

The **goal** of the study — development of specific methodical reasoned proposals on improvement of the mechanism for ensuring sustainable development of the national banking system and its security against external challenges and threats to cyberspace. The **scientific novelty** consists in a comprehensive analysis of the processes of ensuring the cyber stability of the Russian banking system in the context of escalation of external challenges and threats to the digital economy. The authors used the following **methods**: general scientific (observation, comparison, measurement, analysis and synthesis, logical reasoning method), specific scientific (static analysis, peer review, graphical method). In the article conducted a critical review of domestic and foreign scientific literature and practical recommendations to ensure the protection of the banking institution from cyber threats in the digital economy; presented a comparative analysis of the organization of the cybersecurity system in the Russian and foreign banking systems; done multidimensional statistical analysis of cyber threats for Russian banks; substantiated recommendations and proposals on organizational, economic and legal improvement of the system of protection of Russian banks from internal and external cyber threats. As a **result**, it is shown that the main problem points (zones) of the banking system, creating the prerequisites for the occurrence of cyber-risks are: 1) there is no exchange of information on cyber-attacks and their mechanisms; 2) banks interact inefficiently with the state regulator of Internet — Roskomnadzor; 3) low level of competence of bank employees who are responsible for cybersecurity; 4) limited budget of small and medium-sized banks that wouldn't allow them to care independent cyber-protection units; 5) growing popularity of new fintech services and new fintech companies. The author draws a **conclusion** that the following measures are necessary for organizational, economic and legal improvement of the system of protection of Russian banks from internal and external cyber threats: the processes of development of banking ecosystems should be intensified; a federal interbank register of cyber fraudsters must be created; a single banking "polygon" for testing cyber threats needs to be developed.

Keywords: banks; cyber resilience; digital economy; challenges and threats; vulnerabilities; hacker attacks; fintech; personal data; fraud

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INTRODUCTION

The banking system is one of the most receptive areas of the national economy of any country to innovation and the changing architecture of the socio-economic system. This is explained by the dualism of economic interests of the banking institution in the context of digitalization. On the one hand, the formation of the digital economy — is a powerful driver to the qualitative evolution of the product portfolio with the possibility of offering personalized products and services to retail and corporate customers. On the other hand, banks strive to reduce the cost of providing banking services and products to their customers. However, it should be understood that on these "scales of interests" it is still necessary to place the interests of the national state regulator — the Central Bank — and its strategic goals to ensure the safe and sustainable functioning of the banking system of the country as a whole.

The transition of humanity into a new phase of development, called Industry 4.0, carries a number of systemic contradictions and risks for the stable functioning of the banking system. One of the fundamental ones is the large-scale transfer of business processes from physical analogues to digital, the appearance of virtual constructs, which weakens the ability of banks to ensure sufficient control of all these links, which makes them more vulnerable to external challenges and threats to the digital environment.

This scientific article is the result of a structured review of domestic and foreign practice of organization of the system of cyber protection against challenges and threats of sustainable development of the banking system, multidimensional statistical analysis of cyber threats for Russian banks, and also substantiation of specific methodical reasoned proposals on improvement of the mechanism for ensuring the sustainable development of the Russian banking system.

MATERIALS AND METHODS

Theoretical and methodological basis of the study includes scientific works of domestic (A.S. Yablochkin, A.P. Koshkin [1]; I.N. Timonicheva, V.V. Yanovskiy, A.S. Berezhnoy [2]; P.V. Revenkov, A.A. Berdyugin [3]; L.A. Chaldaeva; A.A. Kilyachkov, A.A. Yakorev [4]; N.I. Bykanova, D.V. Gordya, D.V. Evdokimov [5]) and foreign (N.A.-D. Khalifa [6]; Aguayo F. Zabala, B. Ślusarczyk [7]; A.W. Dorn, S. Webb [8]) academic community, also case studies and recommendations of leading consulting agencies (PT Security; PWC; Deloitte; Kaspersky Security Laboratory) and experts (N.N. Fedotov, J.S. Ashmanov; P. Singer, A. Friedman; V. Snyder; B. Tuscan; M. Hupponen) in cybersecurity.

When writing the article general scientific methods of scientific research (observation, comparison, measurement, analysis and synthesis, method of logical reasoning) and specific scientific (static analysis, expert assessment, graphical method) were used. The validity and reliability of the results of scientific research is ensured by the correctness and severity of the construction of the logic and design of the research, as well as the use of verified statistical information from authoritative sources (analytical reports of the Center for monitoring and responding to computer attacks in the financial sphere, thematic reports "Cyber security. Trends and forecasts" PT Security, materials of consulting agencies PWC, Deloitte, Kaspersky Security Laboratory).

REVIEW OF THE LITERATURE AND RESEARCH

Security functioning of any business — is a strategic task of management, the solution of which guarantees its survival in the market conditions and ensuring the trust of customers (without not neglecting other factors of competitiveness). For banks, this postulate is particularly true, as customers provide them with their money for safekeeping or trust

management and use their infrastructure and services for various transactions.

A critical review of domestic and foreign scientific literature and practical recommendations to ensure the protection of the banking sector from cyber threats in the digital economy revealed the presence of significant differences in the cyber security apparatus of the banking system.

In the domestic scientific and practical communities, the conceptual apparatus focuses on the disclosure of the concept of "cybersecurity" and the desire to take into account as many potential points (zones) in the business processes of banks that may be attacked from outside. Note that the domestic practice of banks is defensive and characterized by the desire to accurately and fully explain the content of such concepts as "security of banking business processes in the digital economy", "banking cybersecurity", "cyberstability".

According to Art. 2 of Doctrine of information security of the Russian Federation, *information security* refers to the state of security of individuals, society and the State against internal and external information threats, which ensures the realization of constitutional human and civil rights and freedoms, decent quality and standard of living of citizens, sovereignty, territorial integrity and sustainable socio-economic development of the Russian Federation, defense and security of the State.[1] In our view, this definition contains a rather general approach, reflecting the political orientation of State regulators to prevent the occurrence of potential challenges and threats to the digital economy for the economic security of the country as a whole.

According to S. I. Lutsenko, the cybersecurity of the banking institution should be considered as a complex mechanism for the application of organizational, technological, personnel and administrative tools to counter the influence of external cyberattacks and prevent offences of the internal information circuit of the banking system with its adaptation to the changing information technology landscape of the digital economy.[2] In this definition there is an essential fact that the mechanism should be adaptive, i.e. dynamic and change (more precisely — adapt) to the evolving challenges and threats of the digital economy, thus ensuring the security of financial assets and information of the banking system.

A slightly different approach was presented in the works of A. S. Alpeev, M. M. Bezkorovainy and A. L. Tatuzov. According to them, the cybersecurity of the banking institution — is a proactive system of response to internal and external challenges and threats of cyberspace, which is based on the flexible methodology of Agile, which allows in the shortest possible time to transform banking business processes for new sources of cyber-threats [9, 10]. The value of this definition lies in the feasibility of achieving synergy in the case of the application of flexible methods of project management in the IT sphere (Agile methodology specializes in IT projects) and classic rules of information hygiene in banks. That is, this definition brings us to a new term that was mentioned earlier,— "cyberstability".

In addition, in the work of R.I. Zakharchenko and I.D. Korolev, cyberstability refers to the ability of a business process management system to perform its functions in a complex, sharply changing environment under the conditions of destructive information impacts [11]. This definition refers to the ability of the banking system to remain operational even in the event of a cyberattack, which brings the issue of sustainable development to the level

[1] Doctrine of information security of the Russian Federation: approved by the Decree of the President of the Russian Federation No. 646 from 05.12.2016. URL: https://www.garant.ru/products/ipo/prime/doc/71456224/#0 (accessed on 20.01.2022).

[2] Lutsenko S.I. Policy of the Russian Federation in the field of cybersecurity. URL: http://digital-economy.ru/images/easyblog_articles/504/IB 777.pdf (accessed on 20.01.2022).

of the entire banking system of the country. There should be a complex mechanism of co-insurance of banks in case of cyberattacks from outside and an effective filter to prevent the formation of an aggressive information environment within the banking system.

In foreign practice, both in scientific and legislative works, the categorical apparatus is focused on revealing the essence of challenges and threats to the banking system from the standpoint of the concepts of "cyberattack", "cyberterrorism" and "cyberwar". This allows to make an assumption about the desire of foreign specialists to distinguish the above concepts, which is connected with the interest of state regulators (both financial and military) to consider the digital landscape and its infrastructure as a "theater of military operations". This assumption can be substantiated by the informative analysis of such documents as the "National cyber security strategy",[3] "Tallin Manual on International Law Applicable to Cyber Warfare"[4] (2017) and "Cybersecurity Act"[5] (2019).

Highlight the approach presented by the International Telecommunication Union, which presents cybersecurity as "technologies, concepts, public policies, procedures and practices aimed at protecting assets (computers, infrastructure, applications, services, communication and information systems) and cyberspace from attacks, damage and unauthorized access".[6] The definition makes the orientation of all actors in cyberspace quite clear and implies retaliation against the aggressor (although it is not explicitly declared).

In accordance with Art. 1 The EU Cybersecurity Act defines "cybersecurity" as "activities necessary for the protection of networks and information, users of information networks and other parties that may be affected by cyber threats".[7] However, the Law itself specifies (somewhat diluted) that the activity can be understood as active actions by authorized EU authorities aimed at preventive protection against possible cyberattacks.[8] We consider that the EU Act is oriented towards a possible active offensive policy.

A reference to the perception of cyberspace as an object of EU political and economic interests can be found in EU Directive 2016/1148 on cybersecurity: in particular, articles 9, 11, 13 indicate that, if necessary, authorized state regulators and members of PPP-agreements — owners of critical infrastructure — can participate in organizing active actions aimed at leveling the influence of the source of cyber threats by breaking diplomatic relations with them, blocking financial transactions, exclusion of intermediary institutions from international agreements of exchange of information or corresponding relations in financial (banking) spheres.

In the US National Cyber Security Strategy is a reference to the supplement to the law — Cloud Act, which contains permission to participate American IT-companies of FAMGA Group and separate intelligence Agency in collecting information on potential sources

[3] US New Cyber Security Strategy: Brief Analysis of the New Edition (16.10.2018). URL: http://csef.ru/ru/oborona-i-bezopasnost/272/novaya-strategiya-kiberbezopasnosti-ssha-kratkij-analiz-novoj-redakczii-8665 (accessed on 21.01.2022).

[4] Tallinn Manual 2.0 and Capture Cyberspace (06.02.2017). URL: https://www.geopolitica.ru/article/tallinskoe-rukovodstvo-20-i-zahvat-kiberprostranstva (accessed on 21.01.2022).

[5] Cybersecurity Act (17.12.2019). URL: https://medium.com/lawgeek-by-aurum/eu-cybersecurity-act-review-aurum-law-firm-d588db539e75 (accessed on 21.01.2022).

[6] International Telecommunications Union (ITU) (2008). Overview of Cybersecurity, Recommendation ITU– T X. 1205. URL: https://www.itu.int/rec/T-REC–X.1205–200804-I (accessed on 21.01.2022).

[7] Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA (the European Union Agency for Cybersecurity) and on Information and Communications Technology Cybersecurity Certification and Repealing Regulation (EU) No. 526/2013 (Cybersecurity Act). Official Journal of the European Union, L 151/1. URL: http://data.europa.eu/eli/reg/2019/881/oj (accessed on 22.01.2022).

[8] Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union. URL: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32016L1148 (accessed on 22.01.2022).

of cyber threats and deciding on preventive impact on them up to destruction in order to mitigate the risks of destructive influence on critical infrastructure.

Foreign academic community has a softer view on the disclosure of challenges and threats to the banking system, but generally maintain solidarity to take active action against the source of the threat. Thus, N.A.-D. Khalifa consider that the concept of cyberstability of the banking system should necessarily include a "mechanism of retaliation", which can be implemented both by the victims of the attack and by the principle of solidarity, by other banks — parties to agreements on cyber protection of corporate interests [6, p. 43–44]. In addition, A.W. Dorn and S. Webb consider that banking cybersecurity is a holistic system not only the protection of financial assets and the sustainable functioning of the national financial infrastructure, but also a preventive influence on the world hotspots of cyber-threats and potential cyber-attacks [8, p. 24].

RESULTS AND DISCUSSION

We consider that the presented critical review of domestic and foreign viewpoints on the essence of challenges and threats to the banking system is characterized by an appealing approach. In this regard, we consider it necessary to present a table of results of comparative analysis of the organization of the cybersecurity system in the Russian and foreign banking systems (*Table 1*).

According to the above comparative analysis, in domestic practice banks have sufficient autonomy to organize the cybersecurity system of their own activities. It is also important to note the fact that there are no special programmes for the development of security infrastructure for banks, financed by public sources (extrabudgetary funds, special-purpose budgets of the largest participants of the cybersecurity market of the state form of ownership, for example GC "RosTech"). This makes the banking system more vulnerable, as, with the exception of a group of systemically important banks and included in the top-100, most banks cannot afford such expenses due to their long payback and implicit commercial effect.

Studying the situation of the banking system of Russia from the standpoint of its sustainability before the cyber-threats of the digital economy, we consider appropriate to start with quantitative and qualitative analysis of cyberattacks, which allows to understand their scale and target orientation (*Fig. 1 and 2*).

According to the given data in *Fig. 1*, there is a steady growth in cyberattacks on the Russian banking system, and when analyzing a section of functional levels, it is evident that the main interest of attackers is focused on banks of 2 levels (738 attacks were committed during the research period) and significantly less — on non-bank credit organization (283 attacks). When analyzing the reasons for the increase in attacks on the Russian banking sector, the following was established:

- *first*, the Bank of Russia has seen a steady growth in non-cash settlements in retail banking: so, for 2020 the share of non-cash payments in retail turnover was 70.3% (64.7% — in 2019),[9] which outpaces the development of the remote banking services in most Western European countries and even the US and objectively attracts hacker groups;
- *second,* Russia is in the top three countries with the most active digital transformation of banking services — according to E&Y, in 2019, the share of active digital banking users was 82.0% (for comparison — the world average is 64%).[10] It is important to note that digital transformation in Russian banks comes down from above, i.e. banks' customers motivate them to introduce

[9] Results of the Bank of Russia: briefly about the main thing, 2020. URL: https://cbr.ru/about_br/publ/annrep2020short/platezhnaya-sistema/ (accessed on 26.01.2022).

[10] Global FinTech Adoption Index 2021. URL: https://www.ey.com/en_gl/ey-global-fintech-adoption-index (accessed on 26.01.2022).

the latest digital financial services, and banks often do not have sufficiently reliable systems of protection against external cyber threats, which together increases the interest of hacker groups in attacks;

• *third,* in the Russian banking system the following segments are developing most actively: digital banking (online lending, unsecured deposits, currency exchange, less often — investment products) — this service is developing in 78.7% of all banks and a group of payment and settlement services (money transfers, e-money, P2P-loans), is actually an extended continuation of digital banking for interaction of banks and, for example, telecom operators, manufacturers of gadgets for communication and exchange of financial information — more than 18.0%.[11] This fact of development also contributes to the vulnerability of the Russian banking system, as the rapid development of virtual payment services is not harmonized with financial literacy and digital hygiene of customers while working on the Internet, which multiplies the vulnerability of both sides.

Based on the features of the development of the Russian market of banking services, consider the composition and structure of objects exposed to cyberattacks in 2016–2021 (QI–QIII). At the same time, it should be noted that during this period cyberattacks on the banking system became complex, i.e. their objectives were more than one object, which indicates an increase in risks to the cyberstability of the Russian banking system (*Fig. 2*).

Fig. 2 data suggest that key object of hackers' criminal interests is the banking infrastructure — on average, this facility accounts for 57.5% of all recorded cyberattacks. In the second place — retail clients — a little more than 31.0%, the third place with a significant lag is occupied by the group "ATMs, POS-terminals, mobile devices" — 18.5%. At first glance, it may seem that hackers deliberately choose the safest link — banking infrastructure, but in fact a large number of customers do not declare that they have been attacked, or their gadgets were used as a point of entry, including damage to banking infrastructure.

With the onset of the COVID-19 pandemic, attacks on retail customers, as well as the use of their gadgets for hacker attacks significantly increased due to objective reasons: Introduction of quarantine measures, popularization of non-contact delivery tools and orders of products and services through online shopping, which, together with insufficient digital culture of the population, led to an increase in cyberattacks on these groups of objects.

Note that the fact of the active prevalence of attacks on the banking infrastructure directly indicates the participation of professional hackers of a very high level using powerful equipment (servers, Data-centers). This may indirectly indicate the carrying out of cyber-attacks sanctioned by the state regulators in order to find vulnerabilities in its architecture to obtain a new instrument of political pressure on Russia, at the worst — initiating cyberwarfare.[12]

The next step of this study is to study the tools of cyber-attacks, which is the information basis for developing specific proposals to improve the mechanism of cyber-attack protection and general increase of cyberstability of the Russian banking system (*Fig. 3*).

As follows from the diagram on *Fig. 3*, the key tool of cyber-attacks on the Russian banking system was software containing malicious code — on average, its use in

[11] Research of the market of technological entrepreneurship in Russia, 2020. (21.12.2020). URL: https://drive.google.com/file/d/1NsSN 3e_NkGS 1k2dfVb7cx6fXX8jHCNaA/view (accessed on 26.01.2022).

[12] The main types of computer attacks in the financial and credit sphere in 2019–2020 (2021). URL: https://cbr.ru/Collection/Collection/File/32122/Attack_2019–2020.pdf (accessed on 27.01.2022); Digital Threat: who might be behind cyberattacks on Russia (13.05.2021). URL: https://russian.rt.com/world/article/861272-rossiya-kiberataki-ssha-bezopasnost (accessed on 27.01.2022).

Table 1

Organization of cyber security in Russian and foreign banking systems: a comparative analysis

Criteria comparison	Russian banking system	Foreign banking systems
1. Sources of motivation/interest in developing cybersecurity	– increase in cyberattacks against the banking system from abroad; acute technological inequalities in the protection of banking services; – lack of unified national cyber security standards for banks; – increase the risks of cyberterrorism for EU and US political interests; – tightening international requirements for cybersecurity standards.	– political interests of using tools of cyberattacks on banking systems (USA, UK); – increase incidence of "leakage" of personal information about bank customers (EU, USA); – increase technological inequalities among partner banks (EU); – formation of precedents of sanctions pressure on the banking system and its individual banks (China) with a view to easing it in the world market.
2. Main stakeholders	– President of the Russian Federation – State regulators – Central Bank of the Russian Federation, Ministry of Digital Development, Communications and Mass Communications of the Russian Federation; – systemically significant credit organizations (13 banks).[a]	– European Banking Authority; – Committee on the Global Financial System BIS; – Society of World Interbank Financial Telecommunication (SWIFT); – Financial Industry Regulatory Authority [b]; – Country regulators as represented by Central Banks.
3. Summary of the implementation mechanism of the cybersecurity policy	Banks develop individual risk-strategies and maps of cyber threats, taking into account the specifics of the customer base, applied financial instruments and operating services. The main goal for banks – compliance with the criteria for safe operation established by the Central Bank of the Russian Federation and international regulatory institutions (when maintaining an active international activities). Minimum (thresholds) requirements for banking technology are contained in STO BR IBBS-1.0 "Information Security of Organizations of the Banking System of the Russian Federation. General Regulations".[c] General in GOST R 57580.1 – 2017 "Security of financial (banking) operations. Protection of information of financial organizations. Basic composition of organizational and technical measures".[d] A key expert accumulating information on cyberincidents in banks in the Central Bank Authority – Center for Monitoring and Response to Computer Attacks in the Financial Sphere (FinCERT) of the Information Security Department of the Bank of Russia.[e]	In the *USA*, commercial banks develop a collective cybersecurity policy (Sheltered Harbor[f] project) based on correspondent relations or the composition of the financial group and agree it with the National Cyber Authority.[g] In the *EU*, country-level regulatory banks develop State-wide cybersecurity strategies and coordinate them with the European Central Bank, which allows to harmonize the efforts of individual countries in ensuring the sustainable development of the EU banking system [12, 13]. In the *UK*, since 2014, the National Cyber Security Center, which is linked to all banks of the Kingdom and has the authority to make anti-crisis decisions in case of an attack and threats to destabilize the banking system.[h] In *China*, the cyber-protection system of banks is built on the principle of "soft power": bank system data transfer takes place through a dedicated autonomous network, to which clients are connected only during transactions or services. In addition, the State applies the model of "digital nationalism" – the introduction of special requirements on localization of all data within the jurisdiction of the State. This allows you to collect information about all network users and identify their personality, which is an additional protection against hacker attacks [14].

Table 1 (continued)

Criteria comparison	Russian banking system	Foreign banking systems
4. Sources of funding for cybersecurity projects and programmes	Banks individually set up special funds for financing cybersecurity projects within the framework of a development strategy for a period of 1, 3 or 5 years (forecast), or apply the method of regular contributions to a special fund.[i]	In the *USA*, banks are actively involved in Google and Microsoft-funded cybersecurity programs that test new cyber-attack protection products and then sell licenses to use them.[j] In the *EU*, banks and central banks in member states receive financial support from frameworks approved by the EU Parliament to ensure the cyber-sustainability of banks, and then at the level of regulators of individual countries, financing is distributed among banks. In the *UK*, banks actively engage with venture companies in the area of cybersecurity in the form of partnerships, including providing funding for startups in return for the latest solutions in the field of information protection (for example, the national technology partnership platform "Tech Nation", London Tech and North Tech city platforms to support the IT-community, universities and business schools engaged in cybersecurity research and development).[k] In *China*, in the period from 2020 to 2023, it is planned to spend the state funding in the amount of 40 billion USD for cybersecurity of the country[l], of which almost half are expected to be allocated to the banking sector. Funding will be directed to the development of IT group BAT, Huawei, ZTE.

Sources: compiled by the authors on the data [12–16]:

[a] Bank of Russia approved list of systemically significant credit organizations (11.10.2021). URL: https://cbr.ru/press/pr/?file=11102021_133500PR 2021–10–11T13_27_28.htm (accessed on 22.01.2022); [b] Regulatory overview of financial market (16.05.2016–15.07.2016). URL: https://cbr.ru/finmarkets/files/development/review_020916.pdf (accessed on 22.01.2022); [c] STO BR IBBS-1.0 "Information Security of Organizations of the Banking System of the Russian Federation. General Regulations". URL: https://cbr.ru/statichtml/file/59420/st-10–14.pdf (accessed on 23.01.2022); [d] GOST R 57580.1–2017 "Security of financial (banking) operations. Protection of information of financial organizations. Basic composition of organizational and technical measures": Order of the Federal Agency for Technical Regulation and Metrology No. 822 from 08.08.2017. URL: https://docs.cntd.ru/document/1200146534 (accessed on 23.01.2022); [e] Center for Monitoring and Response to Computer Attacks in the Financial Sphere (FinCERT) of the Information Security Department of the Bank of Russia. URL: https://cbr.ru/analytics/ib/fincert/ (accessed on 23.01.2022); [f] US Banks build system of defense against large-scale cyber-attacks (06.12.2017). URL: https://www.securitylab.ru/news/490069.php (accessed on 23.01.2022); [g] Karasev P. New US cybersecurity strategies (15.11.2018). URL: https://russiancouncil.ru/analytics-and-comments/analytics/novye-strategii-ssha-v-oblasti-kiberbezopasnosti/ (accessed on 23.01.2022); [h] United Kingdom cyberreadiness: a brief overview (October 2016). URL: https://analytica.digital.report/wp-content/uploads/2017/05/CRI-UK-RU.pdf (accessed on 23.01.2022); [i] Cyber security of the Russian economy and banking industry in general (17.02.2021). URL: https://plusworld.ru/professionals/kiberbezopasnost-rossijskoj-ekonomiki-i-bankovskoj-industrii-v-tselom/ (accessed on 23.01.2022); Cybersecurity 2021. Who is to blame and what to do? (12.11.2021). URL: https://plusworld.ru/journal/2021/plus-8–2021/kiberbezopasnost-2021-kto-vinovat-i-chto-delat/ (accessed on 23.01.2022); Revenkov P. Ensuring cyber security in the financial and credit sphere (06.11.2019). URL: https://www.secuteck.ru/articles/obespechenie-kiberbezopasnosti-v-kreditno-finansovoj-sfere (accessed on 23.01.2022); [j] Google and Microsoft has committed to invest in cybersecurity (26.08.2021). URL: https://www.forbes.ru/newsroom/tehnologii/438209-google-i-microsoft-vzyali-na-sebya-obyazatelstva-vlozhitsya-v (accessed on 24.01.2022); [k] Britain's economy tomorrow — the government's plan. URL: https://d-russia.ru/zavtrashnyaya-ekonomika-britanii-plan-pravitelstva.html (accessed on 24.01.2022); Britain's digital economy — state and development plans. URL: https://d-russia.ru/tsifrovaya-ekonomika-britanii-sostoyanie-i-plany-razvitiya.html (accessed on 24.01.2022); [l] Cybercrime and cyberconflict: China (14.07.2021). URL: https://www.tadviser.ru/index.php/Статья: Киберпреступность_и_киберконфликты:_Китай#. (accessed on 24.01.2022).

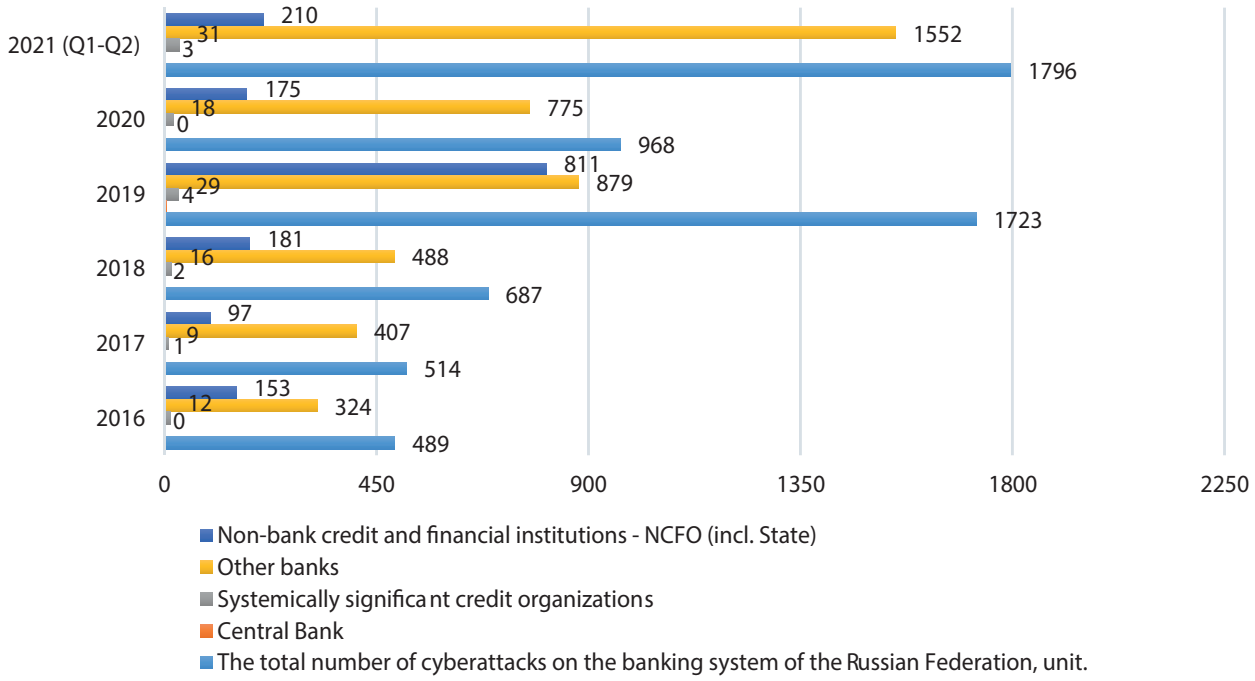

Fig. 1. **Number of Cyber Attacks on the Russian Banking System by Functional Level in 2016–2021 (Q1–Q3), units**

Sources: Overview of transactions made without the consent of clients of financial organizations in 2016: analytical report of the Information Security Department of the Bank of Russia (21.02.2017). URL: https://cbr.ru/Collection/Collection/File/32093/survey_transfers_16.pdf (accessed on 25.01.2022); Overview of transactions made without the consent of clients of financial organizations in 2017: analytical report of the Information Security Department of the Bank of Russia (15.10.2018) URL: https://cbr.ru/Collection/Collection/File/32094/survey_transfers_17.pdf (accessed on 25.01.2022); Overview of transactions made without the consent of clients of financial organizations for 2018: analytical report of the Information Security Department of the Bank of Russia (06.03.2019). URL: https://cbr.ru/Collection/Collection/File/32091/gubzi_18.pdf (accessed on 25.01.2022); Overview of transactions made without the consent of clients of financial organizations for 2019: analytical report of the Information Security Department of the Bank of Russia (19.02.2020). URL: https://cbr.ru/Collection/Collection/File/32189/Review_of_transactions_2019.pdf (accessed on 26.01.2022); Overview of operations performed without the consent of clients of financial organizations for 2020: analytical report of the Information Security Department of the Bank of Russia (12.06.2021). URL: https://cbr.ru/Collection/Collection/File/32190/Review_of_transactions_2020.pdf (accessed on 26.01.2022); Current Cyber Threats: Q3, 2021 (08.12.2021). URL: https://www.ptsecurity.com/ru-ru/research/analytics/cybersecurity-threatscape-2021-q3/#id2 (accessed on 26.01.2022).

attacks was 53.7%. The prevalence of spyware software (in 2020, its share was more than 40.0%) for collecting personal data on customers and their accounts should be noted in its composition.

In second place is a tool of social engineering — 37,7%, which because of the pandemic COVID-19 sharply gained popularity. And its manifestation was both in the "familiar" form for cybersecurity professionals (phone scam), and new, complex formats integrated into customized service processes (for example, partner programs of the bank and representatives of retail, health centers). According to FinCert, in 2020, compared to 2019, the growth of this tool by 86.0%, which not only reduces the work of the security services of banks, but also significantly undermines customer confidence in the banking system as a whole.[13]

The third place is occupied by hacking — 21.8%, and it should be noted that its use was systematic

[13] The main types of computer attacks in the financial and credit sphere in 2019–2020 (2021). URL: https://cbr.ru/Collection/Collection/File/32122/Attack_2019–2020.pdf (accessed on 27.01.2022).

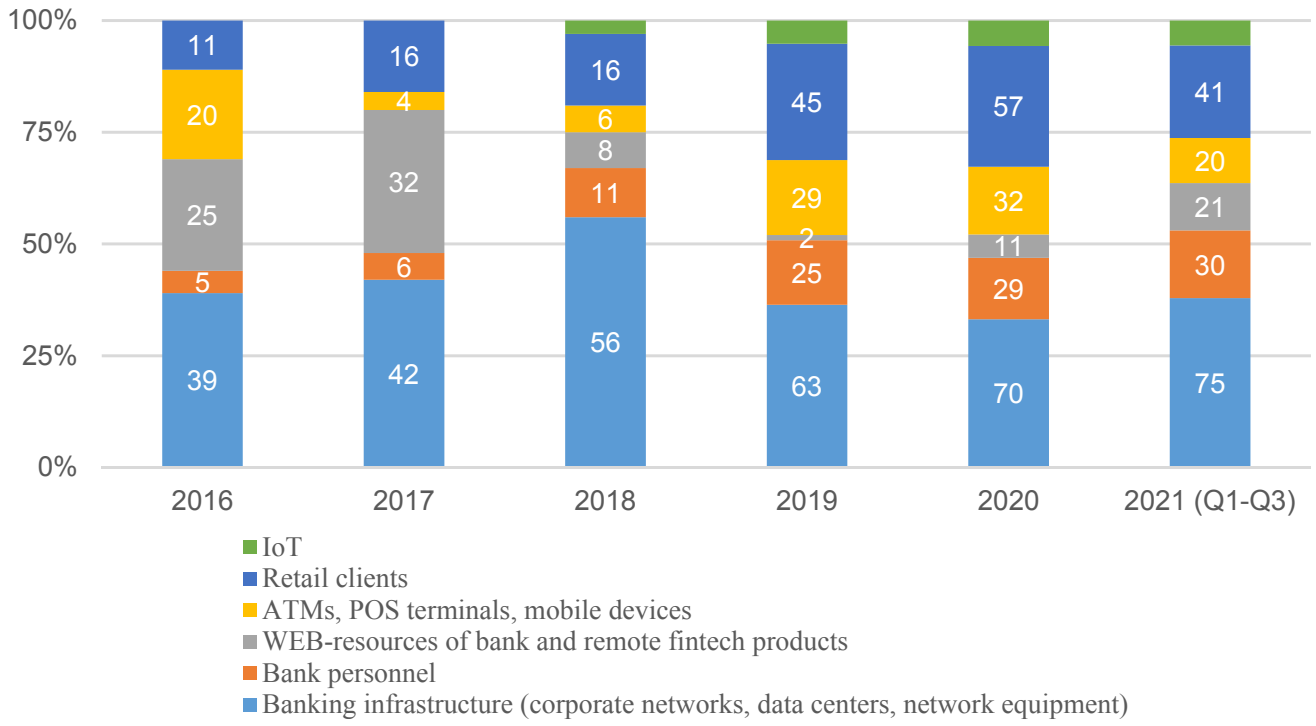

Fig. 2. **Composition and structure of banking system facilities exposed to cyber-attacks for 2016–2021 (Q1–Q3), in %**

Sources: Cybersecurity 2016–2017: from totals to forecasts (26.01.2017). URL: https://www.ptsecurity.com/upload/corporate/ru-ru/analytics/Cybersecurity-2016–2017-rus.pdf (accessed on 27.01.2022); Current cyber threats — 2017. Trends and forecasts (06.03.2017). URL: https://www.ptsecurity.com/upload/corporate/ru-ru/analytics/Cybersecurity-threatscape-2017-rus.pdf (accessed on 27.01.2022); Cybersecurity 2017–2018: figures, facts, forecasts (13.12.2017). URL: https://www.ptsecurity.com/ru-ru/research/analytics/cybersecurity-2017–2018/ (accessed on 27.01.2022); Cybersecurity 2018–2019: figures, facts, forecasts (18.12.2018). URL: https://www.ptsecurity.com/ru-ru/research/analytics/cybersecurity-2018–2019/ (accessed on 27.01.2022); Current cyber threats — 2018. Trends and forecasts (12.03.2019). URL: https://www.ptsecurity.com/upload/corporate/ru-ru/analytics/Cybersecurity-threatscape-2018-rus.pdf (accessed on 27.01.2022); Cybersecurity 2019–2020. Trends and Forecasts (19.12.2019). URL: https://www.ptsecurity.com/ru-ru/research/analytics/cybersecurity-2019–2020/ (accessed on 27.01.2022).

and carefully organized: According to FinCert, 225 attacks by RTM hacker group in 2019–2020 there were[14] (acronym Remote Transaction Manager), the purpose of which was remote management of transactions of clients — owners of foreign currency deposits and investment deposits.

Consider the main motives of cyber-attacks on the banking system of the Russian Federation. The obtained results will determine the main points (zones) of attention of banks when assessing the cyberstability of their own business models (*Fig. 4*).

The data given on *Fig. 4* suggest that the key motive for cyber-attacks is to obtain financial benefits from the steal of money and its equivalents for enrichment — on average it accounted for 72.5%. However, it is important to note that its share in the structure of motives is gradually decreasing: This is due, on the one hand, to the increased work of banks on their own security against external and internal cyberrisks, and, on the other hand, to the more active work of the Central Bank on cyberincident reporting and bank tests for cyberstability.[15]

[14] See ibid.

[15] The Bank of Russia has summed up the results of the first anti-hacker teachings (10.02.2021). URL: https://www.mn.ru/smart/bank-rossii-podvel-itogi-pervyh-antihakerskih-uchenij-uchastie-v-nih-bylo-dobrovolnym (accessed on 28.01.2022).

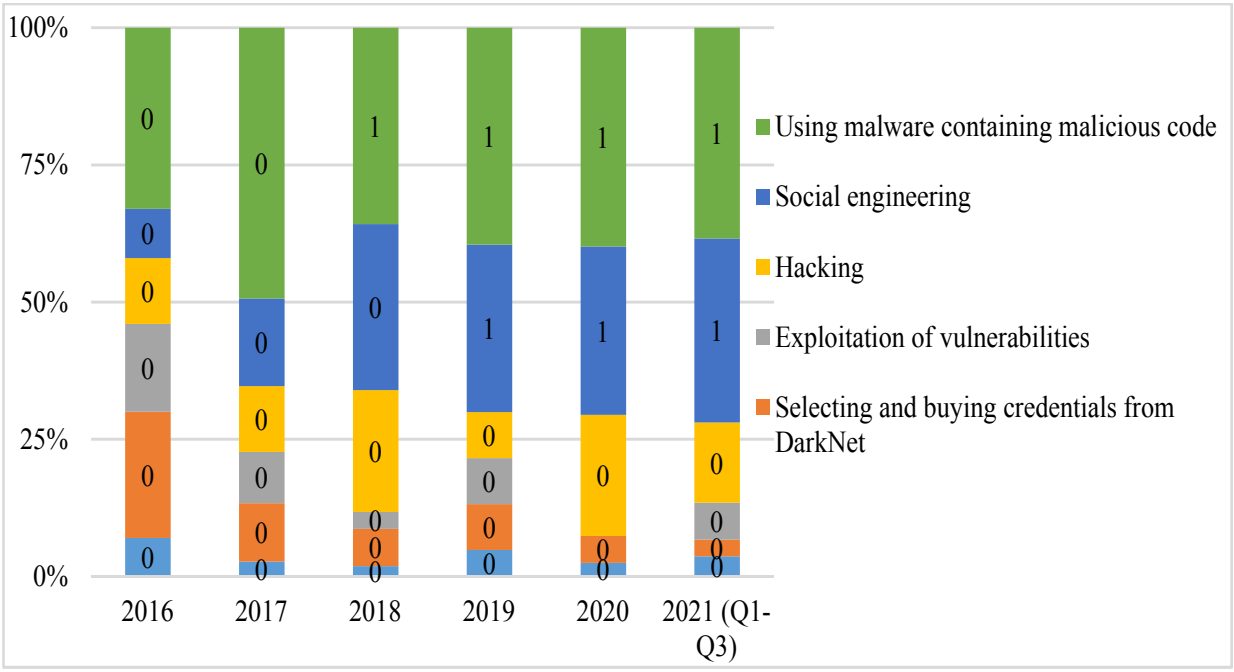

Fig. 3. **Cyberattack tools against members of the Russian banking system in 2016–2021 (Q1–Q3), %**

Sources: Penetration testing in credit sector organizations (20.02.2020). URL: https://www.ptsecurity.com/ru-ru/research/analytics/pentest-finance-2020/ (accessed on 28.01.2022); ART-attacks on the credit and financial sphere in Russia: a review of tactics and techniques (10.10.2019). URL: https://www.ptsecurity.com/ru-ru/research/analytics/apt-attacks-finance-2019/ (accessed on 28.01.2022); Credit and financial security, 2018 results. Positive Technologies Assessment (05.07.2020). URL: https://www.ptsecurity.com/ru-ru/research/analytics/credit-and-financial-security-2019/ (accessed on 28.01.2022); Vulnerabilities of online banks: summarizing the analysis (05.04.2019). URL: https://www.ptsecurity.com/ru-ru/research/analytics/vulnerabilities-rbo-2019/ (accessed on 28.01.2022); Vectors of hacker attacks on banks (05.06.2018). URL: https://www.ptsecurity.com/ru-ru/research/analytics/banks-attacks-2018/ (accessed on 28.01.2022); Financial application vulnerability statistics (24.04.2018). URL: https://www.ptsecurity.com/ru-ru/research/analytics/financial-application-vulnerabilities-2018/ (accessed on 28.01.2022); Current cyber threats: Q3, 2021 (08.12.2021). URL: https://www.ptsecurity.com/ru-ru/research/analytics/cybersecurity-threatscape-2021-q3/#id2 (accessed on 27.01.2022).

At the same time, the share of such motivating factor as receipt and subsequent sale of personal data, blackmail and extortion — for QI–QIII in 2021, its share was 47.0%: the active development of social engineering practices and the popularization of virtual services have led to the development of models of the identity theft for the purpose of their sale to DarkNet-network or use for blackmail and extortion.

By the end of 2021, there was also an increase in such warning factors as hacktivism (popularization of hacker culture and cyberattacks) — 20.0% and the fixation of signs of organized and authorized by the State specialized regulators of cyber-attacks (4.0%).

These two tendencies have dangerous potential, as against the background of a pandemic and a decline in the real incomes of the population, there is an increase in social tension among the population, and the escalation of the military-political confrontation between Russia and NATO may well be supplemented by the conduct of massive cyber-attacks on banking infrastructure facilities.

At the same time, it is not easy to prove the existence of the threat of cyberwar: following rules of international humanitarian law, this means recognition of the State by the

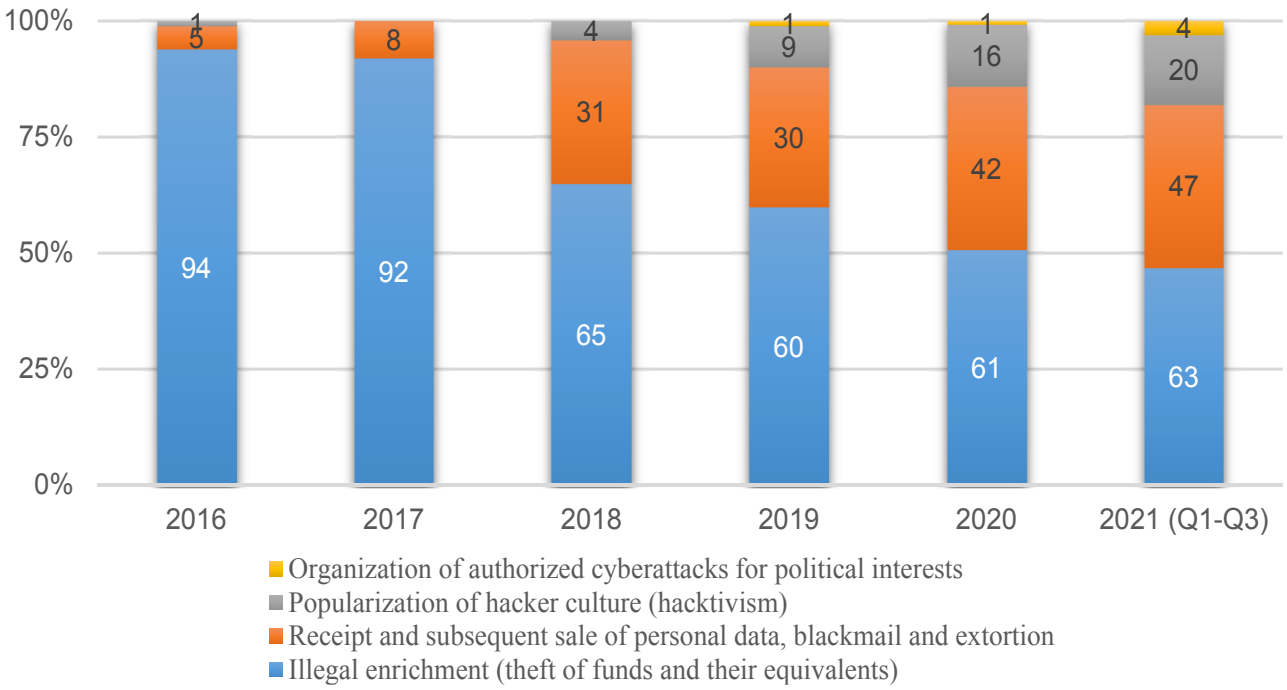

Fig. 4. **Composition and structure of motives for cyberattacks on the banking system in 2016–2021 (Q1–Q3), in %**

Sources: Penetration testing in credit sector organizations (20.02.2020). URL: https://www.ptsecurity.com/ru-ru/research/analytics/pentest-finance-2020/ (accessed on 29.01.2022); ART-attacks on the credit and financial sphere in Russia: a review of tactics and techniques (10.10.2019). URL: https://www.ptsecurity.com/ru-ru/research/analytics/apt-attacks-finance-2019/ (accessed on 29.01.2022); Credit and financial security, 2018 results. Positive Technologies Assessment (05.07.2020). URL: https://www.ptsecurity.com/ru-ru/research/analytics/credit-and-financial-security-2019/ (accessed on 29.01.2022); Vulnerabilities of online banks: summarizing the analysis (05.04.2019). URL: https://www.ptsecurity.com/ru-ru/research/analytics/vulnerabilities-rbo-2019/ (accessed on 29.01.2022); Vectors of hacker attacks on banks (05.06.2018). URL: https://www.ptsecurity.com/ru-ru/research/analytics/banks-attacks-2018/ (accessed on 29.01.2022); Financial application vulnerability statistics (24.04.2018). URL: https://www.ptsecurity.com/ru-ru/research/analytics/financial-application-vulnerabilities-2018/ (accessed on 29.01.2022); Current cyber threats: Q3, 2021 (08.12.2021). URL: https://www.ptsecurity.com/ru-ru/research/analytics/cybersecurity-threatscape-2021-q3/#id2 (accessed on 29.01.2022).

aggressor with all the political and economic consequences for all participants.[16]

At the final stage of the study, an analysis of the security of Russian banks from cyberattacks for 2016–2021 (QI–QIII) was conducted (*Table 2*).

According to *Table 2*, despite an increase in the rate of successfully stopped cyber-attacks against banks (52.7% in 2020 compared to 39.5% in 2016), the volume of losses for the banking system is constantly increasing. In addition, there is a decrease in the index of stability of the national banking system in the category of commercial banks of the second group — in 2020 it was 3.4, whereas in 2016 it was 5.5.

Based on the above analysis, the authors identified the main problem points (zones) of influence on the cyberstability of the Russian banking system in the context of ongoing digital transformations (*Table 3*).

As a result of the description of points (zones) of influence on cyberstability of the

[16] The right tool for the job: how does international law apply to cyber operations? (06.10.2020). URL: https://blogs.icrc.org/law-and-policy/2020/10/06/international-law-cyber-operations/ (accessed on 28.01.2022); Twenty years on: International humanitarian law and the protection of civilians against the effects of cyber operations during armed conflicts (March 2021). URL: https://international-review.icrc.org/articles/twenty-years-ihl-effects-of-cyber-operations-during-armed-conflicts-913 (accessed on 28.01.2022).

Table 2

Key indicators of Russian banks' protection against cyberattacks for 2016–2020

Indicators	2016	2017	2018	2019	2020
1. Indicator of successfully stopped cyberattacks, in% to the total	39.5	42.4	44.7	49.5	52.7
2. The volume of losses of the banking system from cyberattacks, mln rub.	1080	961.3	1384.7	5723.5	8757.2
3. Level of compensation by banks of losses from cyberattacks (amount of returned funds / amount of stolen funds * 100), in% to the total	18.3	17.2	16.2	15	11.3
4. Index of stability of the national banking system (ratio of reflected and successfully stopped cyberattacks) by categories of banking institutions:					
4.1. Central Bank	–	1	2	4	–
4.2. Systemically important credit institutions	7.9	7.2	6.8	8	7.7
4.3. Commercial banks of 2 groups	5.5	4.7	4.9	4.5	3.4
4.4. Non-credit financial organizations (NCFO)	6.2	5.8	5.5	4.9	4.1

Sources: Overview of transactions made without the consent of clients of financial organizations in 2016: analytical report of the Information Security Department of the Bank of Russia (21.02.2017). URL: https://cbr.ru/Collection/Collection/File/32093/survey_transfers_16.pdf (accessed on 17.05.2021); Overview of transactions made without the consent of clients of financial organizations in 2017: analytical report of the Information Security Department of the Bank of Russia (15.10.2018). URL: https://cbr.ru/Collection/Collection/File/32094/survey_transfers_17.pdf (accessed on 17.05.2021); Overview of transactions made without the consent of clients of financial organizations in 2018: analytical report of the Information Security Department of the Bank of Russia (06.03.2019). URL: https://cbr.ru/Collection/Collection/File/32091/gubzi_18.pdf (accessed on 17.05.2021); Overview of transactions made without the consent of clients of financial organizations in 2019: analytical report of the Information Security Department of the Bank of Russia (19.02.2020). URL: https://cbr.ru/Collection/Collection/File/32189/Review_of_transactions_2019.pdf (accessed on 17.05.2021); Overview of transactions made without the consent of clients of financial organizations in 2020: analytical report of the Information Security Department of the Bank of Russia (12.06.2021). URL: https://cbr.ru/Collection/Collection/File/32190/Review_of_transactions_2020.pdf (accessed on 17.05.2021).

Russian banking system in the final part of our research we present recommendations and proposals for organizational, economic and legal improvements of the system of protection of Russian banks from internal and external cyberthreats (*Table 4*).

We consider that ensuring the cyberstability of the banking system of the Russian Federation requires the application of systemic measures that include both administrative (improvement of legislation in the circulation of personal data, tightening of liability for their preservation and commission of cybercrimes), economic (formation by banks of targeted budgets of expenditures for information security) measures, and public education, aimed at developing the necessary competencies in the field of safe behavior of clients in the virtual space.

Table 3

Main problem points (zones) of influence on the cyber resilience of the Russian banking system

Problem Point (Zone)	Characteristics of the problem point (zone), assessment of its impact
1. Lack of market self-regulation and exchange of information on cyber-attacks and their mechanisms	*Characteristic of problem point (zone):* currently, in the Russian Federation there is no institution of market self-regulation of banks, NCFO and their clients (physical and legal), in terms of information exchange about cyberattacks and mechanisms of their commission due to risks of loss of business reputation, weakening of competitive positions in the market, corporate egoism management[a] *Impact assessment of problem point (zone)*: the information vacuum contributes to the scaling and replication of cyberattacks, as the experience of countering them is formed individually by each bank, i.e. the initiators of attacks have a temporary and technological advantage in cyber-attacks and maximization of damage
2. Low efficiency of cooperation of the e-commerce segment with the State regulator of the Internet — Roskomnadzor	*Characteristic of problem point (zone):* currently, between the e-commerce segment and Roskomnadzor, administrative measures prevail on violation of the rules of work with personal data of customers, lack of adequate protection during their processing, etc.[b] At the same time, the issue of preventive protection against cyber-attacks, the increase in cyber literacy of e-commerce management is extremely local and spot nature, which makes the e-commerce segment the point of intrusion of hackers to obtain subsequent access to banking products (cards, mobile banking, etc.) *Impact assessment of problem point (zone):* e-commerce segment is an essential source for the theft of customers' identity and their use to access banking products: according to FreightWave, the number of online e-commerce crime increased by 50% in 2020[c]
3. Insufficient professional training and competence of bank employees in detecting signs of cyber-attack	*Characteristic of problem point (zone):* according to the PWC report, only 16% of bank managers are performing systematic work on the formation of a team of cyber specialists in the security service and their integration into the business processes of all bank's departments, and 23% conduct regular training of the bank staff to identify cyber threats at workplaces[d] *Impact assessment of problem point (zone):* human factor is considered as an important vulnerability for cyberattacks as technical aspects of bank perimeter protection improve. Given the development of social engineering practices, exploiting vulnerability at the expense of the human factor becomes very effective: with a high-quality attack scheme its identification in operational business processes becomes extremely difficult to identify
4. Limited budget for small and medium-sized banks that wouldn't allow them to care independent cyber-protection units	*Characteristic of problem point (zone):* According to the Positive Technologies report, only 29.0% of banks have a regular budget to fund cyber defense programs, and 32.0% have one-time investments in the acquisition of new cybersecurity tools[e] *Impact assessment of problem point (zone):* Acute differentiation of cybersecurity costs affects the overall cyberstability of the banking system, as penetration of a secure perimeter of a malicious object is not only indicative of vulnerability, but given the exponential growth of correspondent accounts between banks multiplies risks of "infection" even the most protected banks

Table 3 (continued)

Problem Point (Zone)	Characteristics of the problem point (zone), assessment of its impact
5. Popularization and active growth of market presence of Fintech-services and companies	*Characteristic of problem point (zone):* Fintech-companies in the Russian Federation are mainly superstructures of banks and are subject to general security policy, but there is also a group of independent NCFO (according to 2022–71 units[f]), targeted use of which is mainly to organize money transfers in circumvention of the bank (anonymous wallets, P2P-transactions). Thus, from January to May 2020, there were 165 thousand fraudulent transactions totaling 1.6 billion rubles[g] *Impact assessment of problem point (zone):* business models of Fintech-companies are based on different principles from traditional banks and, importantly, do not comply with most of the bank safety standards set by the Central Bank. In addition, the unregulated development of Fintech-services threatens Russia's compliance with FATF standards (Financial Action Task Force on Money Laundering) [17]

Sources: developed by authors based on:

[a] The results of a study of the market opinions on the development of financial technologies for 2021–2023 (2020). URL: https://www.accenture.com/_acnmedia/PDF-163/Accenture-Result-Research-Market-Opinion-Russian.pdf (accessed on 28.01.2022); [b] Like war, shares of destruction. How Roskomnadzor fights social networks and what will happen next (06.12.2021). URL: https://skillbox.ru/media/business/kak-roskomnadzor-boretsya-s-sotssetyami/ (accessed on 29.01.2022); [c] E-commerce cybercrime jumped 50% in 2020. URL: https://www.freightwaves.com/news/e-commerce-cybercrime-jumped-50-in-2020 (accessed on 29.01.2022); [d] Global research "Trust in digital technologies" 2021. URL: https://www.pwc.ru/ru/publications/dti-2021/e-version-digital-trust-insights-2021-in-russian.pdf (accessed on 30.01.2022); [e] How much is security. Analysis of information security processes in Russian companies (2017). URL: https://www.ptsecurity.com/upload/corporate/ru-ru/analytics/IS-Cost-rus.pdf (accessed on 30.01.2022); Online security above all for banks (29.04.2021). URL: https://www.comnews.ru/content/214362/2021-04-29/2021-w17/onlayn-bezopasnost-prevyshe-vsego-dlya-bankov (accessed on 30.01.2022). [f] Fintech by the numbers Incumbents, startups, investors adapt to maturing ecosystem (2020). URL: https://www2.deloitte.com/content/dam/Deloitte/ru/Documents/financial-services/fintech-by-the-numbers.pdf (accessed on 30.01.2022); Development of the fintech-market in Russia: neobanks and startups (11.12.2019). URL: https://www.finam.ru/analysis/forecasts/razvitie-fintex-rynka-v-rossii-neobanki-i-startapy-20191211-142048/ (accessed on 30.01.2022); [g] Financial regulator disclosed volume of fraudulent transactions in 2020 (23.06.2020). URL: (accessed on 22.07.2022).

CONCLUSION

Based on the results of the scientific research, it was found that, in general, there is a tendency to increase the threats to the sustainability of the national banking system and the growth of their qualitative, professional component, which indirectly indicates the likely presence of political interests of NATO member states in identifying potential vulnerabilities of the Russian banking perimeter.

In the analysis of the cyber-stability of the banking system of Russia, it was found that, despite the increase in the success of stopped cyberattacks, the losses of the national banking system increased. This is primarily due to an increase in attacks aimed at undermining public confidence in banks, as well as an increase in the use of "white spots" in national legislation by fintech companies in their own self-interest.

Note that the state regulator, represented by the Central Bank of Russia, carries out active and systematic work to reduce the number of sources of cyber-risks and actively improves the legislative base to prevent the use of legal collisions and unresolved issues to prosecute for the acts committed in the crime field using ICT.

The article makes a theoretical contribution to the development of the problems of ensuring the cyberstability of the banking system of Russia and the improvement of practices of the

Table 4

Recommendations and proposals for organizational, economic and legal improvements to the system of protection of Russian banks from internal and external cyberthreats

Recommendations/ suggestions	Contents of the recommendations/suggestions Assessment of the possible effect
1. Intensification of the development of the business model of banking ecosystems	*Content.* The ecosystem as a business model has as its core a strong and financially sustainable bank that is not only able to form a zone of attraction for partners, but is also interested in providing a safe space for transactions for customers and partners, which in fact guarantees the sustainability and economic value of the ecosystem for all its participants *Impact:* 1) formation of market centers for the accumulation of information on cyberthreats within the ecosystem and its circulation between the participants; 2) accumulation of experience against cyberattacks, and reducing their impact on members of the banking ecosystem; 3) scaling up and expansion of complex ICT solutions to secure banking infrastructure and client access devices *Examples of successful practices of applying:* CARTA (Continuous adaptive risk and trust assessment) methodology is implemented in the business model of the ecosystem headed by PJSC "Sberbank" — a special banking structure is constantly monitoring all risks arising in the ecosystem, and protective measures should be considered and implemented in each process, each participant, and the information interaction of the bank — heads of the ecosystem with partners is realized through multi-stage filter-system with implementation of OpenID Connect specification (framework OAuth 2.0) [a]
2. Establishment of a federal interbank registry of cybercriminal' accounts[b]	*Content.* Since 2018, an initiative on the creation of an interbank account register, with the help of which fraudsters withdraw stolen money, but until now its development remains at the level of private decisions of the country's largest banks, which does not allow a systematic approach to the problem *Impact:* 1) reduction of options for moving money abroad; 2) increased transparency and control of questionable transactions; 3) attraction of banks and fintech companies found to be complicit with hackers and fraudsters *Examples of successful practices of applying:* Saudi Arabia's banking regulator implements SOC–Center initiative, which holds the digital profile of each bank and Fintech-company, cyber-attack statistics, experience in their reflection and results of investigations into questionable transactions or bank and fintech fraud
3. Formation of a unified banking "polygon" to test software vulnerabilities	*Content.* Development of a joint infrastructure solution with the participation of the Bank of Russia, GC "Rostech" and the Association of Russian Banks — "testing sandbox" for testing of new software products and solutions in the field of cyber protection, as well as simulations of attacks on existing architecture of organization of protection business processes of banks by so-called "white hackers"[c] *Impact:* 1) formation of national methodology of software testing for vulnerabilities; 2) identification "back entrance" and spy codes in foreign software for banks and Fintech-services; 3) advanced training of specialists in the field of cybersecurity and the popularization of safe work; 4) conducting full-scale exercises of possible cyber-attacks of various scales *Impact assessment.* In the Russian Federation the formation of a testing platform for banking software vulnerabilities and information model architecture is regulated by the Federal Project "Information Security" (program "Digital Economy of the Russian Federation")[d] *Examples of successful practices of applying:* in the US in 2017 the concept of zero trust was adopted (zero trust even to users inside the perimeter of ICT-business architecture) and based on it, a commercial platform was created DataVisor Global Intelligence Network[e], allowing you to test bank software vulnerabilities for a fee, as well as design various scenarios of attacks

Table 4 (continued)

Recommendations/ suggestions	Contents of the recommendations/suggestions Assessment of the possible effect
4. Developing regulatory oversight of fintech services operations	*Content.* Currently, independent Fintech-companies operating outside of bank licenses are virtually unregulated in their operations. In particular, it should consider introducing regulation on such aspects as the introduction of the practice of screen scrapping (monitoring of operational risks), stricter rules of turnover and identification when using SIM-cards, phone numbers, service providers and hosts when renting servers *Impact:* 1) formation an open trust environment for exchanging information about unsafe customers and infrastructure; 2) formation of base of digital profiles of legal entities and individuals with assessment of risks of their financial behavior based on analysis of financial transactions and business operations *Examples of successful practices of applying:* Bank of England in 2015 initiated compulsory transition of banks to API (Application Programming Interface)[f], which will allow banks and the state regulator to identify at an early stage unsafe customers and telecom infrastructure facilities (for example, telecom providers) that provide implementation of potentially cyber-dangerous transactions
5. Development of practice of "cyber patronage" by banks — owners of ecosystems and administrators of super-services	*Content.* An alternative solution to ensure sufficient cybersecurity for small and medium-sized banks under the new cyberstability standards is to enter into a partnership agreement with the managers of ecosystem banks or super-service administrators to grant the right to use a secure infrastructure for a fee. In this case, the risks of attacks are distributed between the parties and both parties get synergistic effect from the interaction of granting the right to use the protected infrastructure for a fee: patrons — additional income, small banks — access to protected infrastructure and opportunity to develop new services and banking products on ecosystem landscape
6. Improvement of financial literacy of retail and corporate clients of banks and NCFO	*Content.* Russian Index of Financial Literacy (RIFL) in 2020 it was 54 points (in 2018–53, in 2017–52) [g], objectively not enough to create safe behavior in the context of the escalation of cyber threats. On this basis, a number of measures should be taken to promote safe behavior on the Internet in financial transactions, as well as to provide advice and education on current cyber threats in the form of TV-shows, podcasts on radio and popular social media forums, online meetings with cybersecurity professionals[h]

Sources: developed by authors based on [18–27]:

[a] Sberbank: ecosystem — new opportunities, new challenges to cybersecurity (11.01.2019). URL: https://www.it-world.ru/cionews/security/158287.html (accessed on 30.01.2022); [b] Cyberattacks on banks: trends, vulnerabilities and the role of regulator (27.07.2018). URL: https://plusworld.ru/professionals/kiberataki-na-banki-trendy-uyazvimosti-i-rol-regulyatora/ (accessed on 30.01.2022); [c] The results of a study of the market opinions on the development of financial technologies for 2021–2023 URL: https://www.accenture.com/_acnmedia/PDF-163/Accenture-Result-Research-Market-Opinion-Russian.pdf (accessed on 30.01.2022); [d] Execution of works on the creation of Cyber Range to training students, specialists and experts of various disciplines, managers in the field of information security and IT to modern security practices. URL: https://digital.gov.ru/uploaded/files/03kiberpoligontz.pdf) (accessed on 31.01.2022); [e] Gartner List: what technologies will help business in 2022 (18.11.2021). URL: https://habr.com/ru/company/netologyru/blog/590117/ (accessed on 31.01.2022); DataVisor. URL: https://www.weforum.org/organizations/datavisor (accessed on 31.01.2022); [f] Information and analytical review of "Russian Banking System Today" (September 2019). URL: https://asros.ru/upload/iblock/c30/20397_informatsionnoanaliticheskoeobozrenie sentyabr2019.pdf (accessed on 17.01.2022); [g] To measure the level of financial literacy: 3rd stage. URL: https://cbr.ru/analytics/szpp/fin_literacy/fin_ed_intro/ (accessed on 31.01.2022); [h] Strategy for improving financial literacy in the Russian Federation for 2017–2023. Order of the Government of the Russian Federation No. 2039 from 25.09.2017. URL: http://static.government.ru/media/files/uQZdLRrkPL AdEVdaBsQrk505szCcL4PA.pdf (accessed on 31.01.2022).

organization of the cyber-defense system in banks and NCFO. We consider that the article will be useful for all those who are interested in the issues of safe financial behavior, as well as those responsible for cyber security in banks, as well as the non-banking sphere, which has a close connection with the banking infrastructure (e-commerce segment, venture teams in the field of financial technologies, etc.).

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The Problem of Asymmetric Development of the Global Financial Market

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ABSTRACT

The transformation of the modern global monetary and financial system involves the elimination of institutional and functional contradictions existing at various levels. Some contradictions arose as a result of the asymmetric development of the global financial market (GFM). **The aim** of the article is to substantiate the asymmetry of the GFM development as an organic phenomenon, which, on the one hand, becomes a serious obstacle to the functioning and progressive development of the world economy, and, on the other hand, is the driving force behind this development. The authors apply general logical, theoretical, empirical, and special research **methods**. The origins of the asymmetric development of the GFM are determined. Endogenous and exogenous factors of GFM asymmetry were revealed. The article considers examples of asymmetry in various GFM segments. The negative impact of the global financial and economic crisis of 2008–2009 and the coronavirus pandemic on increasing the asymmetry of the GFM development has been determined. Based on the analysis of the key macroeconomic indicators of the top 20 countries in terms of GDP, the asymmetric nature and the absence of stable patterns that determine the country's position in the world ranking are revealed. The authors **conclude** that the asymmetry of the GFM development is an organic phenomenon, caused by a wide range of causes of endogenous and exogenous nature. Endogenous asymmetries can be partially compensated either through complete economic isolation, which is likely to lead to a slowdown in development and lagging behind other countries in the future or through active involvement in a system of world economic relations based on fair partnerships. Exogenous asymmetry, due to the peculiarities of the historically established world order, is destructive for all participants in the global economic system, including those whose interests must be protected in the first place.

Keywords: global monetary and financial system; global financial market; asymmetric development; endogenous and exogenous asymmetry factors; regulatory arbitrage; standardization of operations; regulation of the global financial market; fragmentation of the global financial market; macroeconomic indicators; currency composition

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INTRODUCTION

The transformation of the modern international monetary and financial system (IMFS) is due to the formation of a multipolar world economy [1, p. 191] and is aimed at ensuring its stability and sustainability by eliminating the institutional and functional contradictions and imbalances that exist at various levels. Many contradictions and disproportions of the IMFS arose as a result of the asymmetric development of the global financial market (GFM), which is one of the key elements of the IMFS, in the context of this study, defined as a set of mechanisms for the implementation of international monetary relations, including both the processes themselves and the institutions of financial intermediation, mobilization savings and distribution of credit, as well as the creation and management of money itself [2, p. 456].

Within the framework of the scientific school of the Financial University under the Government of the Russian Federation, GFM is understood as "the form of movement of world finance in certain parameters of international financial relations and the global financial system".[1] The GFM includes a set of interconnected national and international markets that ensure the redistribution of various financial products through financial institutions, which can be conditionally divided into mainly foreign exchange, stock, credit, insurance, and investment.

In practical terms, the GFM is an economic abstraction, since the trade in financial resources and its regulation are always carried out on the territory of a particular country or between countries. This can be traded in both national and international financial resources, in which both residents and non-residents can take part [3, p. 77]. It should be emphasized that, despite the active development over the past decades, the GFM should be considered, first of all, as an auxiliary (servicing) element of the world economic system. Without being tied to real assets, the GMF becomes an increasing abstraction, forming an illusory successful economy based on virtual assets (i.e. potential, not really existing, but possible, which can or should appear under certain conditions) that can instantly lose their value. The secondary, dependent nature of the GFM is confirmed, in particular, by the fact that "the asymmetry of world economic development, erroneous decisions in the choice of directions and prospects for the world economy cause violations and failures in the global financial system" [4].

The doctrine of symmetry originated in ancient Greece when philosophers and mathematicians studied the harmony of the world. In the context of this study, the authors share the point of view of A. V. Shubnikov and V. A. Koptsik that "structureless objects do not exist in nature", that "structurality is a fairly general form of the existence and development of matter",[2] and symmetry is "the law of the structure of structural objects or, more precisely, a group of permissible transformations that preserve the structural integrity of the systems under consideration" [5, p. 323, p. 383].

Socio-economic (social) systems have a complex structure, consisting of a large number of constantly interacting elements, but they, like natural systems, are characterized by a desire for harmonization by maintaining internal integrity and stability, which is ensured by the presence of symmetry. According to A. V. Shubnikov and V. A. Koptsik, "stationary symmetry of isolated systems can change only upwards", and "for dissymmetrization, it is necessary to expand the system, violating its isolation" [5, p. 352].

If we understand the symmetry of the GFM as a mirror correspondence of the interrelated socio-economic and financial parameters that characterize different countries of the world and their interaction and ensure a

[1] World Finance. Ed. by Eskindarov M. A., Zvonova E. A. Moscow: KNORUS, 2017. P. 22.

[2] In this case, we are referring to the social form of matter.

stable state of the world economy and world finances, then, in our opinion, the asymmetry of the financial market can be considered an organic phenomenon, which, on the one hand, becomes a serious constraint that impedes the further functioning and progressive development of the world economy, but, on the other hand, it is the driving force behind this development. Speaking about the financial system, it should be noted that its unstable state is more of a rule than an exception to the rule [6]. In this regard, it seems relevant to analyze the causes and consequences of the asymmetric development of the global financial market.

ORIGIN OF ASYMMETRY OF THE GLOBAL FINANCIAL MARKET

Since, as noted earlier, the GFM is by its nature a serving, secondary element of the global economic system, the origins of its asymmetry should be sought in the basic principles of building the world economy in general and the IMFS in particular. In our opinion, according to the sources of occurrence and the nature of the impact, the factors causing GFM asymmetry can be divided into endogenous and exogenous. Endogenous factors stem from the very nature of international economic relations; their elimination is impossible or impractical. Exogenous factors, on the contrary, are external in relation to the object under consideration and, as a rule, can be corrected. Let us consider in more detail the main factors of an endogenous nature that lead to asymmetry.

The instability of the GFM is one of the manifestations of its essence as a mechanism for the cross-border redistribution of various financial products, which breaks the isolation of the country's economic systems and thereby leads to their dissymmetrization, which, in turn, dissymmetries the GFM itself. Considering the economy of a single country as an isolated system, it can be argued that its state bodies have a sufficient set of tools to maintain internal symmetry and ensure economic balance, however, the possibilities for developing a closed system are significantly limited, therefore, sooner or later (depending on the availability of resources and a number of other factors) it will be forced to one degree or another to engage in the international exchange of goods. The financial stability of a closed state system is ensured primarily by the fact that, as a rule, one currency is used in the country, the issue and circulation of which are strictly controlled by a single center. That is why counterfeiting was recognized as a serious crime at all stages of the development of the Russian state. Strict penalties for counterfeiting banknotes are also established in most countries [7, p. 69].

When two countries enter into commodity exchange relations, their internal economic systems cease to be closed, isolation is broken and conditions for dissymmetrization are created. Along with new opportunities, cross-country commodity exchange gives rise to certain problems, as it disrupts the existing balance. First of all, the question arises of choosing the currency of the transaction, since the payment can be made in the currency of the exporter, in the currency of the importer, or in another currency other than the monetary units of the participants in the transaction.

If, for example, payment is made in the importer's currency, then the contractual amount of "foreign" currency enters the exporter's country, which, in order to restore equilibrium, should be directed to the purchase of the importer's country goods. Since, as a rule, transactions are carried out with the participation of a certain number of market participants, the circulation of "foreign" currency occurs in the exporting country, which, in the absence of state control and regulation, can lead to economic imbalance. In the event that all the "foreign" money that entered the country is immediately used to pay for goods from the importing country, the balance is not disturbed, and the economy continues to function in its usual format, using the advantages of international

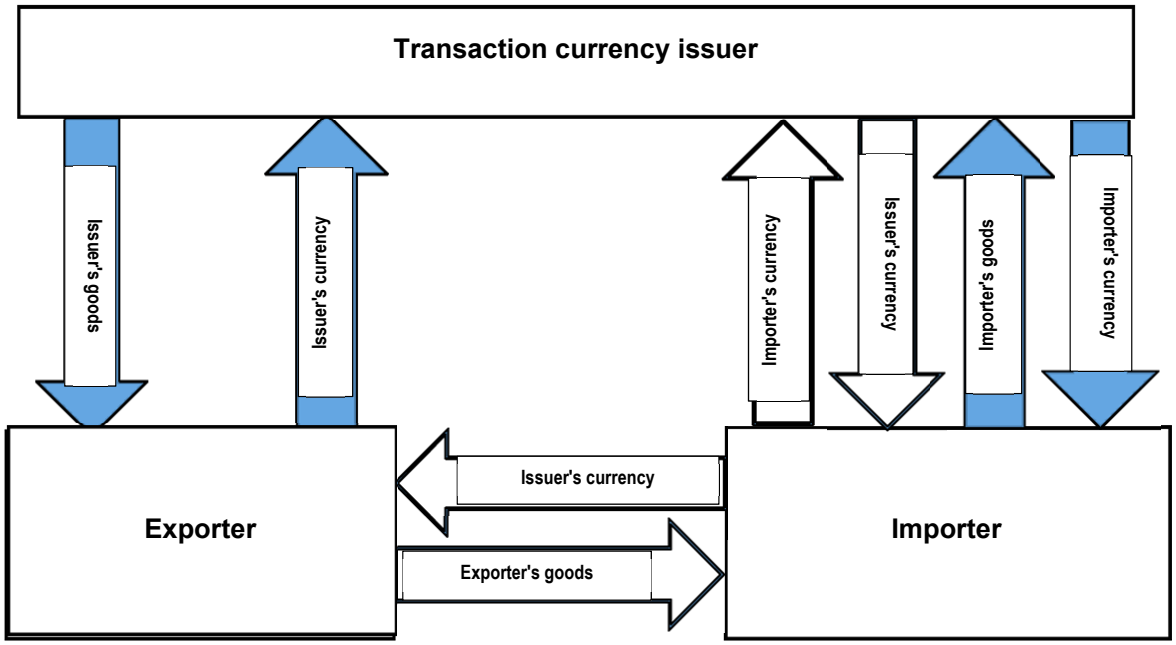

Fig. 1. **Model of maintaining the balance of three participants in cross-country commodity exchange**

Source: compiled by the authors.

trade. Such a model of foreign economic policy was, in particular, characteristic of the Council for Mutual Economic Assistance (CMEA) created after the Second World War, headed by the USSR [8, p. 255]. Foreign trade in the CMEA countries was a state monopoly, which completely ruled out the possibility of uncontrolled operations.

When using a currency other than the monetary units of the participants in the barter transaction as a means of payment, the situation is even more complicated, since the threat of economic imbalance arises among all market participants. The exporter must purchase the goods of the issuer of the "foreign" currency received by him, the importer must ensure the availability of the goods required by the issuer of the "foreign" currency, and the issuer of the currency, which needs to purchase the goods of the importing country, must return the "foreign" money previously exchanged on its currency, as well as to ensure the possibility of buying its goods for the exporter. *Fig.* schematically describes the situation above. Colored arrows indicate transactions that have a balancing nature in relation to the main transaction.

If all international trade transactions were symmetrical, then countries could agree that they would all be carried out, for example, in the exporter's currency. In this case, all currencies of all participants would actually receive the status of "international", but at the same time, each country pair must ensure the balance of bilateral export-import transactions, which significantly limits the possibilities of international trade due to different levels of economic development, different resource endowment, different involvement in the global division of labor and other regional differences between participants in foreign economic activity (FEA).

Thus, the rejection of economic isolation necessitates the internationalization of currencies, i.e. "the exit of the national currency beyond national borders by assuming the functions of (1) settlement and circulation, (2) accumulation, and (3) a universal measure of value in international economic relations"[3] and becomes an endogenous factor

[3] Internationalization of the ruble: Prospects and risks, as well as the role of the Russian ruble in foreign economic relations. Analytical note of the Bank of Russia, July 2017. URL: https://cbr.ru/Content/Document/File/16745/01.pdf (accessed on 10.04.2022).

Table

Functions of world money

Money function	Private use	Official use
Medium of exchange	Vehicle currency a) In goods exchange: – foreign trade vehicle; – domestic trade vehicle (direct currency substitution); б) In currency exchange: – FOREX vehicle	Intervention currency
Unit of account	**Quotation currency**	**Pegging currency**
Store of value	Investment currency (including indirect currency substitution)	Reserve currency

Source: Hartmann Ph. Currency Competition and Foreign Exchange Markets: The Dollar, the Yen and the Euro. Cambridge University Press. 1998. P. 14 [9].

predetermining the further asymmetry of both the IMFS as a whole and GFM in particular.

In our opinion, the most correct definition of the process of internationalization of currencies is the broad interpretation proposed by Ph. Hartmann, who, based on the analysis, concluded that "the internationalization of a currency begins when an individual agent or institution located in a country other than the country of this currency, accepts or uses it as a medium of exchange, a unit of account or a store of value" [9, p. 14]. As a result of internationalization, national money is transformed into international (global) money. Ph. Hartmann systematized the functions of international money as follows (*Table*).

The approach proposed by Ph. Hartmann allows one to form a comprehensive understanding of the functions of world money, which differ depending on the type of subject using them. As a rule, in the scientific literature, these sets of functions are analyzed separately, which does not give a complete picture of world money and can lead to erroneous conclusions about their role. Meanwhile, it is world money that becomes the main factor influencing the formation of the world order and predetermining the emergence of imbalances and contradictions associated with dissymmetrization.

The subject that carries out the official use of world money is the state represented by the central bank, the ministry of finance, and other similar structures. An agent appointed by the state affects the exchange rate of the national currency, interfering in the functioning of the foreign exchange market through interventions. Since the national currency can be exchanged for many foreign currencies, the agent first needs to determine the intervention currency. Intervention is carried out only in those currencies in which the central bank has certain reserves. Under conditions of floating rates, the central bank is forced to diversify the structure of its reserves in order to reduce the risk of their depreciation. Sometimes central banks choose an anchor currency against which the national currency rate must be maintained at a fixed level (or fluctuate within a certain interval). In this case, world money performs the function of a measure of value.

Private use in this context implies a broad interpretation that includes all types of commercial transactions. As a medium of exchange, payment currencies or, in other words, vehicle currencies can be used in barter and currency exchange transactions.

In turn, barter operations can be carried out both between countries (foreign trade operations) and within individual countries. Barter transactions give rise to the need to form a foreign exchange market, operations of which can be both bilateral (when one currency is exchanged for another by the type of "currency barter"), and multilateral using the world vehicle currency, which, as a rule, is the most "liquid" currency.

The quote currency is the currency in units of which the price of a good or asset is expressed if it differs from the national currency of the supplier of the good or the owner (issuer) of the asset. Investment currencies are currencies in which transactions with assets are carried out, including bonds, deposits, etc.

The participation of countries in world trade has always been unequal, therefore, as a result, some of them had a deficit in the balance of payments, while others (active exporters) had a large surplus, which created the prerequisites for an internal economic imbalance in both of them. If countries with a surplus could, for example, simply increase their reserves, then to compensate for the deficit, more active actions were needed (in particular, of a deflationary nature, which had a negative impact on their domestic economy), including with the participation of surplus countries (in particular, lending to "deficit" countries or buying their national currencies).

The competition of currencies that occurs during the process of internationalization reinforces the asymmetry, since some currencies are more universal and stable, and therefore are used more often than others. In economic history, various "currency wars" have repeatedly arisen, causing serious concern for the leaders of states, since they could arise unexpectedly and have a strong negative impact on the national economy. The active development of international trade has caused the need to coordinate the actions of the countries participating in foreign economic activity in the financial sector, which, in fact, is the basis of the world order, recognized and observed by most countries of the world. One of the key goals of the formation of the global world order is to minimize the negative consequences of dissymmetrization that occurs in the process of the development of world trade for endogenous reasons.

MANIFESTATION OF EXOGENOUS ASYMMETRY OF GFM

The asymmetry of the IMFS in general and the GFM in particular, due to endogenous reasons, is intensified under the influence of external factors related to the peculiarities of the established institutional and functional structure, as well as the mechanisms for its regulation at the national and supranational levels. Let us consider some examples of exogenous asymmetry in more detail.

Asymmetry as one of the problems of modern GFM has been studied in the works of a number of Russian scientists. In particular, L. Krasavina noted the discrepancy between the Jamaican monetary system and the new realities [10]. E. Rozhentsova believes that any asymmetry violates the stability of the monetary system and forces countries to leave it, which, in turn, reduces its quality as a whole [11]. E. Zvonova identified forms of asymmetry in the mutual exchanges of the Russian and European financial markets and analyzed the risks of the identified forms of asymmetry [12]. A. Kuznetsov drew attention to the asymmetry in access to capital markets [13].

One of the examples of exogenous asymmetry is considered, in particular, in the study of O. Butorina. Based on the analysis, she came to the conclusion that, although one of the main goals of creating a single European currency was to eliminate the asymmetry of the mechanism of collective floating of currencies, nevertheless, due to the weakening of the automatic stabilizers of the economy, the reduction of national monetary policy instruments and the growth of

interdependence the creation of an economic and monetary union retained a high degree of asymmetry [14].

The IMFS that has developed to date began to take shape after World War II and actually represents the implementation of the idea of creating the "American World" (Pax Americana), the foundations of which were laid by US President Wilson at the beginning of the 20th century [15, p. 133]. The special role of the United States in the modern system of world finance is emphasized, in particular, by experts from the European Central Bank [16]. They note the significant impact of changes in the US financial and economic system on the state of the economy and finances of the euro area countries. At the same time, problems arising in the financial and economic sphere of the euro area have a much smaller impact on the state of the US economy and finances (in contrast, for example, to an increase in the level of risk in the global financial system). Thus, the impact of changes in the GFM on the macroeconomic indicators of individual countries (or groups of countries) largely depends on what (or who) is the main driver of these changes. This is one of the manifestations of the exogenous asymmetry.

Liberalization of the functioning of the GFM at the turn of the 20th-21st centuries led to the growth of virtually generated profits and the separation of the prices of various financial assets from their economic basis, there was a "financialization of the world economy, i.e. advancing the development of the financial system in comparison with other sectors" [17, p. 6].

The increase in the volume of capital on the GFM contributed to a decrease in its value and an underestimation of investment risk. On the part of international investors, a markedly increased "appetite" for risk was noted, which as a result led to the phenomenon of its extremization, i.e. increased willingness of investors to take on existing risks [18]. On the other hand, companies and banks began to actively use cheap debt financing to develop their business to the detriment of the need to reduce their production costs. The weakening of control over operations at the GFM eventually destabilized the world economy, increased its asymmetry, making it more sensitive and receptive to various shocks and upheavals, and also led to the frequency and deepening of financial and economic crises at various levels. The climax in this respect was the global financial and economic crisis of 2008–2009.

The COVID-19 pandemic has become one of the exogenous factors intensifying the asymmetry in the development of GFM. Many enterprises have temporarily suspended their activities, severe restrictions on movement around the world have been imposed on individuals, a critical situation has developed in the financial markets, confidence on the part of business and market participants has been lost, and general uncertainty has increased. As a result, output in many countries dropped significantly, and consumer spending fell by a third.[4] Governments around the world have been forced to take unprecedented measures to combat the corona crisis, resulting in a sharp increase in public spending. In terms of its scale, the negative impact of the coronavirus pandemic on the global economy and global finances has significantly exceeded the consequences of the 2008–2009 crisis.

The Asian Development Bank Institute, based on a study of changes in macroeconomic and financial indicators of 38 countries (including 14 developing countries), concluded that as a result of the pandemic, developing countries (especially in Asia and Europe) suffered compared with developed countries [19]. The corona crisis has had a very negative impact on stock prices, bond yields, and the

[4] Global financial markets policy responses to COVID-19. OECD. 01 April 2020. URL: https://www.oecd-ilibrary.org/finance-and-investment/global-financial-markets-policy-responses-to-covid-19_2d98c7e0-en (accessed on 12.04.2022).

exchange rates of the national currencies of developing countries, and has also led to a sharp and significant outflow of capital. In addition, the influence of a number of global factors and the results of the activities of the world's leading financial centers on the state of the economy of developing countries was revealed.

In recent years, the asymmetric development of the GFM has also increased due to the active inflow of capital from China. If previously accumulated funds within the country were accumulated in the accounts of the People's Bank of China or used to develop the national economy, now domestic investors are looking for the possibility of diversifying investments in profitable projects in other countries [20]. The main driver of China's portfolio investment abroad is institutional investors, who are showing an increased interest in acquiring shares in high-tech companies in developed countries. In addition, Chinese portfolio investments in other countries are directed mainly to those sectors of the economy that are underdeveloped in China and are concentrated in those countries where these sectors of the economy are most developed. Moreover, the level of profitability of overseas portfolio investments is by no means always the determining motive for Chinese institutional investors. As a result, the massive influx of Chinese domestic savings to the GFM, which are distributed there extremely unevenly, disrupts the symmetry and balance of its development.

The analysis of statistical data carried out by the authors as part of the study allows us to illustrate the presence of asymmetry in various segments of the GFM. For example, according to the Bank for International Settlements (BIS), at the end of Q4 2021, the share of the US dollar in the total volume of outstanding international debt securities in the international debt market was 47.1%, the share of the euro was 38.3%, the share of the pound sterling — 7.9%, and the share of the Chinese yuan — only 0.4%.[5] At the same time, according to the World Bank (WB), in 2021, the United States accounted for 23.9% of global GDP (current US$), China — 18.5%, the euro area — 15.1%, and the UK share — 3.3%.[6]

According to the IMF, in the fourth quarter of 2021, the total volume of official international reserves reached a value equivalent to 12,937.27 billion US dollars, of which the US dollar accounted for 58.9%, the euro — 20.6%, the Japanese yen — 5.5%, the pound sterling — 4.8%, the yuan — 2.8%.[7] It is obvious that the US dollar still remains the main world reserve currency, which is a direct consequence of the historically established structure of the world monetary system. The absence of an equivalent alternative contributes to the preservation and strengthening of the role of the US dollar as the main world currency, although the economic role of the United States is gradually becoming less significant: if in 1960 the US accounted for almost 40% of world GDP, then over the period from 2000 to 2021, the share of the United States in world GDP, calculated in accordance with purchasing power parity, fell from 20.9% to 15.7%.[8]

Among the currencies of developing countries, the most widely used currency internationally is the Chinese yuan. According to SWIFT, in January 2022, the yuan ranked fifth in terms of share in the total volume of international payments with a share of 2.3% (for comparison: in January 2020 it was eighth with a share of 1.1%). However, the most universal settlement currencies remain the US

[5] Calculated by the authors based on BIS database. URL: https://stats.bis.org (accessed on 12.04.2022).

[6] Calculated by the authors based on World Bank database. URL: https://databank.worldbank.org/source/world-development-indicators# (accessed on 01.08.2022).

[7] Calculated by the authors based on IMF database. URL: https://data.imf.org/?sk=E 6A5F467-C 14B-4AA8–9F6D-5A09EC 4E 62A4 (accessed on 29.07.2022).

[8] Calculated by the authors based on World Bank database. URL: https://databank.worldbank.org/source/world-development-indicators# (accessed on 04.08.2022).

dollar and the euro, which account for 80.5% of all international payments.[9]

In terms of total global payments, according to SWIFT,[10] in January 2022, the combined share of the US dollar and the euro accounted for over ¾ of all payments, although the combined population living in the US and the euro area is only 8.7% the population of the earth.[11] At the same time, the yuan ranked fourth in terms of share after the leading world currencies with a share of 3.2% (for comparison: in January 2020, it was sixth with a share of 1.7%), although almost 18.2% of the world's population lives in China, and the Indian rupee was not included in the twenty leading world currencies, although almost 17.8% of the world's population lives in India.[12]

The debt market is also asymmetric [21, p. 264]. The combined share of the US, UK, and euro area countries accounts for about 54% of global external debt (9.5% of the world's population), while China, India, Indonesia, Brazil, and Russia, whose combined population exceeds 44% of the world's population, account for only 5.2%. Almost 88% of the world's external debt falls on just 20 countries of the world.[13]

As part of the study, the authors analyzed the key development indicators of the twenty largest countries in the world in terms of GDP in order to identify the degree of dissymmetrization of the GFM. The results indicate that, for example, in terms of the size of the monetary aggregate M2, which is the money supply in the national definition,[14] China is the absolute leader, the money supply of which exceeds the money supply of the United States following it by almost 1.8 times, and the money supply ranked third Japan — 4.2 times.

The highest monetization ratio (227.8%) is in the Chinese economy, which, apparently, is one of the factors providing rapid economic growth. It is worth noting that the high level of monetization of the Chinese economy is not accompanied by an increase in inflation — over the past five years, the maximum annual inflation rate in the country did not exceed 2.9% (2019), and in 2021 inflation was only 1%.[15] In second place is Japan (180.1%), in third is South Korea (161.5%), in fourth is Switzerland (140.4%), and in fifth is the UK (124.7%). The United States was in tenth place with 95.1%, and Russia was in the fifteenth (48.6%).

China is the leader in terms of official international reserves. Its official international reserves are more than five times that of the US. In terms of "Total Official Reserves in Months of Imports", Saudi Arabia ranks first, outperforming the United States by more than 14 times. Russia is in third place, and China is in sixth place (slightly behind Brazil).

At the end of 2020, the maximum net inflow of foreign direct investment (FDI) as a percentage of GDP was noted in Germany (2.93%), Mexico was in second place (2.89%), Spain was in third (2.63%), on the fourth — Brazil (2.62%), on the fifth — Indonesia (1.81%). In 2020, three G20 countries saw a net outflow of FDI — Switzerland (–34.21% of GDP), the Netherlands (–16.34% of GDP), and Italy (–1.17% of GDP).

An analysis of the current account of the balance of payments shows that in 2021, only thirteen of the top 20 largest economies in the world had surpluses, ranging from $ 287.57 billion for Germany to $ 0.45 billion for Mexico. China ranked second in this ranking with $ 277.15 billion. In addition to the countries mentioned, current account

[9] Official website of SWIFT. URL: https://www.swift.com (accessed on 13.04.2022).

[10] Official website of SWIFT. URL: https://www.swift.com (accessed on 13.04.2022).

[11] Calculated by the authors based on World Bank database. URL: https://databank.worldbank.org/ (accessed on 12.04.2022).

[12] Ibid.

[13] Ibid.

[14] Official website of Bank of Russia. URL: https://cbr.ru/statistics/macro_itm/dkfs/monetary_agg/ (accessed on 13.04.2022).

[15] World Bank database. URL: https://databank.worldbank.org/ (accessed on 12.04.2022).

surpluses are recorded in Japan, Italy, Canada, South Korea, Russia, Australia, Spain, the Netherlands, Saudi Arabia, and Switzerland. The United States has the largest negative current account balance (–$ 796.12 billion), followed by the UK (–$ 104.62 billion), France (–$ 48.99 billion), India (–$ 30.37 billion), Turkey (–$ 19.35 billion), Brazil (–$ 8.53 billion) and Indonesia (–$ 3.11 billion).

Thus, the results obtained allow us to conclude that the main indicators of the economic development of the twenty largest countries in the world are absolutely asymmetric, there are practically no stable patterns that determine the country's position in the world ranking.

IMPACT OF REGULATION ON ASYMMETRIES OF MODERN GFM

The existence of regulatory arbitrage, the meaning of which is the use of special strategies by market participants to avoid severe pressure from national regulators (in particular, by transferring trade abroad or transferring the activities of financial institutions to other jurisdictions) is one of the exogenous factors that increase the asymmetry of the GFM. Such arbitrage can provoke regulatory competition between different jurisdictions, which may respond to the movement of financial services (or the threat of movement) by relaxing their regulatory standards. Although competition between different countries in the field of regulation has certain advantages in the form of the search for effective regulatory standards, however, a significant risk lies in the fact that countries lower their standards solely for the sake of attracting business and thereby have a negative impact not only at the GFM, undermining global financial stability [22], but also on the world economy as a whole, contributing to the deepening of existing imbalances and contradictions.

After the 2008–2009 crisis experts drew attention to the need for stricter regulation at the GFM of the activities of not only banks, which turned out to be the most vulnerable market participants, but also other organizations that also have a significant impact on ensuring financial stability [23]. Along with this, an increase in political influence on the financial and economic system (especially in developing countries) was noted. The allocation of public investment resources was carried out extremely asymmetrically (funds were received mainly by companies that have formal or informal relations with government officials). As a result, the efficiency of investments turned out to be at a low level, which negatively affected the economic development of countries [24].

According to some researchers [25], the lack of an adequate level of standardization of the operations carried out, as well as the products and services offered by the GFM, reduces the efficiency of its activities, weakens competition between participants, and hinders the introduction of innovative financial instruments. The main reason is the underdevelopment of institutions that set appropriate performance standards for the GFM (unlike, for example, the electronic and electrical industries, healthcare, etc.).

At the GFM, standardization is most developed in the field of messaging about completed trade transactions, payments, and settlements (the so-called transactional standards). Standardization is not sufficiently developed in the area of accounting for financial risks by individual corporations when aggregating the necessary data and existing risks. This poses challenges with the need to comply with new post-crisis regulatory requirements for OTC trading collection and reporting, data aggregation, and risk assessment, as well as compliance with the banking and exchange Know Your Customer (KYC) counterparty identification procedure.

In order to solve existing problems in the field of standardization of the GFM, a report prepared by a group of scientists for the UK government proposes to create a supranational body for the management of

standards for the GFM, which will provide oversight of both the compliance with established standards and compliance with the basic principles of financial activity [25, p. 72]. At the same time, it is noted that the creation of such a body will only make sense if it can help improve the efficiency of practical activities at the GFM. In the near future, the main focus is proposed to be on establishing an informal dialogue between regulators and financial market participants in order to discuss various problems related to setting standards for the GFM. It is obvious that such coordination will not solve the key problems of the functioning of the GFM, but it can help to smooth out the existing contradictions and imbalances.

The asymmetric development of the GFM can cause a new financial crisis if funds are excessively concentrated in a certain market segment, a certain geographical region, or a certain type of financial asset. In this regard, after the crisis of 2008–2009, the national central banks tightened control over operations in the financial market. For example, in the United States and the European Union (EU), the largest banks are required to periodically report on the largest loans issued by them, and in India, banks are required to provide information on the 20 largest borrowers every month [26]. Based on the analysis of information provided by banks, the central bank determines the degree of the aggregate credit risk of the national banking sector.

The asymmetric development of the GFM is also intensifying as a result of the complexity of its infrastructure and the emergence of new cross-sectoral and transnational financial products and instruments. This requires new approaches to regulating operations at the GFM and overseeing the activities of its participants and their compliance with established market rules. After the global crisis of 2008–2009, a number of international organizations (Group of 20, OECD, Financial Stability Board, and BIS) have established stricter rules and regulations for the GFM, but it has not been possible to significantly strengthen the supervision of the GFM participants, since these functions are carried out at the national, and not at the international level. Recently, the EU has been discussing the issue of changing the existing system of supervision over the largest exchanges, central counterparties, and depositories by establishing direct centralized supervision by a specially authorized body [27, p. 23].

A number of experts in their studies note the strengthening of the asymmetry of the GFM in connection with the use of new high-tech financial instruments. In particular, a significant asymmetry was revealed in the segment of virtual financial assets associated with the use of bitcoin [28]. S. Glaz'ev drew attention to the fact that the modern information technology system of the financial market operates on automatic algorithms performed by robots, whose operations are programmed according to certain rules. The application of these rules is strict, generating periodic financial market failures [29, p. 7].

One of the drivers of the asymmetric development of the GFM in recent years is its increased fragmentation. It is based on various reasons: natural barriers and disagreements (for example, investor preferences regarding the object and type of investments), differences in the level of development of financial systems (for example, the depth and volume of capital markets), the presence or absence of synchronization of financial cycles, differences in taxation systems and the level of competition in individual countries. Market fragmentation can also arise from differences in financial regulation and supervision. Moreover, the reason for this may be not only national or regional rules used to regulate international activities, but also different approaches to the use of international principles and standards in individual countries or their inconsistent and

contradictory application by national financial regulatory and supervisory authorities. As a result, bona fide market participants may opt out of cross-border activities in order to avoid the associated increase in costs and excessive supervisory pressure.

Fragmentation can not only exacerbate the asymmetry in the development of the GFM but also increase financial instability. At the same time, according to some experts, a compromise can be found between market fragmentation and financial stability. To do this, it is necessary to assess the overall social costs and benefits of fragmentation and understand whether the existing market fragmentation is capable of increasing systemic risk to a critical level. Then, an action plan should be developed that can reduce fragmentation and increase financial stability. The final stage is the choice of the most effective instrument of state intervention in the functioning of the market [30]. On the other hand, according to BIS experts [31, p. 3], the development of financial markets in developing countries is hampered by excessive state control, as well as the lack of the necessary legal framework and an effective regulatory system.

Although over the past thirty years a differentiated approach to the specialized management of global finance has brought certain results in terms of their greater control and manageability, however, along with this, there has been an increase and expansion of the shadow banking business. Separation of financial regulation without linking it with other segments of the world economy has led to an increase in the desire of financial intermediaries to make a profit at any cost (including through the use of the imperfection of the management mechanisms of the GFM). As a result, at the supranational level, it was not possible to achieve a greater balance of the world economy, since the management and regulation of the global financial system should be synchronized with the management and regulation of world trade and investment flows.

Some experts directly point out the fallacy of the idea that the international financial order can exist separately from the world monetary, trade, and investment order and be regulated by specific standards specially developed by the relevant supranational institutions represented by the Basel Committee on Banking Supervision and the Financial Stability Board [32, p. 3]. The authors share this point of view, because, as noted earlier, they consider the GFM to be a serving element of the world economic system. However, this does not mean that it is impossible to smooth out existing imbalances and contradictions with the help of financial regulation measures. At the same time, as a result of insufficiently effective management by various regulators, the asymmetry in the development of the GFM may increase.

CONCLUSION

The analysis of the GFM carried out by the authors made it possible to theoretically substantiate the conclusion about the asymmetry of its development as an organic phenomenon, which, on the one hand, becomes a serious obstacle to the functioning and progressive development of the world economy, and on the other hand, is the driving force behind this development. The asymmetry of GFM development is due to a wide range of endogenous and exogenous causes. Endogenous reasons inherent in the very nature of intercountry relations are primarily associated with significant regional differences that characterize different countries of the world, forcing them to enter into international trade, and thereby breaking economic isolation, which, in turn, leads to dissymmetrization. Resource provision, climate, territory, population, customs, and traditions, historical features have a significant impact on the level of economic development of individual countries, which determines their role and place in the world economy.

Since economic isolation is likely to slow down development and lag behind other

countries, the negative consequences of endogenous asymmetry can be partially compensated only by building a system of fair partnerships between countries that take into account, to the maximum extent, the national interests of all participants. The complete elimination of endogenous asymmetries is not possible, which under certain conditions can be considered as a positive factor that disrupts the economic balance and thus compels the search for ways and solutions aimed at further development. There are many examples in world economic history when limited resources forced countries to make technological breakthroughs in order to ensure the transition of the national economy to a qualitatively new level.

Exogenous can be considered a wide range of factors related to the foundations of the historically established world order, the peculiarities of the regulation of international financial and economic relations in general, and the GFM in particular. The destruction of the bipolar world that emerged after the Second World War (the US and its allies vs the USSR and its allies) led to the creation of a unipolar IMFS dominated by one national currency. The liberalization of the economy in the context of the emerging unipolar world order means the unconditional submission of all participants to the rules established by the main world power, the role of which is played by the United States. In return, the United States took on the responsibility of maintaining world stability, which they were unable to cope with, which became even more obvious after the 2008–2009 crisis. The model of the world order actively promoted by the United States temporarily strengthened its position due to the collapse of the USSR, since the countries of the collective West in the 1990s gained simplified access to new markets and sources of resources, and the former socialist states were forced to accept the rules imposed on them.

If after the Second World War the United States was the most powerful state in the world, which only the USSR together with the allied countries could compete with, now the situation has changed dramatically: the economic influence of the United States and other developed countries is steadily weakening, and the role of developing countries, on the contrary, is gradually increasing. It is becoming more obvious that the current model of the world order is outdated and has become not only a deterrent but also a real threat to its existence. The exogenous asymmetry due to the peculiarities of the historically established world order, in our opinion, is destructive for all participants in the world economic system, including those whose interests should be protected.

The special military operation conducted by Russia in Ukraine increases the risk of violating the stability of the existing IMFS and may further increase the asymmetry of the further development of the GFM. Reassessment of existing risks could exacerbate problems that arose during the COVID-19 pandemic and lead to a sharp decline in financial asset prices. According to the IMF experts, exogenous factors of increasing asymmetry in the GFM can be inflationary pressure due to commodity price fluctuations, direct and indirect risks of banks and non-bank financial intermediaries, commodity market failures, increased counterparty risks, reduced market liquidity, difficulties with funding, as well as cyber-attacks that negatively affect the stability of the GFM participants.[16] Although the IMFS was able to cope with the consequences of the global crisis of 2008–2009 and the coronavirus pandemic, future shocks could be more devastating.

Asymmetries will also widen as countries face worsening external financing conditions due to growing geopolitical uncertainty, which could lead to a reduction in portfolio

[16] Global Financial Stability Report. April 2022. International Monetary Fund. URL: https://www.imf.org/en/Publications/GFSR/Issues/2022/04/19/global-financial-stability-report-april-2022 (accessed on 02.07.2022).

investment inflows. To contain inflation, many countries will have to raise interest rates well above the usual average. Such actions may complicate and slow down the recovery of the global economy after the pandemic and a new round of crisis caused by the active sanctions policy.

In the short term, we can expect a further increase in fragmentation of the GFM's debt segment based on currency diversification, which could lead to a decrease in the global influence of the US dollar. In addition, due to the possible introduction of central bank digital currencies in different countries, the fragmentation of the global payment system may increase. Taking into account the growing differences in the world between individual countries and groups of countries, the consolidation of efforts to solve existing problems on the basis of multilateral cooperation at this stage seems unlikely.

It seems that the problem of the asymmetric development of the GFM will continue to remain relevant and acute and will be perceived by market participants as a normal phenomenon that must be taken into account, and different countries will respond to manifestations of the asymmetry of the GFM individually, smoothing out the contradictions and imbalances that arise with the help of tools existing in their disposal.

In order to overcome the exogenous asymmetry, the world is likely to be divided into several blocks with the creation of internal payment systems that will build financial and economic relations in a new way and interact with each other in the interests of their participants, and the issues of creating reserve instruments, apparently, will be decided by the associations themselves, depending on the composition of their members. This trend has already become irreversible, since even the IMF report published in July 2022 noted that in the medium term, a serious risk is the fragmentation of the world economy into geopolitical blocs with clearly distinguishable technological standards, cross-border payment systems, and reserve currencies.[17]

The authors express the hope that the results of the analysis carried out can become the basis for future scientific research within the framework of this topic, and the author's calculations and conclusions can be used in educational activities related to the world economy and world finance.

[17] Official website of information agency Rosbizneskonsalting. URL: https://www.rbc.ru/economics/29/07/2022/62e281919a7947ba48758474 (accessed on 29.07.2022).

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Factors and Directions of Transformations of the Integration Financial and Economic Cooperation of the EAEU Countries in Modern Conditions

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ABSTRACT

The article defines and analyzes the features, factors, and directions of transformation of the model of regional monetary and financial integration of the countries of the Eurasian Economic Union (EAEU). The **aim of the study** is to develop and systematize a set of measures to develop the investment direction of integration cooperation between the EAEU countries, reduce their dependence on the highly volatile international economic and financial environment and neutralize the negative impacts of Western sanctions for national economies. The **objectives** of the study are as follows: analysis of trends and problems of the investment process in the economies of the EAEU countries for 2013–2021, substantiation of proposals and recommendations for optimizing the model of integration financial and economic cooperation of the EAEU countries based on increasing the regulatory role of the state and regional financial institutions in attracting investments. The research **methodology** includes the analysis of the EAEU legal framework, statistical information, official reports of state bodies of the EAEU countries and the Eurasian Economic Commission, regional development institutions, scientific monographs and publications of Russian and foreign economists, and periodicals. Based on the **methods** of econometric analysis, the expediency of introducing into circulation a monetary unit of collective use of the EAEU countries independent of the US dollar and euro for mutual settlements is substantiated. The authors **conclude** that it is necessary to supplement and, in some cases, substitute the predominantly market-oriented model of Eurasian financial and economic integration with a regulatory investment model of regionalization with an increased role of national and regional management institutions in promoting integration processes.

Keywords: regional integration model; EAEU; economic sanctions; investments; investment financing; integration regulation mechanisms; regional development institutions; fiscal regulation; strategic planning; EAEU single payment system; collective currency

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INTRODUCTION

Recently, fundamental processes of transformation have been taking place in the global economy, accompanied by a stiffer competition between countries and regions for access to commodity and raw materials and investment resources. In the new realities, a polycentric model of the system of international financial and economic relations is being formed on the basis of regional and interregional institutional associations using new conceptual forms and mechanisms of integration investment cooperation, the role of regional institutions in the formation of a global financial security network is increasing [1, 2]. In the scientific expert community, in the leadership of the Eurasian integration bodies, topical problems of the development of the economies of the EAEU countries, features and directions for improving Eurasian integration cooperation in modern conditions are comprehensively discussed.

The EAEU has a high geo-economic potential, however, as an analysis of mutual trade in goods and services, as well as investment cooperation between the EAEU countries, shows, the degree of economic integration does not meet the interests of strengthening Eurasian cooperation [3]. The recent increase in political, trade, and financial sanctions aimed at forcing individual

countries to comply with the requirements of economically strong states and blocs requires active action on the part of the EAEU to counter these threats and protect sovereignty by increasing the competitiveness of national economies and active joint investment and innovation activities [4]. The modernization of the economy and the development of integration of the EAEU countries are possible based on the development and implementation of a rapid development strategy as a set of key measures to ensure the growth of production and investment, as well as through the formation of the general budget of the EAEU, pursuing a balanced macroeconomic policy, stabilizing the exchange rates of national currencies and expanding the scope of their use in mutual settlements.[1]

Given Russia's critical role in pricing on the global energy market, additional opportunities are being created for settlements in national currencies, reducing the economy's dependence on external conditions [5]. The creation of a common financial market of the EAEU countries takes a special place in the context of the new paradigm of Eurasian integration the criterion for the effectiveness of which is to ensure the inflow of long-term investments in the real sector, in the modernization and sustainable growth of national economies [6].

An important role in financing long-term investments in the economies of the EAEU countries is assigned to the Eurasian Development Bank (EDB), which, along with the investment function, also performs a financial function, contributing to the formation and development of a common financial market. At the same time, the lack of a common vision by the EAEU countries of the strategic role and tasks of the EDB in integration processes remains a problem [7]. The contradictory experience of financial and economic integration in the European Union (EU) confirms the conclusion that the development of various areas of innovative modernization of the economy, including the new industrialization of the Eurasian Economic Union, should be based on a unifying ideology of equal Eurasian partnership and development of the countries of the region, in contrast to the neoliberal ideology of Western-type regional integration, which ensures the dominance of corporate and private interests of the political and economic elites of its participants [8].

Considerable attention is paid to the study of problems and prospects of regional financial and economic integration in the scientific publications of the Financial University under the Government of the Russian Federation. In particular, the collective monographs of recent years have comprehensively studied the issues of structural transformations in global and regional finance [9], disclosed the goals, features and prospects of strategic planning in priority sectors of the economy at the regional and country levels [10], approaches and directions for the adaptation of Russia and other emerging market countries to new trajectories for the development of international financial relations are determined [11].

FEATURES OF A MARKET-ORIENTED MODEL OF REGIONAL MONETARY AND FINANCIAL INTEGRATION

Historically, integration processes on the European continent within the EU and in the Eurasian Space within the EAEU have generally similar conceptual models. The paradigm of the laws of classical economic integration is based on the general methodological approaches formulated in the theory of economic integration by B. Balassa. The algorithm of the market integration model provides for a gradual change in the institutional forms of economic integration with the transition from a free trade area to an economic and monetary union based on a common European capital market [12–14]. The final link in full-fledged integration is the creation of a supranational administrative

[1] Glazev S. Yu. Report "On Strategic Directions for the Development of the EAEU" dated February 25, 2020. URL: https://glazev.ru/articles/6-jekonomika/76650-o-strategicheskikh-napravlenijakh-razvitija-eajes (accessed on 18.07.2022).

structure.[2] In accordance with the paradigm of the evolutionary approach, R. Mundell's theory of the optimal currency area was also developed. The main message of the theory lies in the possibility of realizing the benefits of a monetary union only if there is a close correlation between the business cycles of integrating countries and a high degree of mutual openness of national economies and internal factor mobility [15].

Since the early 2000s, in the process of creating the Economic and Monetary Union in the European Union, priority has been given to the creation of a market-oriented model of financial regionalization, which is seen as a key component of the overall institutional structure of economic integration [16]. At the same time, the monetary union in the new design was not supported by the creation of real economic, budgetary, and tax unions [17]. The mixed model of centralized management of the sphere of monetary circulation, combined with decentralized budgetary and tax policies, predetermined the high degree of vulnerability of the European Economic and Monetary Union (EMU) as an integration project. According to M. Demertzis and N. Viegi, employees of the European think tank Bruegel, "in order to curb the overly expansionary nature of the ECB's monetary policy, closer fiscal cooperation between the countries of the European EMU and an understanding of the fact that monetary union imposes such strategic interdependencies is necessary, that need to be taken into account".[3] The result of the incompleteness of the regional project was the increased vulnerability of the entire EMU structure to internal and external shocks, which was most clearly manifested at the peak of the COVID-19 pandemic [18, 19].

The conceptual model of the European EMU in general terms was also tested in the Eurasian Space. By the decision of the Interstate Council of the EurAsEC at the level of heads of state No. 220 dated June 22, 2005, the Concept of Cooperation of the Member States of the Eurasian Economic Community in the Monetary Sphere was approved.[4] The document, by analogy with the European Union, is based on the methodology of an evolutionary step-by-step approach. In the process of its implementation, in 2010, the Customs Union was created in the Eurasian space, and in 2012, the Eurasian Economic Space. These first institutional forms of economic integration became the basis for the creation of the Eurasian Economic Union in 2014.

The institutional basis for financial and economic integration in the EAEU is based on the following regulatory principles:

1) liberalization of currency regulation, the use by the EAEU countries of the regimes of the floating exchange rate of national currencies and the freedom of cross-border movement of factors of production, including capital;

2) the priority of the monetary policy of the central banks of the EAEU countries, aimed at ensuring price stability, excluding its active role in stimulating production activities;

3) determination in the EAEU, by analogy with the Maastricht Treaty in the European Union, of a triad of quantitative financial criteria in order to maintain macroeconomic stability in the EAEU countries:

- the annual deficit of the consolidated budget of the public administration sector of

[2] According to B. Balassa's theory, economic integration is defined both as a process and as a state. As a process, it implies a set of measures aimed at eliminating discrimination between economic units belonging to different states; presented as a state, it implies the absence of any form of discrimination between the economies of individual countries. The forms of eliminating discrimination are the free trade area, the customs union, the common market, and the economic union (Economic integration. Bela Balassa. Economic theory/Ed.: corresponding member of RAS B.C. Avtonomov. Moscow: Infra-M; 2004. P. 931).

[3] Demertzis M., Viegi N. Policy coordination failures in the euro area: not just an outcome, but by design. Bruegel Blog. 20 December 2021. URL: https://www.bruegel.org/2021/12/policy-coordination-failures-in-the-euro-area-not-just-an-outcome-but-by-design (accessed on 18.07.2022).

[4] The Concept of Cooperation of the Member States of the Eurasian Economic Union in the Monetary Sphere (approved by the Decision of the Interstate Council of the EurAsEC dated June 22, 2005 No. 220). URL: http://www.evrazes.com/docs/view/66 (accessed on 18.07.2022).

the EAEU countries at the level of no more than 3% of GDP;

- the debt of the general government sector should not exceed 50% of GDP;
- the level of inflation in a member state of the EAEU cannot exceed by more than 5 p.p. inflation rate in the member country of the association, in which this indicator has the lowest value.

The principles and criteria for its creation, initially laid down in the design of the Eurasian Economic Union, predetermined the predominantly market model of regulation of the Eurasian financial and economic integration, which was subsequently supplemented by two interstate investment promotion institutions — the Eurasian Development Bank and the Eurasian Fund for Stabilization and Development (EFSD). However, these institutions, having relatively small resources, do not have a significant impact on investment processes in the region. With the weak development of national financial markets in the EAEU, a unified regional budget has not been formed as a source of financing for common investment projects, there is no unified fiscal policy that contributes to the financing of long-term investments in the economy of the EAEU countries.

FACTORS OF TRANSFORMATION OF THE MARKET-ORIENTED MODEL OF FINANCIAL AND ECONOMIC INTEGRATION OF THE EAEU COUNTRIES

As practice confirms, the predominantly market-oriented financial zoning model operating in the EAEU does not solve the problems of regional integration traditionally associated with structural imbalances in the economies of the association countries, low levels of investment in fixed capital, and the incompleteness of creating a single internal market. Under the influence of the aggravation of systemic, financial, market, and sanction risks for economic entities, in some EAEU countries and in the region as a whole, weak economic growth rates are observed (*Table 1*).

Pervasive underfunding of industrial investments in the economies of the EAEU countries has become one of the main factors in the transition to a new model of Eurasian monetary and financial integration. The low and unstable economic growth rates in the EAEU are largely due to the low level of investment, which tends to decrease in Armenia, Belarus, and Kyrgyzstan (*Table 2*).

The most acute problem of lack of investment in the economies of the EAEU countries manifested itself in 2020 at the peak of the COVID-19 pandemic. At the beginning of 2021, the total volume of accumulated direct investments in the EAEU from all countries of the world decreased by 5.8% and amounted to $ 731 billion. The share of mutual accumulated investments of the EAEU countries in their total volume at the beginning of 2021 amounted to 2.3%. The predominant instruments of mutual direct investment are investments in the capital of companies, including reinvestment of income, investments in shares, and shares of investment funds. At the same time, there is a low level of investment in new projects, primarily in R&D. In the first quarter of 2021, the total volume of investments in the EAEU countries (out of all countries of the world) in the amount of $ 7.1 billion, the share of mutual investments was 9%.[5] In recent years, Russia and other EAEU countries have been dominated by the share of their own funds in financing investments, and this share tends to grow. For example, in Russia, according to the Ministry of Economic Development, this share increased from 51.3% to 56.7%[6] over the period from 2017 to 2020.

Along with traditional structural problems, the negative consequences of the COVID-19 pandemic for the EARU countries and strict

[5] Mutual investments of the EAEU Member States. Eurasian economic information. Express Information July 8, 2021. URL: http://www.eurasiancommission.org/ru/act/integr_i_makroec/dep_stat/fin_stat/express_information/Documents/mutual_investments/express_mi_4Q2020.pdf (accessed on 18.07.2022).

[6] Investments in fixed assets in the Russian Federation in 2020. 2021. P. 8. URL: https://rosstat.gov.ru/storage/mediabank/SRseY 8Jp/inv_osn2020.pdf (accessed on 18.07.2022).

Table 1

Indices of physical volume of GDP of the EAEU countries in 2013–2021, %

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average for 2013–2021
EAEU	102.1	101.1	98.4	100.2	102.1	103.0	102.4	97.3	104.6	101.2
Armenia	103.3	103.6	103.2	100.2	107.5	105.2	107.6	92.6	105.7	103.2
Belarus	101.0	101.7	96.2	97.5	102.5	103.1	101.4	99.3	102.3	100.6
Kazakhstan	106.0	104.2	101.2	101.1	104.1	104.1	104.5	97.5	104	103.0
Kyrgyzstan	110.9	104.0	103.9	104.3	104.7	103.8	104.6	91.6	103.6	103.5
Russia	101.8	100.7	98.0	100.2	101.8	102.8	102.2	97.3	104.7	101.1

Source: IMF. URL: https://www.imf.org/en/Publications/WEO/weo-database (accessed on 18.07.2022).

Table 2

Dynamics of the total volume of investments in the economy of the EAEU countries in 2013–2021, % of GDP

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average for 2013–2021
Armenia	22.1	21.0	21.2	18.0	18.4	22.4	17.4	17.9	16.1	19.4
Belarus	38.8	34.8	29.0	26.5	28.0	28.1	29.2	26.3	25.6	29.6
Kazakhstan	24.6	25.8	27.9	27.8	26.4	25.3	27.6	28.5	26.6	26.7
Kyrgyzstan	33.5	36.4	34.3	31.6	30.7	27.7	26.4	18.6	26.4	29.5
Russia	23.3	22.4	22.1	23.1	23.6	21.9	22.8	24.0	23.5	23.0
Average for the EAEU countries for 2013–2021:										25.6

Source: IMF. URL: https://www.imf.org/en/Publications/WEO/weo-database (accessed on 18.07.2022).

sanctions regime against Russia and Belarus, which occupy leading positions in the economy, trade and investment in the EAEU, have become new acute challenges for Eurasian integration over the past three years. Since the end of February 2022, the United States, the European Union, and other unfriendly countries have introduced and are constantly increasing sanctions and restrictions on Russian and Belarusian government agencies, and the banking and manufacturing sectors of the economy.

In the new conditions, in order to neutralize the negative impact of sanctions on the national economy in Russia, a large-scale structural restructuring of the established norms and rules for the functioning of the economy is taking place, and the regulatory role of the state in financing investments in the economy is increasing. The monetary authorities and the government are taking a set of measures to increase the liquidity of the financial market and banks. The role of the state and monetary authorities in financing

investments in infrastructure projects and import-substituting industries is growing significantly. The Bank of Russia extended the terms for granting permanent loans secured by securities (lombard loans) from one day to 90 days, significantly reducing the key rate from 20% to 8.0% from April 8 to July 22, 2022. The introduced currency control measures, including the mandatory sale of 80% of foreign exchange earnings by participants in foreign economic activity from February 28, 2022, contributed to the reduction of capital outflow and the strengthening of the ruble against the US dollar and the euro. Postponement by the Bank of Russia of the introduction of new regulatory requirements for banks, scheduled for 2022, and the use of increased risk ratios for credit requirements when calculating the mandatory ratios of banks contributed to the stabilization of the financial stability of credit institutions. The terms for using credit ratings when the Bank of Russia conducts operations to provide credit institutions secured by credit institutions have also been postponed from April 1, 2022, to January 1, 2023. Nevertheless, the problem of bank liquidity remains acute and is being solved by credit institutions by reducing the balances on correspondent accounts of banks with the Central Bank of the Russian Federation. In March-April 2022, the balances decreased three times compared to the average level of January-February 2022. The new conditions for the functioning of the economy of Russia and other EAEU countries require supplementing measures at the national level by consolidating efforts to develop and deepen integration cooperation in the monetary and financial, and economic spheres on an updated conceptual basis.

MEASURES TO FORM THE INVESTMENT MODEL OF FINANCIAL AND ECONOMIC INTEGRATION COOPERATION OF THE EAEU COUNTRIES

The key direction for the successful development of regional financial and economic integration is defined in the joint documents of the EAEU countries to promote the inflow of mutual investments into national economies. The decision of the Supreme Eurasian Economic Council dated May 21, 2021 No. 9 "On the main guidelines for the macroeconomic policy of the Member States of the Eurasian Economic Union for 2021–2022"[7] set the task of creating favorable conditions for increasing investment, developing scientific and technological potential and industrial cooperation of the Member States of the EAEU. Particular attention in the priorities of the basic guidelines of macroeconomic policy is given to increasing the share of gross fixed capital formation in the GDP of the EAEU countries to the global average in the medium term. However, the mechanisms and measures for the implementation of these tasks contained in the documents of the EAEU are not specific enough. In particular, the Resolution of the Council of the Eurasian Economic Commission dated September 14, 2021 No. 16 "On the list of measures to implement the main guidelines for the macroeconomic policy of the Member States of the Eurasian Economic Union for 2021–2022" determines that the expected result of the agreed measures to develop national capital markets and the development of the mechanisms of the financial market of the EAEU is the financing of projects with integration potential, including cooperation projects aimed at modernizing and (or) expanding existing production. However, there are few specifics as measures taken by the Eurasian Economic Commission to solve these problems, only an analysis of the measures implemented by the Member States in this direction and the preparation of proposals for expanding internal sources of long-term investment resources in the Member States of the Union are defined.[8]

[7] The decision of the Supreme Eurasian Economic Council dated May 21, 2021 No. 9 "On the main guidelines for the macroeconomic policy of the Member States of the Eurasian Economic Union for 2021–2022". URL: https://legalacts.ru/doc/reshenie-vysshego-evraziiskogo-ekonomicheskogo-soveta-ot-21052021-n-9 (accessed on 18.07.2022).

[8] Resolution of the Council of the Eurasian Economic Commission dated September 14, 2021 No. 16 "On the

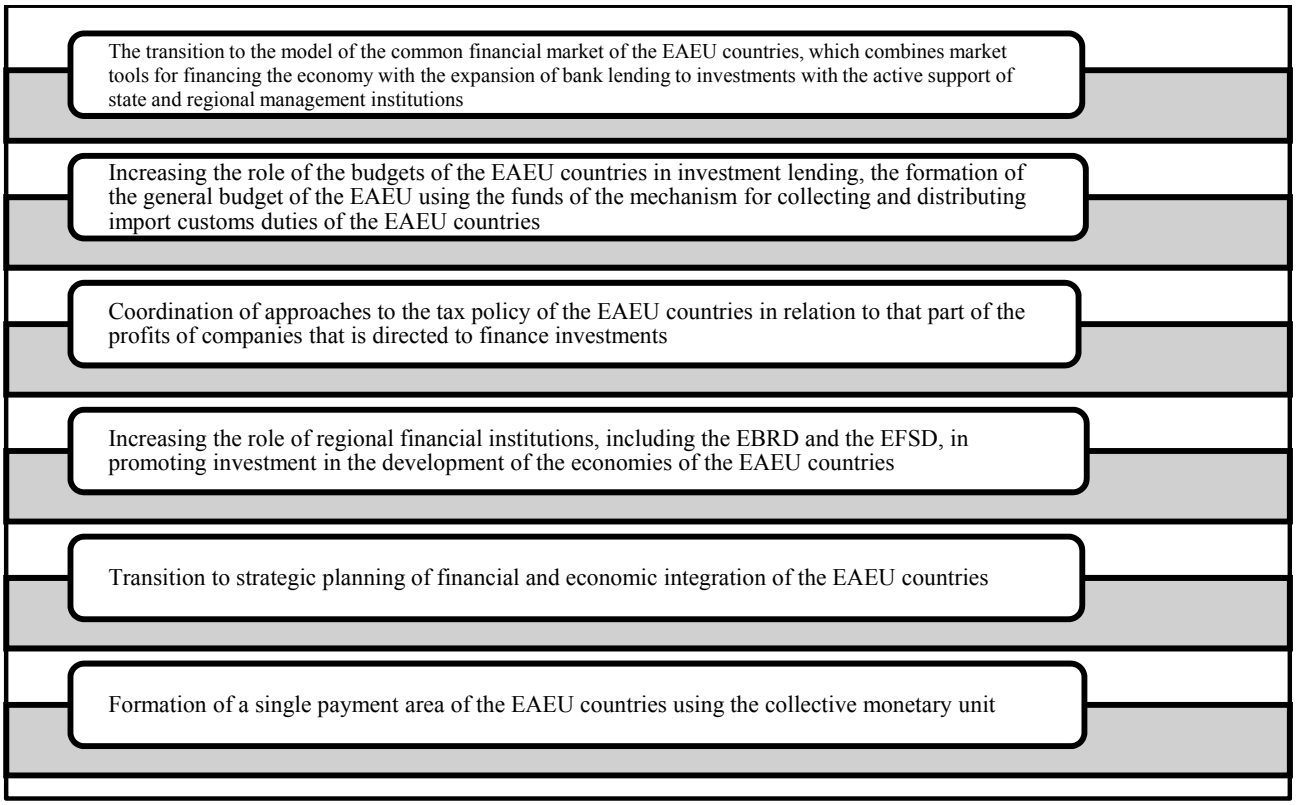

Fig. **Structural components of the investment-oriented model of financial and economic integration of the EAEU countries**

Source: compiled by the authors.

Solving the strategically important task of increasing the investment potential of the EAEU objectively requires a restructuring of the historically established market approach to Eurasian financial and economic integration in the direction of increasing the role of national and regional financial mechanisms and institutions. Priority is given to measures to consolidate the investment model of integration interaction between the EAEU countries by increasing the regulatory role of the institutions of governance of the countries of the region and developing tools for integration interaction (*Fig.*).

The model of regional integration, adapted to the new conditions, involves the development of investment-oriented market instruments for financing long-term investments in the economy based on the creation of a common financial market in accordance with the Concept for the formation of a common financial market of the Eurasian Economic Union, approved by the Decision of the Supreme Eurasian Economic Council dated October 01, 2019 No. 20.[9] At the same time, taking into account modern realities, a significant increase in the role of national state and supranational regional institutions for regulating integration processes, harmonizing the instruments of budgetary-tax and settlement-payment mechanisms of cooperation between the EAEU countries is in demand.

In particular, in the new paradigm of Eurasian financial and economic regionalization in the medium term, the importance of budget

list of measures to implement the main guidelines for the macroeconomic policy of the Member States of the Eurasian Economic Union for 2021–2022". URL: https://sudact.ru/law/rasporiazhenie-soveta-evraziiskoi-ekonomicheskoi-komissii-ot-14092021 (accessed on 18.07.2022).

[9] The concept of forming a common financial market of the Eurasian Economic Union (approved by the Decision of the Supreme Eurasian Economic Council dated October 01, 2019 No. 20). URL: http://www.eurasiancommission.org/ru/act/finpol/dofp/Pages/conception.aspx (accessed on 18.07.2022).

financing of investments at the national and regional levels, including using the potential of the EDB and EFSD, is growing. It is also relevant to coordinate approaches to the formation of a common investment-oriented budget of the EAEU, to reduce the tax burden on that part of the profit that is directed to investments. A significant synergistic effect for the development of financial and economic integration in the EAEU can be achieved through the harmonization of the Strategic Directions for the Development of Eurasian Economic Integration approved by the Supreme Eurasian Economic Council for the period up to 2025 and the national strategies for economic development adopted by the member states of the EAEU also for the period up to 2025. The transition to strategic planning of financial and economic activity should be considered as an important element of the regulatory model for managing the financial and economic system in the EAEU.

In recent years, the European Union has gained some experience in the formation of a new paradigm of financial and economic regionalization. In 2015, at the highest level of the EU leadership, a 10-year concept document "Completing the European Economic and Monetary Union",[10] was adopted, which sets out the principles, organizational forms and main directions for restructuring the institutional model of European financial and economic integration. The reform of institutions in the European Union is aimed at the formation and practical implementation by 2025 of an action plan for the consolidation of the EMU. Along with the gradual dismantling of the market institutional foundations of monetary and financial integration (suspension in March 2020 for an indefinite period of the Stability and Growth Pact as a basic document for ensuring macroeconomic stability in terms of price, budgetary, and debt sustainability), the importance of interstate financial regulation of integration due to funds of the general budget and joint funds of the EU in overcoming the crisis phenomena in the integration association. In particular, in the new seven-year EU budget for 2021–2027 in the amount of € 1,074.3 billion, priority financing is provided for projects on the technological modernization of the European Union and the sustainable development of the European economy. In 2020, the Next Generation EU was created within the EU's general budget, with € 750 billion of resources dedicated to stimulating public investment in the economy.[11]

Management decisions in the development of the Strategic Directions adopted in the EAEU, designed for the medium term, will allow optimizing and consolidating the activities of state and interstate financial institutions in deepening integration, facilitating long-term investments in the economy, and maximally adapting the existing models of monetary and credit and foreign exchange policy in the EAEU countries to new challenges, including the creation of a single payment and settlement system of the Member States of the EAEU.

The creation of a sovereign regional payment and settlement system (PSS) using a collective monetary unit for mutual settlements is a natural reaction to the weakening of the global role of the US dollar and euro reserve currencies in the global economy, the introduction of blocking sanctions restrictions on international settlements on operations of foreign economic activity of residents of Russia and Belarus, which negatively affects the situation in other EAEU countries and the prospects for regional integration in general.

FORMATION OF A SINGLE PAYMENT AREA OF THE EAEU MEMBER STATES. RATIONALE FOR USING THE COLLECTIVE CURRENCY OF THE EAEU COUNTRIES

In the Strategic Directions for the Development of Eurasian Economic Integration for the period up to 2025, special attention is paid to

[10] Juncker J.-C., Tusk D., Dijsselbloem J., Draghi M., and Schulz M. Completing Europe's Economic and Monetary Union, 2015, p. 23. URL: https://www.ecb.europa.eu/pub/pdf/other/5presidentsreport.en.pdf (accessed on 18.07.2022).

[11] Next Generation EU: A Bold European Recovery Strategy. 24th June 2021. URL: https://eucalls.net/blog/next-generation-eu (accessed on 18.07.2022).

the development of a single payment area in accordance with the Concept for the formation of a common financial market of the EAEU.[12] This direction of development of regional monetary and financial integration seems to be particularly relevant and significant at the present time in the context of the strengthening of the sanctions regime against Russia since February 2022. An acute problem is the disconnection of a number of systemically important Russian and Belarusian banks from the SWIFT international financial messaging system and the freezing of settlements in US dollars and euros, the arrest of the official foreign exchange reserves of the Bank of Russia in the amount of about $ 300 billion. On March 11, 2022, the US Treasury introduced a ban on new investments in any sector of the Russian economy, and on April 6, 2022, on making dollar payments on debt from the accounts of the Russian government in US financial institutions. As a result, the risks of a crisis in the payments and settlements sphere, including in the Eurasian space, are growing, given the high share of the US dollar and the euro in international settlements and the significant role of Russian credit institutions that have fallen under sanctions in servicing settlements between trading partners of the EAEU countries. As a result of the "freezing" of the settlement and investment functions of the ruble in international circulation, the access of Russian companies and banks to external borrowings is actually blocked and the settlement servicing of Russian foreign trade operations in rubles is significantly hampered. In connection with this, an option to resolve the situation could be the creation within the EAEU with the participation of interested third countries (China, Iran, Turkey, and other participants) of a non-dollar system of international settlements. The internal value of a new collective monetary unit can be backed up by the strategic resources available to the participating countries (gold, precious metals, strategic goods). The exchange rate of a collective unit of account can be tied to the weighted average price of the resources that provide it on the world market. Settlements are serviced by the clearing center, which, when conducting foreign trade operations, converts national currencies into a collective unit of account.

The first practical step in order to mitigate payment risks was the decision taken on March 17, 2022, at a meeting of the Council of the Eurasian Economic Commission in Yerevan on a phased transition to settlements in national currencies when making customs payments within the Eurasian Economic Union.[13] At present, the problem of creating a collective monetary unit in order to improve and ensure the security of payments and settlements within the EAEU is one of the most important areas of monetary and financial integration and requires substantive consideration and justification from the standpoint of the expediency of its use.

The creation and development of a single payment area of the EAEU in accordance with the Concept for the formation of the EAEU OFR is of strategic importance for the economic security of Russia and other EAEU countries. Earlier, at a meeting of the Supreme Eurasian Economic Council, held in St. Petersburg on December 6, 2018, the President of the Russian Federation V. V. Putin proposed to elaborate on the issue of creating a unified settlement infrastructure in the EAEU using modern financial technologies. This would allow, in his opinion, "to increase the stability of the national payment systems of our countries, making them less dependent on the US dollar and other foreign currencies. This ensures the strengthening of economic sovereignty".[14]

[12] Strategic Directions for the Development of Eurasian Economic Integration for the period up to 2025 (approved by the Decision of the Supreme Eurasian Economic Council dated December 11, 2020 No. 12). URL: http://www.eurasiancommission.org (accessed on 18.07.2022).

[13] "Single ruble area": EAEU countries agreed on settlements in national currencies. March 18, 2022, Forbes Staff. URL: https://ru.armeniasputnik.am (accessed on 18.07.2022).

[14] Single payment system, common markets for oil and gas in the center of attention of the leaders of the EEU. 06.12.2018. URL: https://www.1tv.ru/news (accessed on 18.07.2022).

Ensuring the financial and economic sovereignty of the EAEU countries is directly related to the elimination of critical dependence on the US-controlled global financial messaging system SWIFT [20]. In 2019, the Eurasian Development Bank developed and implemented a project for a clearing and settlement system (CSS) in the national currencies of the EDB Member States. According to the Deputy Chairman of the Board of the EDB A.A. Krainii, "the most important feature of the system is the possibility of using it for settlements in national currencies, bypassing SWIFT and converting transferred funds into US dollars. The creation of the CSS contributes to solving the issue of forming a common settlement infrastructure in the EAEU using modern financial technologies and national payment systems and reducing dependence on the US dollar and other foreign currencies.[15]

The successful functioning of a single payment and settlement system depends on the choice of a settlement currency for collective use. The most logical option for the EAEU countries at this stage in the development of integration seems to be the concept of a parallel accounting unit. Such a decision, while making it possible to use almost all the advantages of a collective currency, does not affect the sensitive issues of partial or complete renunciation of the monetary sovereignty of the union member states. An important institutional issue is the choice of a supranational emission institution that implements the mechanism for issuing a collective monetary unit. Obviously, for the full implementation of the function of ensuring intercountry settlements within the framework of the EAEU, the emission of the collective supranational currency of the EAEU must be of a continuous credit nature. A loan in the collective currency should be provided by the issuing institution as part of settlement services for foreign trade and investment operations of economic entities of the EAEU member countries. In this regard, the function of the regional issuing institution of the EAEU can be entrusted to the EDB as a financial institution with international legal competence. The currency structure of the collective monetary unit of the basket type is built taking into account the specifics of trade and economic relations and the scale of the economies of the EAEU member countries. Taking into account the significant bias of the economies of the EAEU countries in terms of scale and level of development in favor of Russia, it is reasonable when building a collective monetary unit to limit the share of the Russian ruble in the basket to a value not exceeding 50% and recalculate the shares of other currencies based on the distribution of the remaining 50%, taking into account the size of the economy and size of trade turnover with the EAEU countries [21].

JUSTIFICATION OF THE CREATION AND USE OF THE COLLECTIVE MONETARY UNIT IN MUTUAL SETTLEMENTS BY THE EAEU COUNTRIES

To determine the potential and prospects for creating a collective currency for making payments and settlements within the EAEU, it is advisable to assess the dynamics and scale of mutual trade between the countries of the region. As can be seen from *Table 3*, the dynamics of mutual trade between the EAEU member states after the coronavirus pandemic was positive. After a decline in trade activity in 2020, the volume of mutual trade between the EAEU in 2021 increased by almost 32%.

To obtain objective data in order to justify the introduction of the EAEU collective currency into circulation, the authors developed and used a two-stage econometric regression model for assessing the factors affecting the mutual trade turnover of the EAEU countries in national currencies. On its basis, a comparative analysis of the influence of independent variables — GDP, employment rate, the yield on federal loan bonds, and the level of currency risk on the volume of mutual trade between the

[15] The EDB has created a clearing and settlement system in national currencies. 21.12.2018. URL: https://eabr.org/press/news/v-eabr-sozdana-raschetno-kliringovaya-sistema-v-natsionalnykh-valyutakh (accessed on 18.07.2022).

Table 3

Growth rate of mutual trade between the EAEU countries in 2015–2021, as a % of the previous period

Year	EAEU	Russia	Belarus	Kazakhstan	Armenia	Kyrgyzstan
2015	74.6	78.1	68.0	71.6	79.1	64.3
2016	94.2	93.0	103.4	76.8	153.7	109.0
2017	127.4	129.4	119.9	133.9	145.0	121.1
2018	110.1	112.3	102.1	114.9	120.6	118.3
2019	102.3	100.8	104.6	105.9	111.7	100.2
2020	89.0	86.8	96.1	86.5	91.7	85.1
2021	131.9	134.3	124.7	134.9	125.2	144.9

Source: Eurasian Economic Commission. URL: http://www.eurasiancommission.org (accessed on 18.07.2022).

EAEU countries over the following time periods was carried out:

1) from Q3 2015 to Q3 2020;
2) from Q3 2015 to the end of 2021;
3) from January 2021 to January 2022.

Both at the first and second stages, the simulation results indicate that the dependence of the mutual trade turnover of the EAEU on independent variables was stronger until Q3 2020, i.e. the peak of the coronavirus pandemic. After conducting a similar study for the period up to the end of 2021, this dependence slightly decreased, which can be explained by fluctuations in the national economies of the EAEU countries due to the corona crisis, and the imposition, and removal of restrictions on the activities of enterprises.

The following two hypotheses were tested using the regression model:

1) hypothesis H0: the financial condition of Russian enterprises and the level of currency risk have a significant impact on the volume of mutual trade between the EAEU countries, carried out in the national currencies of the member states of the union;
2) hypothesis H1: the financial condition of Russian enterprises and the level of currency risk do not have a significant impact on the volume of mutual trade between the EAEU countries, carried out in the national currencies of the member states of the union.

At the first stage of the model, the following indicators were used:

Y_1 — the volume of mutual trade in the national currencies of the EAEU countries (billion dollars); X_1 — the total GDP of the EAEU countries (billion dollars); X_2 — the volume of Russia's exports to the EAEU countries (billion dollars).

When building the model at the second stage, the following indicators were used:

Y_2 — the volume of mutual trade in the national currencies of the EAEU countries (billion dollars); X_3 — the unemployment rate in Russia in accordance with the methodology of the International Labor Organization (%); X_4 — federal loan bonds yield level with full redemption after 2 years, in accordance with the zero-coupon yield curve of the Moscow Exchange (%).

At the first stage, the aggregate GDP of the EAEU countries and the volume of Russian exports to the EAEU countries were used as independent variables, and at the second stage, the rate of unemployment in Russia and the yield of Russian federal loan bonds. The volume of mutual trade between the EAEU countries with settlements in national currencies was chosen as a dependent variable at both stages.

This indicator reflects the total volume of payments in national currencies for servicing the mutual trade of the EAEU countries. The change in this indicator indicates both an increase and a decrease in the volume of mutual trade of the EAEU member states using national currencies.

Justification of independent variables. The aggregate GDP of the EAEU countries is an indicator of the general state of the economies of the member states countries. The volume of Russian exports to the EAEU countries shows the total Russian exports to the countries of the union. Changes in this indicator indicate an increase or decrease in the trading activity of Russian exporting enterprises focused on the EAEU countries. The unemployment rate in Russia indicates the financial condition of Russian enterprises. With an increase in the unemployment rate, the number of enterprises that experience financial difficulties increases, and with a reduction, it decreases. The unemployment rate, according to the methodology of the International Labor Organization, is the proportion of the unemployed of the total number of the economically active population, i.e. residents of Russia aged 10 to 72 years. The federal loan bonds yield level, in accordance with the zero-coupon yield curve of the Moscow Exchange, shows how much yield the federal loan bonds bring, excluding coupon income upon the final redemption of the bond. The Ministry of Finance includes currency risk in the federal loan bonds yield level, namely, the risk of the high volatility of the ruble, including in connection with the imposition of US and EU sanctions. A decrease in federal loan bond yields indicates a reduction in foreign exchange risk, while an increase is the opposite.

The following regression model formulas were used for calculations:

$$Y = \alpha_1 + \beta_0 X_1 + \beta_1 X_2, \quad (1)$$

$$Y = \alpha_2 + \beta_2 X_3 + \beta_3 X_4. \quad (2)$$

For the values Y, X_1, X_2, X_3, X_4, 3 of the above periods were chosen, namely: from Q3 2015 to Q3 2020; from Q3 2015 to the end of 2021, and from January 2021 to January 2022.

The calculations carried out at the first stage of modeling indicate that there is a strong correlation between the independent and dependent variables at the level of 98% in 2020 and 94% in 2021. At the same time, for 2021, the correlation between the volume of mutual trade between the EAEU countries in national currencies, of the total GDP of the member state countries, and Russian exports to the EAEU countries decreased by 4%. The calculations performed at the second stage of the model also confirm a significant correlation between the independent variable (the volume of mutual trade between the EAEU countries in national currencies) and dependent variables (the unemployment rate in Russia and the federal loan bonds yield rate) — at the level of 88% in 2020 and some decrease to 82% in 2021.

Taking into account the decrease in the dependence of the mutual trade turnover of the EAEU in national currencies on independent variables at the first stage by 7% and at the second stage by 10%, the degrees of correlation between the data at the first and second stages were calculated. The results of the calculation show that the mutual trade up to Q3 2020 correlated with the GDP of the EAEU countries by 92%, with Russia's exports to the EAEU — by 98%, with the unemployment rate in Russia — by 63%, with federal loan bond yields — by 62%. By the end of 2021, EAEU mutual trade correlated with independent variables by 90%, 90%, 62%, and 47%, respectively. This means that by 2021 the dependence of mutual trade on Russian exports to the EAEU has decreased more than the dependence on the general state of the national economies of the EAEU countries. As a result, the influence of both independent variables of the first stage of the model on the volume of mutual trade turnover of the EAEU became equivalent. Also, by the end of 2021, the dependence of mutual trade on federal loan bond yields decreased by 15%.

In general, the results of the regression model, built on the basis of data for 2015–2021,

only partially confirm the hypothesis H0 about the significant impact of the financial condition of Russian enterprises and the level of foreign exchange risk on the volume of mutual trade between the EAEU countries is carried out in the national currencies of the member states of the union. If the financial condition of Russian enterprises really has a significant impact on the volume of mutual trade in the national currencies of the EAEU countries, then the level of mutual exchange rate risk of the Russian ruble ceases to have a decisive influence on the volume of mutual trade of the EAEU countries in national currencies. This is due to the political decision of the member states to follow the course of a significant reduction in the share of the US dollar and the euro in the currency structure of mutual settlements and an increase in the corresponding share of the national currencies of the EAEU countries.

The results of the first stage of the regression model confirm that there remains a significant dependence of the volume of mutual trade between the EAEU countries in national currencies on the total GDP of the EAEU countries and the volume of Russia's exports to the EAEU countries. However, dependence on Russian exports no longer prevails over dependence on the general economic situation of the member states, expressed in the total GDP of the EAEU countries. Despite the fact that the ruble occupies a 72% share in the currency structure of mutual settlements between the countries of the association, the influence of the level of the ruble currency risk in the study period from 2015 to 2021 was not decisive when choosing the currency of settlements between Russia and other EAEU countries. The EAEU countries recognize the expediency of maintaining and increasing the share of national currencies in mutual settlements and are more guided by the decisions made to reduce the share of the US dollar in mutual settlements. According to the results of the second stage of the regression model, there is a steady dependence of the volume of mutual trade of the EAEU countries in national currencies on the unemployment rate according to the methodology of the International Labor Organization, while the dependence of mutual trading on the federal loan bonds yield level in accordance with the zero-coupon yield curve of the Moscow Exchange is decreasing. In turn, the decrease in the unemployment rate is due to the strengthening of the financial position of Russian enterprises and, as a result, the expansion of the scale of their foreign economic activity, including those related to exports to the EAEU countries.

The results of the two-stage regression model allow us to conclude that in the period up to the beginning of 2022, the role of the ruble currency risk as one of the dominant factors affecting mutual trade in national currencies was decreasing. However, since the end of February this year, the Russian economy has found itself in an extreme political and economic situation under the influence of a tough sanction regime. This led, especially at the initial stage, to significant volatility of the ruble exchange rate against foreign currencies, including the currencies of the EAEU countries.[16]

CONCLUSIONS

The results of studying the problems and prospects for the development of regional monetary and financial integration within the EAEU allow us to draw the following conclusions and suggestions. The theoretical and methodological significance of the analysis of integration problems lies in substantiating the conclusion about the inefficiency of the historically established market-oriented model of financial and economic regionalization of the Member States of the EAEU, based mainly on the triad of institutions — a free trade area, Customs Union and Eurasian Economic Space. The removal of restrictions on the cross-border movement of production factors did not lead to a significant increase in mutual investment, could not have a significant positive impact on GDP growth, and increase the competitiveness

[16] In this regard, to confirm or refute the hypotheses proposed in the model, it will be necessary to build a regression model based on updated representative data.

of the economies of the union countries. More than half of all investments in the development of economic activities of enterprises in Russia and other EAEU countries are financed from their own funds, and in recent years this share has been increasing. It is conceptually important, in order to deepen the economic integration of the Member States of the EAEU based on an increase in the share of gross fixed capital formation in the GDP of these countries, that the market-oriented model of Eurasian financial and economic integration be supplemented and, in some cases, replaced by a regulatory investment model of regionalization based on a set of effective joint institutions for managing integration processes.

The applied significance of the analysis carried out in the article lies in the systematization of specific measures to consolidate the cost-effective investment model of Eurasian integration by supplementing market instruments of the Eurasian financial market and bank lending instruments for infrastructure investment projects with more substantial support and assistance from state and interstate management institutions, regional financial institutions — The EDB and EFSD investments in the economies of the EAEU countries, as well as through the formation of a single investment fund, and in the future — the general budget of the EAEU used for this purpose, for example, the funds of the mechanism for collecting and distributing import customs duties in the EAEU since 2010 within the framework of the EAEU.

An important measure stimulating mutual investment could be the harmonization of approaches to the fiscal policy of the EAEU countries in terms of reducing income tax and using it to invest in fixed assets of enterprises.

The development of strategic planning of integration processes at the regional and national levels, and the coordination of investment policy can give a new quality to sustainable economic growth in the EAEU countries.

In order to solve the problem of creating a single payment area within the EAEU countries, set in the Strategic Directions for the Development of Eurasian Economic Integration for the period up to 2025, the article substantiates the proposal to create a collective settlement monetary unit for mutual settlements using econometric methods of analysis. The research results using econometric modeling methods confirm that Russia, Belarus, Kazakhstan, Kyrgyzstan, and Armenia when choosing a currency of collective use for mutual settlements on trade and financial transactions, should take into account the existence of dependencies between mutual trade in the national currencies of the EAEU and independent variables reflecting the state of the economy and finances of the Eurasian region in general and Russia in particular. The results of the study using econometric analysis methods confirm the persistence during 2015–2021 of the strong dependence of mutual trade of the EAEU countries on the general state of national economies, Russian exports, and unemployment in Russia and, to a lesser extent, on changes in the exchange rate of the Russian ruble. The need in the context of the growing decentralization of the global monetary and financial system for coordinated actions of the EAEU countries to strengthen de-dollarization and the formation of a single payment area using the EAEU collective currency in circulation is justified.

The implementation of the proposed set of measures will make it possible to intensify the integration investment cooperation of the EAEU countries, reduce their dependence on the extremely volatile international economic and financial environment and provide a certain degree of protection from Western sanctions.

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Do Exogenous Shocks in Macroeconomic Variables Respond to Changes in Stock Prices?

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ABSTRACT

The research aims to examine the unexpected changes in stock prices due to external shocks given to the macroeconomic variables to forecast future stock market returns. **The study applies** two econometric models such as "Variance Decomposition" (VDC) and "Impulse Response Function" (IRF) for examining the exogenous shocks in macroeconomic variables respond to changes in stock prices. Monthly time series data of five significant macroeconomic variables Real Exchange Rate, Interest Rate, Consumer Price Index (CPI), Crude Oil Prices, and Trade Openness, taken as independent variables and BSE SENSEX as a dependent variable. The research period is from Jan 2009 to Dec 2019. The study has taken the responsibility to reveal a few strong evidences for changes in stock prices due to exogenous shocks in Exchange Rate, Trade Openness, Inflation, and Interest rate along with crude oil prices. According to the results, changes in the stock market are due to external factors like changes in dividend policy or capital loss, and some changes in the stock market are due to its own innovative shocks. This study suggests to reduce unexpected changes in stock prices frequently, companies should control capital loss and focus on stable return/dividend policies. There are divergent views in the literature review in the context of measures of these variables, however no research has been done on exogenous shocks in macroeconomic variables to BSE SENSEX for the Indian stock market with this particular data set and duration.
Keywords: BSE Sensex; exchange rate; interest rate; consumer price index; crude oil prices; trade openness; variance decomposition; impulse response function

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INTRODUCTION

An appreciation factor in the context of the stock market investigated is the ability of the Various communities to improve the financial important indicators, mostly cash inflows [1]. The share market is always susceptible to additional price-shaping information, which can be relevant for market developments and future trends. The factors related to price formulation generally include macroeconomic variables but sometimes inner and subjective factors impact the investor's behavior which may affect the entire conduct of the whole stock market and its volatility (which grows along with the growing numbers of market participants), the developments of technologies and impact of globalization [2]. In determining the share price, macroeconomic factors such as inflation, money supply, and commodity prices always play a significant role. "The monetary policy represents the most efficient instrument in different countries" [3]. Because the overall development of the monetary policy is the essential instrument for influencing the business and economy, now this is essential to comprehend the impact of the variations on the Indian capital market in macroeconomic factors. Stock markets always have an essential role in allocating resources to their most productive applications [4]. As per the Arbitrage Pricing Theory, macroeconomic factors like unexpected inflation, industrial production, and interest rate highly affect the stock market [5]. It is widely accepted in financial economics that macroeconomic variables have a strong effect on stock markets. The association between the stock market and macroeconomic variables creates attention for researchers and policymakers [6]. It is also attracted, economists and financial investors. In some developed economies, the nature of the stock market and macroeconomic variables may be different from the developing economy.

The investigations had practical significance because a deep understanding of the behavior of the stock market allows firms to work more efficiently [7]. By gaining knowledge about this relationship, governments can establish the economy and the stock market, attracting more investors and firms that can control the economic situation [8]. It can be the first step towards a strong

economy. In 1965, Efficient Market Theory was introduced in the security market [9]. According to the definition of "A market where a large number of rational profit maximizers actively competing with each other and try to predict the future market values of individual security and the current information of the stock market easily available for everyone." Although this definition provides an understanding of what the efficient market is? Fama (1991) renamed the three concepts as inner information, event studies, as well as predictability for semi-strong form, strong form, along with weak side [10]. Different additional knowledge about what is meant by the available data makes clear what the efficient market is.

The weak state of the market itself confines just one subset of public information, basically historical data, i.e., As a result, the current asset values integrate all relevant previous information, such as dividend payments, trading volume as well as prior asset prices [11]. The previous nature of the stock market has not given any future prediction — Asset prices are predicted to evolve in accordance with the EMH theory on the hypothesis that they do [12]. From the standpoint of an investor, whatever information is accessible in the market should not result in an unusual profit in the stock market, regardless of the source of the information [13]. An investor can not beat the market consistently. This is compatible with a financial concept, according to which the highest price that investors are ready to pay is equal to the present value of future cash flows. An investment's present value is often assessed using a discount rate that signifies the uncertainty degree related with the investment based on all available information [14]. As the BRICS nations' economic and social transformations have progressed over the past several decades, they have made a significant contribution to the development of the financial sector [15]. It is widely known that economic growth is the most powerful driver for reducing inequalities by reducing the disparities in economic growth positively [16]. An effective financial system is essential for enhancing economic growth and development [17]. Many empirical studies have shown that a scarce financial market can be a source of financial imperfection and income inequalities [18]. The Indian economy has demonstrated a remarkable performance on the international platform in the last decade [19]. According to the global monetary fund, in GDP terms, the economy of India is the third-largest economy as well as the seventh-largest economy in the world [19, 20]. Indian officials have declared that their country was classed as a Newly Industrialized Country by the Central Intelligence Agency [21].

LITERATURE REVIEW

An analysis with sectoral stock indices was conducted to investigate the impulse changes due to exogenous shocks in certain macroeconomic variables in the short as well as long run. Results were found as the sectoral stock indices fluctuated and responded with shocks to FDI, imports, and exports at a certain level of variation [22]. The financial integration had been investigated between four major stock markets in the SAARC region. Results confirmed that Bangladesh's market fluctuates more than other markets, and the stock prices are changing due to different innovative changes in macroeconomic variables [23]. The reactions of oil prices as well as the currency rate to inflation have been considerable, according to the results of the Impulse Response Function. Within the first few months, the relationship between inflation and labour costs became considerable. Economic policies, fiscal and monetary policies play a vital role in controlling inflation. The price of crude oil had been an external element in which it has been necessary to find alternate means of reducing the inflationary effect [24]. Liquidity in the stock market increases after the increased price of oil from the demand side. Imagine that the oil price shocks originate on both the demand and supply sides of the oil industry. As a result, the liquidity of the stock market is adversely correlated with oil prices in such circumstances [25]. After the 2008 Global financial crisis, the U.S. financial risk structure changed. After Q.E. (quantitative easing) announcements, This occurs as a result of the risk spillover shifting from purchased to non-purchased resources [26]. The impact of quantitative easing on real economy quantifying in the research filtered an unobservable propensity to Q.E. and delivered impulse responses to the Q.E. shocks. Other approaches reveal that the business cycle is studied in terms of unexpected policy shocks. Q.E. shocks lead to a decrease in interest rates and an increase in stock prices [27]. Based on the VAR model impulse response function results found strong evidence that FIIs destabilize the stock market, especially with selling activities, and significantly increase the share price volatility [28]. By estimating the VAR-BEKK model, in the Greater China Area evidence

was found of return and volatility spillovers among stock markets. The results of the impulse response function are used to measure the influence of the financial crisis on unanticipated conditional stock price volatility in the short term. The Greater China capital market is highly responsive to exogenous shocks [29]. The research examined the association between key macroeconomic variables such as government policies, disposable income, inflation rate, stock prices, and exchange rate. A strong long-run cointegration relationship had been seen between stock market returns along with macroeconomic variables. Increases in the inflation rate eroded the panorama of the positive performance of the Sensex, but it was not significant [30]. The study employed certain macroeconomic factors and analysed their influence on stock market returns in order to create a (CCA) canonical association analysis model for ZSE "Zimbabwe stock exchange". Most of the movements in the money supply, exchange rate, consumer price index, unemployment rate, mining along with the industrial index, and other economic indicators have an impact on stock returns. A key contribution to the development of the CCA model came from the stock returns of Barclays, Bindura, Hwange, Ariston, and Falcon [30, 31]. The findings of the multivariate analysis demonstrated a long-run causality between stock indexes and the T-bill rate, but no short-run relationship was discovered. The findings of the variance decomposition suggest that the stock index has a high degree of relative homogeneity, and the impulse response function demonstrates that the stock market responds positively to shocks in macroeconomic variables that are innovative [32]. The Nepalese monetary authority was only able to impact the stock market in the short term, and not in the long term [33]. Bank stock prices have been significantly affected by the changes in the inflation rate, interest rate, along with Exchange rate in the duration from 2000 to 2015. In this duration, the government ensured a stable macroeconomic environment and moderated policy-making for monetary policy. Banks are also having the responsibility for not engaging the speculations in foreign currencies. The fluctuations in currency value also affect bank stock prices [34]. Money supply, T-bill rate, exchange rate, and federal fund rate were suitable targets for the government for stabilizing the Islamic capital market as well as inspiring more capital flows into the market. When the interest rate rises at either the national or international level, the investors more will buy compliant stocks [35]. A long-run relationship and a substantial short-run relationship had been found between stock prices as well as macroeconomic variables in the stock market of Malaysia. The exchange rate has a negative association with the stock price value. Money supply papers have immediate favourable liquidity impacts and negative long-run effects on stock prices as a result of money supply expansion [35, 36]. Some macroeconomic factors, for example, treasury bill rate, customer pricing index, and money supply have a considerable impact on the stock market variables when the variables are measured in the past. The stock market, on the other hand, has no effect on the macroeconomic indicators that have been picked. After analyzing with Variance Decomposition and impulse response function only a minority of the forecast variance error of the market index. Three principles were identified through factor analysis such as interest rate, exchange rate, as well as inflation. A statistically substantial association has been discovered between stock market indicators as well as macroeconomic factors. It is discovered that there is a one-way causation from the stock market to the actual economy. It was discovered that there were around five cointegration linkages between macroeconomic factors along with stock market indicators. Maybe diverse macro dimensions are responsible for stock price movements [36]. It has been discovered that there are significant disparities between the portfolios when the OLS approach is applied. In the serial connection problem discussed by utilizing Durbin-Watson statistics a big difference had been found among the market portfolios against macroeconomic variables against variation of R. No evidence was suggested in other market portfolios [1, 36]. Both long-run and short-run links between macroeconomic factors and stock prices have been established in this study. For the Sri Lankan stock market, the validity of the semi-strong form of the EMH theory was demonstrated, as was the existence of an opportunity for investors to make investments in both the domestic and foreign equity markets. Several methodological weaknesses were found during the research [37].

Statement of the Problem

After reviewing a lot of research papers from the last decades, it was found that no research has been done on

exogenous shocks in macroeconomic variables to BSE Sensex for the Indian stock market with this particular data set and period. Thus, the study has taken the responsibility to reveal strong evidence for changes in stock prices due to exogenous shocks in macroeconomic variables.

Need of the Study

In the last two decades, Global financial markets, particularly the capital market, have undergone a significant transformation. The successive changes in macroeconomic variables have been the underlying reasons for these shifts in the economy. These modifications resulted in a major rise in the volatility of the stock market and the number of trades. In the context of measurements of these variables, there are a variety of points of view expressed in the literature review. The Indian economy has undergone tremendous changes in the last decades. The present study is expected to add some key contributions to the present literature. This study will examine the level of changes in macroeconomic variables due to innovative external shocks, which may cause a change in share prices in stocks listed in BSE Sensex. This study is expected to offer some acumens to policymakers, investors, and portfolio managers.

OBJECTIVES

To examine the unexpected changes in stock prices due to the external shocks given to the macroeconomic variables (i.e., Exchange Rate, Inflation, Interest Rate, Crude Oil Prices, and Trade Openness) to forecast the future stock market returns.

HYPOTHESIS

H0: Stock prices do not respond to an external shock from any of the macroeconomic variables.

H1: Stock prices respond to an external shock from any of the macroeconomic variables.

RESEARCH METHODOLOGY

Sample Selection

The present study includes the estimation findings for the unexpected changes in stock prices due to external shocks given to macroeconomic variables using the monthly frequency data. We have taken five macroeconomic variables, i.e., Exchange Rate (EXR), Crude Oil Prices (C.O.), Interest Rate (I.R.), Consumer Price Index (CPI), and Trade Openness and BSE SENSEX (B.S.) for stock prices.

Source of Data

The source of data is https://fred.stlouisfed.org/ & www.bseindia.com.

Period Taken for the Study

The period of the study is taken from January 2009 to December 2019

Tools & Models used in the Study

E-views 11 is used for the analysis. For converting time series data into stationary series Augmented Dicky Fuller Test had been applied. The Impulse Response Function has been used to examine the external shocks Variance Decomposition Model and check the impulse responses.

Model Specification

$$LBS = \alpha 0 + \alpha 1LCO + \alpha 2CPI + \alpha 3LEXR + \alpha 4LIR + \\ + \alpha 5LTO + \mathcal{E}t.$$

DATA ANALYSIS AND DISCUSSION

Variance Decomposition Results

The Variance Decomposition analysis provides the percentage values of forecasted error variance in a single variable, based on the forecasted error variance. The empirical results are illustrated in *Table 1*, which shows that 95.77% of stock prices changed by innovative shocks. The crude oil prices have a more significant impact, around 1.78%, whereas trade openness has contributed a .95% impact on the BSE. However, the analysis explains the maximum percentage of variation after the prices of crude oil which affect the stock market. The contribution of other variables is very minimal.

Impulse Response Functions

As a result of an external change, the impulse response function depicts the reaction of some dynamic system. Using this method, you may figure out how sensitive each of the dependent variables in the VAR is when a shock is applied to the variable in question. Graph No. 2 shows the estimation from the impulse response function of the stock market index as against the "own

Table 1

Results of Variance Decomposition

Variance Decomposition of DBS:							
Period	S.E.	DBS	DCO	DCA	DEXTER	DIR	DTO
1	1089.165	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	1106.142	97.29432	1.533761	0.324406	0.094107	0.752060	0.001350
3	1131.913	96.16228	1.785321	0.319205	0.232665	0.722288	0.778235
4	1134.004	95.85114	1.780334	0.380576	0.231825	0.833000	0.923124
5	1134.731	95.79291	1.787323	0.381532	0.247423	0.850064	0.940752
6	1134.849	95.77335	1.787888	0.386212	0.247406	0.850327	0.954817
7	1134.875	95.77037	1.788449	0.386194	0.247860	0.852088	0.955042
8	1134.877	95.77007	1.788473	0.386296	0.247865	0.852238	0.955059
9	1134.878	95.77002	1.788510	0.386298	0.247866	0.852246	0.955064
10	1134.878	95.77000	1.788510	0.386298	0.247866	0.852249	0.955073
Variance Decomposition of DCO:							
Period	S.E.	DBS	DCO	DCPI	DEXTER	DIR	DTO
1	4.968296	0.064685	99.93531	0.000000	0.000000	0.000000	0.000000
2	5.350178	2.228039	96.26406	0.107869	0.291521	1.019707	0.088805
3	5.381352	2.493096	95.72546	0.295593	0.348509	1.036288	0.101059
4	5.392125	2.739793	95.34631	0.318969	0.351754	1.066785	0.176387
5	5.393157	2.739539	95.33409	0.321746	0.355290	1.066781	0.182553
6	5.393622	2.742391	95.32288	0.322281	0.359785	1.068995	0.183664
7	5.393652	2.742428	95.32201	0.322507	0.359849	1.069003	0.184202
8	5.393663	2.742443	95.32178	0.322514	0.359875	1.069156	0.184236
9	5.393664	2.742457	95.32175	0.322515	0.359876	1.069160	0.184238
10	5.393664	2.742459	95.32175	0.322515	0.359877	1.069160	0.184238
Variance Decomposition of DCPI:							
Period	S.E.	DBS	DCO	DCPI	DEXTER	DIR	DTO
1	0.728475	6.635239	0.105598	93.25916	0.000000	0.000000	0.000000
2	0.742328	7.966931	0.145100	91.51259	0.215895	0.044889	0.114593
3	0.760494	8.309864	1.186148	87.22171	0.478072	1.087939	1.716266
4	0.763803	8.337282	1.382817	86.46902	0.521916	1.183103	2.105863
5	0.764073	8.333694	1.382311	86.40814	0.564171	1.198845	2.112840
6	0.764276	8.329917	1.381626	86.36283	0.564088	1.215673	2.145863
7	0.764309	8.329448	1.382427	86.35523	0.564866	1.216641	2.151393
8	0.764321	8.329352	1.382581	86.35277	0.564853	1.219111	2.151328
9	0.764322	8.329331	1.382600	86.35239	0.564851	1.219167	2.151657
10	0.764323	8.329320	1.382600	86.35230	0.564854	1.219210	2.151714
Variance Decomposition of DEXR:							
Period	S.E.	DBS	DCO	DCPI	DEXTER	DIR	DTO
1	1.330815	14.14855	0.004007	0.057641	85.78980	0.000000	0.000000
2	1.433250	16.10615	0.212214	3.652014	76.23171	3.625078	0.172833
3	1.474954	16.71446	1.051329	5.545052	71.99604	4.501969	0.191147

Table 1 (continued)

Variance Decomposition of DEXR:							
Period	**S.E.**	**DBS**	**DCO**	**DCPI**	**DEXTER**	**DIR**	**DTO**
4	1.483369	17.20902	1.118085	5.486907	71.18695	4.489730	0.509303
5	1.484276	17.20873	1.147853	5.507854	71.11378	4.498001	0.523780
6	1.484882	17.21150	1.152670	5.504787	71.06012	4.528039	0.542879
7	1.484952	17.21107	1.152585	5.506950	71.05356	4.527995	0.547839
8	1.484976	17.21106	1.152683	5.506868	71.05122	4.530236	0.547940
9	1.484979	17.21102	1.152679	5.506894	71.05097	4.530295	0.548148
10	1.484980	17.21102	1.152682	5.506909	71.05087	4.530376	0.548148
Variance Decomposition of DIR:							
Period	**S.E.**	**DBS**	**DCO**	**DCPI**	**DEXTER**	**DIR**	**DTO**
1	0.400924	4.30E-05	1.255395	0.064041	0.614634	98.06589	0.000000
2	0.402214	0.170434	1.261692	0.064925	0.881465	97.58133	0.040153
3	0.409696	0.169739	1.228133	0.727353	1.251220	96.58273	0.040822
4	0.410004	0.299136	1.232075	0.728171	1.249815	96.44587	0.044937
5	0.410367	0.310222	1.242527	0.779892	1.267747	96.32801	0.071604
6	0.410461	0.332449	1.247422	0.780643	1.267593	96.28405	0.087845
7	0.410478	0.333234	1.247884	0.782902	1.267504	96.27977	0.088709
8	0.410488	0.334407	1.248111	0.782961	1.267505	96.27587	0.091150
9	0.410489	0.334425	1.248106	0.783074	1.267512	96.27569	0.091192
10	0.410489	0.334454	1.248108	0.783072	1.267511	96.27559	0.091263
Variance Decomposition of DTO:							
Period	**S.E.**	**DBS**	**DCO**	**DCPI**	**DEXTER**	**DIR**	**DTO**
1	4.452876	0.391262	0.010824	0.266691	1.022135	0.082661	98.22643
2	5.092322	4.809630	0.628899	0.205265	1.022690	0.063329	93.27019
3	5.209225	5.463493	1.128258	0.323462	1.176100	2.747543	89.16114
4	5.246499	5.439944	1.142569	0.323952	1.159757	3.169740	88.76404
5	5.256885	5.452165	1.138108	0.344805	1.155294	3.197613	88.71201
6	5.259247	5.447832	1.137124	0.348671	1.155373	3.274045	88.63696
7	5.259513	5.447286	1.137199	0.349876	1.155623	3.277364	88.63265
8	5.259602	5.447222	1.137341	0.350509	1.155620	3.278131	88.63118
9	5.259619	5.447187	1.137366	0.350507	1.155620	3.278582	88.63074
10	5.259621	5.447236	1.137367	0.350526	1.155623	3.278586	88.63066
Cholesky Ordering: DBS DCO DCPI DEXR DIR DTO							

Source: E-Views 11.

shocks" along with shocks of crude oil prices, interest rate, exchange rate trade openness, and inflation. Results in *Fig.* are represented in graphs. Results show the impulse response in crude oil prices to BSE SENSEX in the first graph that shows the value of crude oil prices is rising from the first period. After a short period, it will be declined, and after the sixth period, it is stable. Results show in the second graph, the impulse response in CPI (Consumer price index) to BSE SENSEX, which shows the value of CPI is declining, and after a short

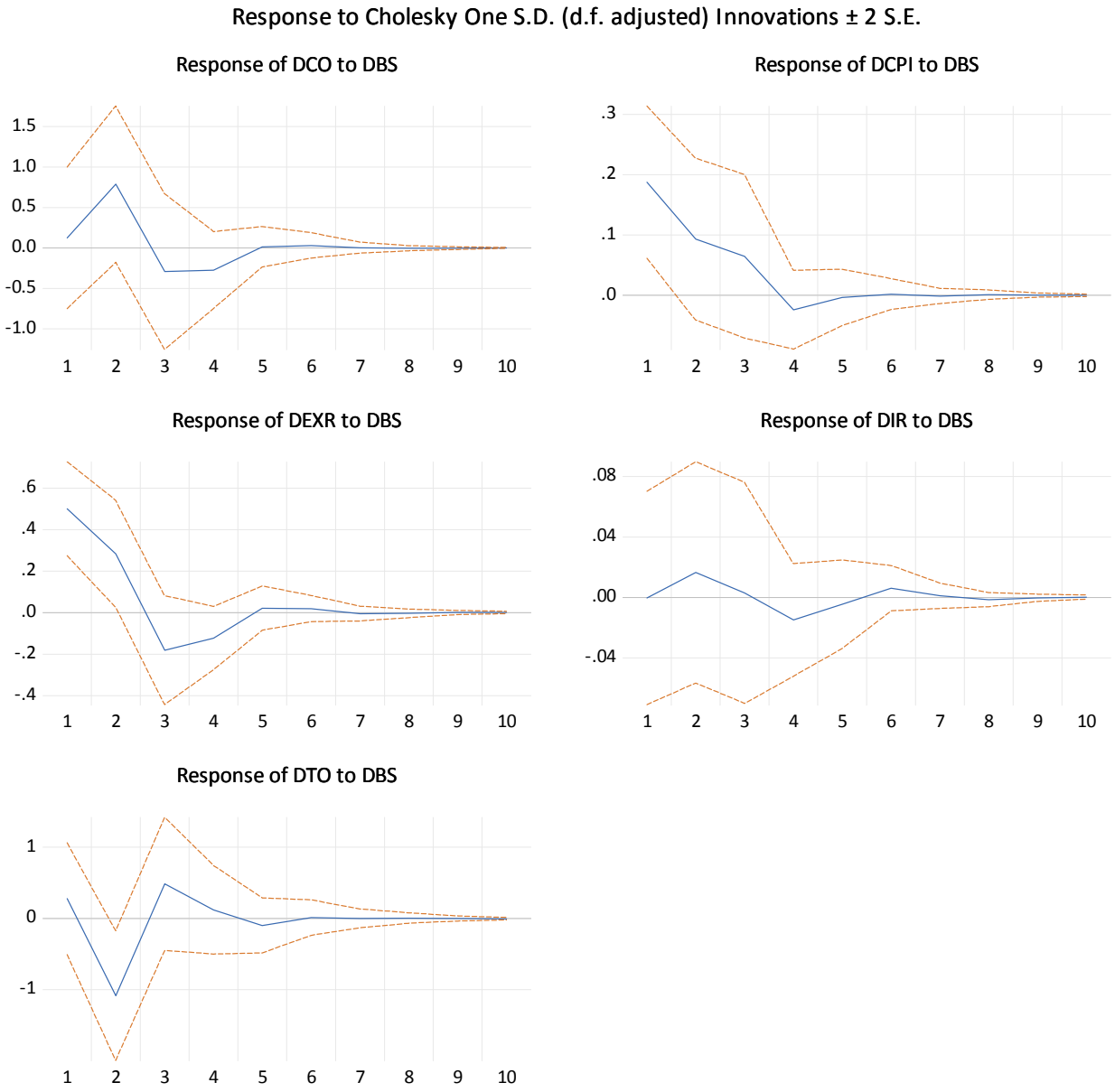

Fig. **Combined Graph of Impulse Response Function Analysis**

Source: E-Views 11.

period, it was rising. Results show in the third graph the impulse response in Exchange Rate to BSE SENSEX, which shows the value of the Exchange Rate is declining and after a short time period it is rising. Results in *Table 2* show the impulse response in the Inflation Rate to BSE SENSEX in the fourth graph, which shows the Inflation Rate is rising from the first period. After a short period, it will be declined, and after the sixth period, it is stable. Results show the impulse response in Trade Openness to BSE SENSEX in the fifth graph, which shows the value of Trade openness is declining. After a short period, it rises, and after the fifth period, it is stable.

Findings

1. According to the results, the Null Hypothesis H0 is rejected.

2. In order to predict the short and long-run shocks, variance decomposition is utilized for the study; VDC analysis results show that a significant unexpected change in stock prices is due to external factors like changes in dividends, and also most of the changes are due to exogenous shocks in macroeconomic variables which have been taken for the study in-sample period and some changes in the stock market are due to its own innovative shocks.

Table 2

Results of Impulse Response Function

Period	DCO	DCPI	DEXTER	DIR	DTO
1	0.126360	0.187647	0.500580	−0.000263	0.278532
	(0.43736)	(0.06307)	(0.11295)	(0.03530)	(0.39167)
2	0.788540	0.093221	0.283325	0.016603	−1.081499
	(0.48197)	(0.06718)	(0.12858)	(0.03656)	(0.45473)
3	−0.290192	0.064486	−0.181019	0.003031	0.485133
	(0.48039)	(0.06773)	(0.13128)	(0.03657)	(0.46710)
4	−0.273168	−0.024064	−0.122651	−0.014763	0.121700
	(0.23717)	(0.03276)	(0.07617)	(0.01861)	(0.31048)
5	0.015201	−0.003674	0.021367	−0.004423	−0.096495
	(0.12394)	(0.02331)	(0.05335)	(0.01461)	(0.19312)
6	0.031102	0.001920	0.019263	0.006139	0.012481
	(0.07820)	(0.01283)	(0.03155)	(0.00751)	(0.12448)
7	0.004399	−0.001244	−0.005076	0.001171	0.001280
	(0.03382)	(0.00636)	(0.01778)	(0.00417)	(0.06703)
8	−0.002762	0.000954	−0.003524	−0.001415	0.005733
	(0.01591)	(0.00383)	(0.01034)	(0.00231)	(0.03571)
9	−0.002106	0.000307	0.000673	−0.00018	0.000333
	(0.00824)	(0.00177)	(0.00515)	(0.00118)	(0.01798)
10	0.000762	−8.28E-05	0.000741	0.000225	−0.003882
	(0.00331)	(0.00097)	(0.00280)	(0.00070)	(0.00872)
Cholesky Ordering: DBS DCO DCPI DEXR DIR DTO					
Standard Errors: Analytic					

Source: E-Views 11.

3. VDC Analysis results show that Crude oil prices have a more significant effect on BSE SENSEX, whereas other macroeconomic variables have moderate effects on the BSE SENSEX.

4. The results of IRF show that all macroeconomic variables are changing due to impulse changes in BSE SENSEX due to exogenous shocks.

SUGGESTIONS

1. To reduce these unexpected changes frequently, companies should control the capital loss and focus on some stable policies regarding dividends.

2. Changes in stock market returns are more affected by changes in crude oil prices in India. The reason could be, the companies in Energy, Industrial and Material sectors raise the value of shares to rise in oil prices. Raising prices in oil is a positive signal to the investors in India to increase the amount of investment.

3. A hike in oil prices will have a positive impact on other commodity prices like Gold prices.

4. And if there is a hike in share prices, commodities prices will go down in the coming years.

CONCLUSION

An attempt was made in this research work to investigate the impact of macroeconomic factors on the Indian stock market. The empirical study began with testing stationarity of the time-series data, and lag length criteria were decided. Finally, the model's short-run and long-run shocks were predicted using the Impulse Response Function as well as Variance Decomposition analysis, respectively. According to the findings, crude oil prices have a greater influence on the BSE Sensex than other factors, with other variables having a small impact. The results of VDC analysis discover that stock prices change due to their innovative shocks. The macroeconomic variables were selected based on the existing literature and the availability of the resources.

LIMITATIONS OF THE STUDY

The study has considered a limited number of macroeconomic variables, i.e., Exchange Rate, Consumer Price Index, Interest Rate, Crude Oil Prices, along with Trade Openness and stock index i. e BSE Sensex. Other macroeconomic variables could have a considerable impact on the movement of the stock market. In contrast, Other stock indexes are just as important for assessing the overall influence of macroeconomic factors on stock market performance as the Dow Jones Industrial Average.

SCOPE OF FURTHER RESEARCH

Further study might re-examine the difficulties raised in this work using a more complete data collection that includes more macroeconomic solid factors and stock indexes, in addition to the data set used in this paper. Research can be enhanced by including the study of a structural break in the time series data due to the Covid-19 pandemic. The Indian market also can be examined by comparing it with the stock market of developed countries at the international level.

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Satyendra P. Singh — discussed and suggested the analysis methods and implications.

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ORIGINAL PAPER

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Impact of the Debt Sustainability of State-Owned Companies on Russia's Corporate External Debt under Sanctions

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ABSTRACT

The subject of the research is the influence of the debt burden of state-owned companies on the dynamics of Russia's corporate external debt. The **relevance** is due to the unprecedented combination of sanctions in 2022, which created default risks of national companies. The **goal** of the article is to identify factors influencing changes in the amount of external debt. Based on a quarterly sample for 2010–2019 (37 observations), using the least squares **method** (LSM), a regression model was built for the dependence of corporate debt dynamics on micro– and macroeconomic factors (debt service ratio and credit rating of companies, foreign assets, ACRA financial stress index, rate changes of USD/RUB, credit default swap (CDS), export volume, balance of payments). An analysis of their credit risk was carried out by comparing the dynamics of the debt sustainability ratio (DSR) with the rating and cost of CDS, and the quarterly income support of debt was calculated. As a **result** of testing the hypotheses, a positive relationship was revealed between DSR and ratings of state-owned companies for changes in banks' external debt, while for enterprises they do not play a key role. It was concluded that the growth of loan premiums in 2014–2015 was due to political factors, and by the new crisis, the companies had accumulated reserves for absorbing the shock. Measures are proposed to reduce debt risks — coordination of debt policy, debt "import substitution", monitoring of new financial indicators of companies, control of cross-border capital flow, etc.

Keywords: external debt; CDS; credit rating; default; sanctions; risk management

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INTRODUCTION

After recovering from the COVID-19 crisis, the Russian financial system has faced new challenges — sanctions that have not been imposed on any country in the world before. Financial shock in early 2022 was much stronger than forecasts in risk scenarios of the Bank of Russia[1]: the prices of many shares of Russian companies have fallen to historical lows, and volatility has increased dramatically; after the blockage of the "bridge" by European depositories with MOEX bonds on external debt markets lost liquidity, and the panic of investors led to a record outflow of capital — more than 240 bln dollars.

To restore financial stability, the Bank of Russia was forced to raise the interest rate to 20%, temporarily paralyzing domestic debt markets, but only by correcting the yield curve of Federal loan bond (FLB), in September the RGBI index began to decline again.

Despite a significant change in macro environment, Russian companies still have significant external debt. Disconnection of both the Ministry of Finance and national companies from the international payment system SWIFT prevented its use to service its obligations. It was a paradoxical situation for agents with reserves (although many assets were frozen) to fail to make scheduled payments, leading to a de jure default.

At the same time, the local crisis may be exacerbated by the approaching global. Government support to many countries in the COVID-19 period smoothed the economic recession with excessive monetary and fiscal stimulus, which, together with anti-Russian sanctions, led to record inflation— in the USA, it rose to 8.3%.[2] In turn, the reciprocal sharp monetary tightening of central banks carries the risks of a debt crisis for all markets and could lead to a deep global recession.

New threats once again called into question the possibility of stable development of the Russian economy, which is subject to regular actions of various kinds of "turbulence". In the current Economic Security Strategy of Russia, the main threats include "exposure of the financial system to global risks",[3] that depends to a significant extent on the sustainability of state companies — organizations with a high share of state ownership in the share capital (shareholding — 50% + 1 share or more) studied in this work.

FINANCIAL STATUS OF RUSSIAN CORPORATIONS

Were our companies prepared for such events? Liquidity shortage in the market and declining incomes during macroeconomic shocks often force the State, including private companies, to insure with its reserves: during the 2008 crisis, the government refinanced such debts with the Reserve Fund — about 50 bln dollars. The Russian crisis of 2014–2015 was characterized by the fact that prior to this period, companies were freely occupied in the world market, and after the sanctions restrictions they experienced an acute liquidity shortage — in 2014–2017, the company needed to be on-lending by about 112 bln dollars, while the issue volume of Eurobonds decreased by almost 90% [1, p. 88]. And this time, the idea of purchases of corporate debts and their payment by the State was put forward, but the government managed to stabilize the situation with the help of reserves [2, p. 53]. According to the statistics of the Bank of Russia, the peak debt of credit organizations on operations repurchase agreement in foreign currency reached 35.39 bln dollars. (*Fig. 1*) and continued until the end of 2017. As a result of sanctions, corporate debt began to decline from its peak in the Q1 of 2014 and at the beginning of the Q3 of 2022 it amounted to 381 bln dollars.[4]

[1] Monetary Policy Report. Moscow: Central Bank of the Russian Federation; 2019;2. 93 p.

[2] Consumer Price Index Summary. URL: https://www.bls.gov/news.release/cpi.nr0.htm (accessed on 29.10.2022).

[3] Decree of the President of the Russian Federation No. 208 "Economic Security Strategy of the Russian Federation to 2030". URL: https://www.garant.ru/products/ipo/prime/doc/71572608 (accessed on 29.10.2022).

[4] External debt of the Russian Federation. URL: https://cbr.ru/vfs/statistics/credit_statistics/debt/debt_new.xlsx (accessed on 29.10.2022).

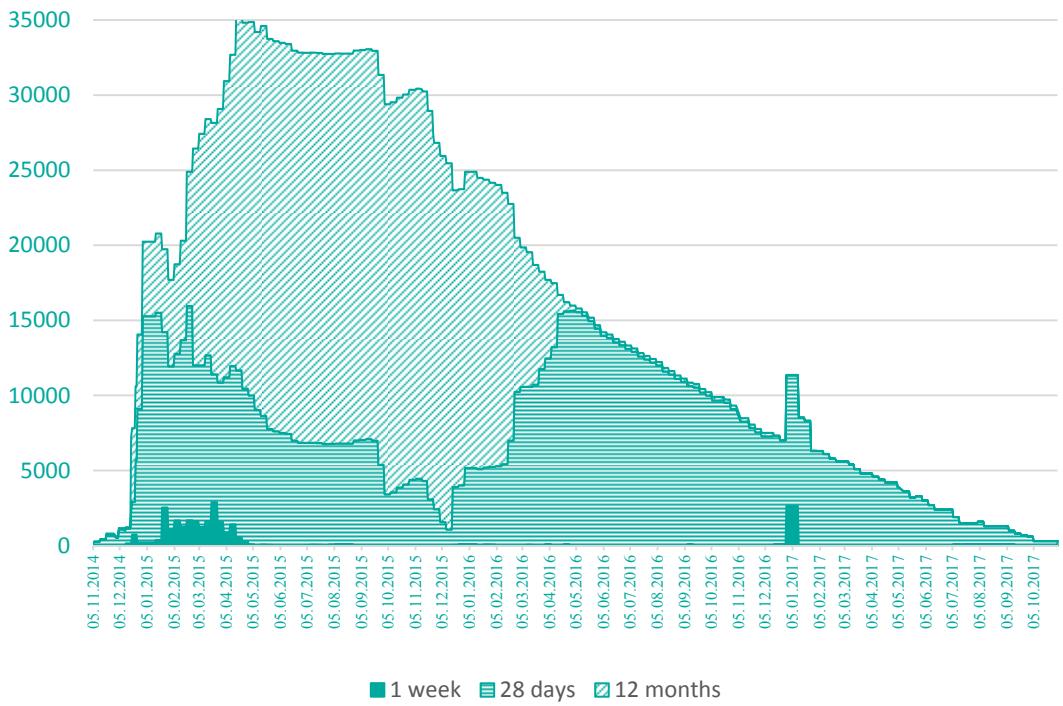

Fig. 1. **The volume of funds provided by the Bank of Russia to credit institutions under the first leg of REPO transactions in foreign currency, USD mln.**

Source: Bank of Russia data. URL: https://www.cbr.ru/hd_base/repo_debtusd (accessed on 29.10.2022).

The current crisis has a slightly different scenario for external corporate debt shocks — it is the sovereign who has been subjected to the most severe sanctions and has been forced to "insure" national companies. So far, Russian government measures have smoothed the shock, but Western governments are forcing Russian companies to artificial default. An additional negative factor — is the freezing of assets of State-owned companies, which will negatively affect the state reserves and the budget, like previous crises due to their "quasi-State" nature [3, p. 117]. Organizations that experienced instability in 2014–2015 significantly improved currency imbalances in assets and liabilities (aggregate effective currency mismatch — AECM).[5] As a result, since the Q3 of 2016, assets have fully covered the entire amount of external debt (*Table 1*), and the country's gold reserves covered all corporate debt and at the beginning of 2022 amounted to 630.6 bln dollars.

From the Q2 of 2014 to the Q1 of 2022[6] *banks'* assets declined from 288.67 to 182.7 bln dollars, but debt declined further — from 208.86 to 80.4 bln dollars, net external debt — 102.23 bln dollars (*Fig. 2*).

Assets of *non-financial enterprises* grew from 249.68 to 340 bln dollars, debt decreased from 450.56 to 303.78 bln dollars, net external debt was 22.01 bln dollars (*Fig. 3*), while before the crisis they had significant currency imbalances AECM.

Despite the improved balance sheet, after the sanction arrest of about 300 billion reserves of the Bank of Russia and the companies' assets, solvency has deteriorated significantly. The fact is that the period of low interest rates (2020–2021) allowed not only to refinance the debt, but also to accumulate excess liabilities.

[5] Net external debt of the Russian Federation. URL: https://www.cbr.ru/vfs/statistics/credit_statistics/debt_sector/61–debt_sector_20.xlsx (accessed on 29.10.2022).

[6] After the start of special military operation, the Bank of Russia decided not to publish detailed statistics.

Table 1

Change in net position on external debt, USD bln.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Banks	–36.9	–48.4	–79.81	–101.6	–87.19	–97.51	–77.81	–111	–105	–102.2
Organizations	143.9	211.5	200.8	108.45	93.32	70.41	36.07	10.626	8.057	–36.17
Total	107.02	163.1	121	6.851	6.137	–27.1	–41.74	–100.4	–96.97	–138.4

Source: Net External Debt Position of the Russian Federation by Sector. URL: https://cbr.ru/statistics/macro_itm/svs (accessed on 29.10.2022).

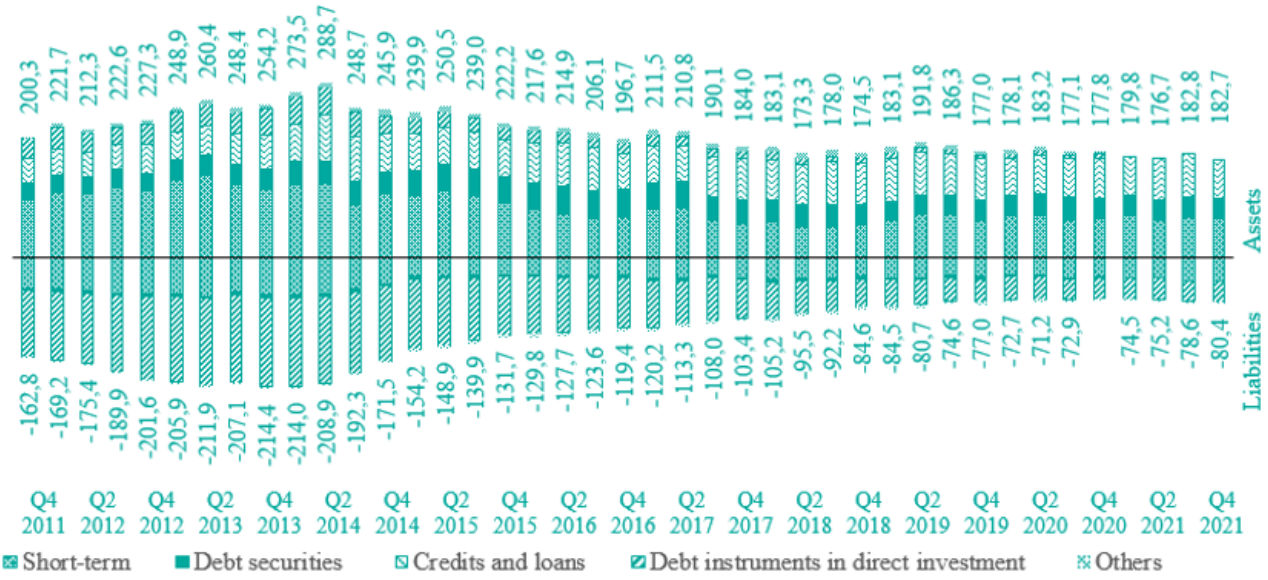

Fig. 2. **External assets and liabilities of Russian banks, USD bln.**

Source: Net external debt position of the Russian Federation by sector. URL: https://cbr.ru/statistics/macro_itm/svs (accessed on 29.10.2022).

Now the start of a new phase of sanctions confrontation with the West, after the start of a special military operation in Ukraine, negatively affects the debt sustainability of companies and may lead to a chain of defaults due to the embargo, asset freezes, problems with payment and depository infrastructure. All this forces to research the factors that influence the debt volumes and to develop the state risk management of corporate debts.

OVERVIEW OF RISK ASSESSMENT TOOLS

In this article we are contributing to the discussion about the factors that contribute to the accumulation of external debt in a small open export-oriented economy,[7] on the example of Russia. In domestic studies, there is a lack of attention to the analysis of debt risks of state-owned companies, and proposals to regulate debt levels require detailed study. Estimates are not quantified, some works are written for the experience of the 2008 crisis and require updating, in turn, the world experience must be adapted to Russian conditions.

[7] After the sanctions of 2022 "openness" has deteriorated significantly, but we expect external and internal financial repression to weaken over time.

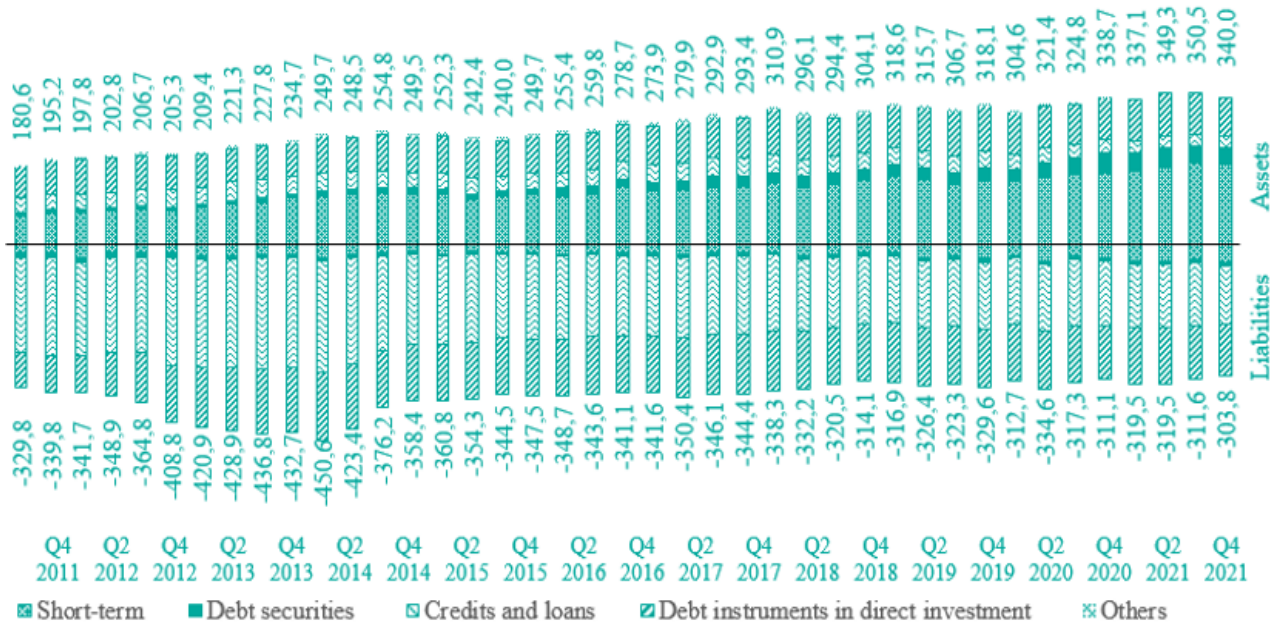

Fig. 3. **External assets and liabilities of Russian enterprises, USD billion**

Source: Net external debt position of the Russian Federation by sector. URL: https://cbr.ru/statistics/macro_itm/svs (accessed on 29.10.2022).

Is external debt a positive or negative characteristic of the country? Such borrowing goes beyond the creditor-debtor relationship, as it relates to the degree of liberalization of capital markets and, consequently, their international flows, the relative value of the national currency, the state of the country's balance of payments. On the one hand, access to foreign markets contributes to investment and economic growth, as additional financing from a large number of creditors expands production in the context of limited domestic loan capital. On the other hand, due to the weak diversification of commodity economies, the rising prices of exported goods have led to increased foreign exchange inflows and high credit rates in local financial markets. Since the prices of these goods (oil, metals, wheat, etc.) are determined in the world markets, it is considered as an exogenous income transfer. High export costs dampen risk premiums and further boost capital flows to these countries [4, p. 8]. Strong correlation of credit and commodity cycles can lead to a sharp deterioration in the quality of banks' loan portfolio due to reduced solvency of borrowers and create systemic risk [5, p. 42], when there is a price shock and a reverse capital outflow.

These risks are typical for developing countries, with the channels of shock being the interest rate, currency mismatch on companies' balance sheets, financial leverage and limited working capital [6, p. 39]. Often not even the fact of debt, namely, currency mismatch becomes the cause of crisis. Low interest rates and sharp increases in central bank balances contribute to facilitating of finance, particularly by increasing borrowing in foreign currency. Such monetary policy may change the incentives of companies to issue short-term bonds, thereby increasing the refinancing risk at the expense of future financial stability [7, p. 7].

The mismatch between national and foreign currencies occurs when an enterprise balance sheet or income flows are sensitive to exchange rate. According to the concept of "original sin", introduced by B. Eichengreen, R. Hausmann and U. Panizza, borrowers from developing countries cannot borrow abroad in their national currency (although after the sanctions of 2022 Russia urgently replaces euro bonds with ruble bonds),

which naturally leads to currency mismatches on their national balance sheets. How serious the problem depends on a country's "net" foreign currency position (called MISM), i.e. excluding the balance between assets and liabilities against non-residents, which is calculated as follows [8, p. 15]:

$$MISM = \frac{Foreign\ currency\ of\ Total\ debt}{export\ /GDP}. \quad (1)$$

Another indicator — aggregate effective currency mismatch (AECM) — is important for the dollar economy. Although the foreign currency debt ratio (FC% TD) may be large, the degree of risk also depends on the net foreign exchange on external debt. Therefore, countries with a strong positive position on net foreign exchange assets can more easily stand commodity price shocks. AECM is calculated using the following formula:

$$AECM = \frac{Net\ foreign\ currency\ assets}{Export} * \\ * Foreign\ currency\ of\ Total\ debt. \quad (2)$$

As for Russia, the above processes are accompanied by shocks of price and non-price factors of influence on the debt policy. On the one hand, as a result of the rise in political risks, the revision of credit ratings and the change in the degree of inclination of foreign investors to risk (observed in 2014–2015), there was a reduction in external financing. On the other hand, non-price factors — different types of sanctions have not only influenced by an increase in the risk premium, but have effectively closed access to long-term financing in global debt markets [9, p. 96].

Due to the need to respond to the 2008 crisis, Central Banks and supervisory authorities around the world gained new powers to ensure financial stability, which pursued the following objectives [10, p. 8]:

- improving the financial system's resilience to shocks by creating buffers of foreign exchange reserves;
- AECM currency mismatch limits for open currency positions and currency asset type restrictions;
- controlling the risk accumulation of systemically important organizations by limiting leverage.

However, exactly the last point concerns state-owned companies, the debt portfolio of which in our economy sufficiently significant and high debt burden can threaten the economic security of the country, make it vulnerable to external crises [11, p. 22]. If we formulate the concept of economic security (in the context of debt relations), then it is such *a set of characteristics (volume, urgency, currency structure) of debt, in which the State is able to ensure the continuity of the financial market and the sustainability of the budgetary system, while at the same time making efficient use of borrowing, timely servicing and repayment, preserving the country's financial sovereignty and credit rating* [12, p. 66].

How to assess debt risks? The globalization of financial markets has led to the need to harmonize methods for comparing credit risks of enterprises, banks and States. One such tool is *credit ratings*, which provide standardized, easily perceived, consistent, independent assessments and reflect the credit quality of the counterparty, issuer or investment product.[8] They include such indicators as: financial sustainability, transfer risk, elements of state support. The development of macroprudential tools that are implemented in response to systemic shocks made ratings an important benchmark for asset risk group. For example, in 2014 the Bank of Indonesia created a requirement for companies which borrows on foreign markets: their rating from international agencies should be at least BB. A relatively high financial sustainability is required because of the above-mentioned cyclicality. However, changes in ratings are delayed towards the credit cycle — "at the moment of the crisis,

[8] Increasing the sustainability of the banking sector. Basel Committee on Banking Supervision. Moscow: Bank of Russia; 2009. 107 p.

Table 2

Comparison of the ratings used

	Ratings used									
Scale	11	10	9	8	7	6	5	4	3	2
S&P	BBB+	BBB+ n.f.	BBB	BBB n.f.	BBB–	BBB– n.f.	BB+	BB+ n.f.	BB	BB n.f.
Moody's	Baa1	Baa1–	Baa2	Baa2–	Baa3	Baa3–	Ba1	Ba1–	Ba2	Ba2–

Note: on the Moody's scale "–" — negative forecast, in S&P "n.p.", in other cases — the forecast is "stable".

Source: Bloomberg Terminal.

ratings are relatively high" [13, p. 154], and a sudden downturn in the coming recession often leads to a sale of securities by investors.

Over the past decade, Russia has pursued a consistent policy of macroeconomic stability, reduced the impact of oil price volatility and increased resilience to external shocks. As a result, the agencies upgraded sovereign and corporate ratings to investment grade (Fitch's highest level — BBB with stable outlook). In the article uses the types of ratings that most closely characterize credit risk on foreign liabilities (if there is a rating):

1. *Probability of default* — opinion on the probability of default.[9]
2. *Foreign currency issuer credit* — opinion on the ability and willingness of the borrower to meet its obligations in foreign currency.[10]
3. *Foreign long-term bank deposits* — opinion on the bank's ability to discharge its foreign currency deposit obligations in full and on time.

Comparison of rating scales is given in *Table 2*.

Another risk measurement tool is CDS — credit default swap. This is an agreement between the two parties under which the former pays the second insurance amount if the debtor has a credit case. A credit event can be an issuer default, coupon/denomination delay or default, bond price or credit rating collapse, debt restructuring [14, p. 634]. Unlike periodic rating updates, the market price of CDS reacts instantly to changes in risk.

The methodology of credit default swap pricing is widely described in the foreign academic literature, and the most famous in terms of practical application are the model of bank JP Morgan CreditGrades and the model of the company that specialized in credit risks, KMV (Kealhofer, McQuown, and Vasicek — as of now unit of the Moody's agency) [15]. The CreditGrades model was first used in the work [16, 17] which studied the risks of low-rating developing country instruments. This study uses five-year CDS 5Y awards for each of the companies under review at the end of the quarter.

Bank for International Settlements [18, p. 23] and IMF[11] proposed another risk measurement methodology with a debt service ratio (further — DSR). Its economic meaning is to determine the ratio of profit to debt service. In this article, this indicator is calculated as the ratio of operating income to interest expense per quarter. Such models of assessment of solvency are similar to stress tests,[12] the purpose of which is to identify unstable organizations by assessing the balance under extreme macroeconomic scenarios, for example in "serious economic downturn or liquidity

[9] Moody's Rating Symbols&Definitions. URL: https://www.moodys.com/sites/products/ productattachments/moodys%20rating%20symbols%20and%20definitions.pdf (accessed on 29.10.2022).

[10] S&P Global Ratings Definitions. URL: https://www.standardandpoors.com/en_US/web/guest/article/–/view/sourceId/504352#ID 993 (accessed on 29.10.2022).

[11] Global Financial Stability Report. Potent Policies for a Successful Normalization. IMF. 2016. 204 p.

[12] Review of BCBS supervisory and internal stress testing procedures. Moscow: Bank of Russia; 2017. 72 p.

shortage in financial markets" [19, p. 88]. As the default risk increases during shocks, the critical level is the company's lack of current income to service short-term liabilities: DSR < 2.

Another frequent tool to assess the issuer's risk on foreign borrowing (for the model, the article prefers CDS tool) is the spread between Eurobond yields. In recent years, the Russian economy has experienced several crises and naturally, the dynamics of spreads have been volatile — sharp "spikes of profitability to the level of 400 p.p. alternated with reaching the level of a safe haven" [20, p. 202].

Summarizing the review of the literature, let us propose two research hypotheses:

H1: Growth of debt sustainability ratio (DSR) of state-owned companies negatively affects the debt policy of the entire corporate sector.

H2: Change in the credit rating of state-owned companies is a signal of growth / reduction of external corporate debt.

THE DSR MODEL INTERCONNECTION OF STATE COMPANIES AND EXTERNAL DEBT

The above problem sets the task of building an econometric model, which would help to identify the relationship and nature of the impact of macro- and microeconomic (primarily — the debt burden of major state companies) the dynamics of Russia's total external corporate debt. To this end, a sample of state-owned companies with the largest external debt (covering more than 60% of quasi-public debt) was selected. Selection criteria are justified by the particularly high probability of government support in case of temporary financial insolvency (*Table 3*) during macroeconomic shocks.

The work uses quarterly consolidated accounting statements (IFRS) of companies for the period from Q1 2010 to Q1 2019 (37 observations). Main data source — Bloomberg Terminal and Bank of Russia website. Structure — panel data, calculations were made in Stata 14.2 software package.

In the first stage graphical analysis of ratings dynamics, CDS and DSR was conducted. He showed that credit rating does not always objectively assess the sustainability of companies and, of course, lags behind in comparison with permanent pricing of CDS. Ratings were barely adjusted until the 2014 sanctions, and after the economic recovery and adapting to the limitations (2017–2018), they remained at relatively low levels. Their collapse in 2014–2015 was largely due to political circumstances and does not fully reflect the dynamics of financial sustainability of companies such as Sberbank or Gazprom (if you estimate stability by DSR). On the other hand, calculations of the debt service ratio showed that some companies often faced difficulties in servicing the debt (e.g., VEB and Inter RAO), but the rating could not change. The detailed dynamics of the studied indicators are shown on *Fig. 4*.

By the least squares method (LSM), the debt dynamics are related to the micro and macro variables (data are divided both for each organization and separately by sector). The total amount of external debt of the banking sector and of non-financial enterprises separately is selected as the regressor, and the regressors are: total debt service ratio, credit rating on foreign currency liabilities (if any), volume of foreign assets of banks and enterprises, Bank of Russia reserves, five-year default swap premium for each organization, ACRA FSI[13] financial stress index, export value and balance of payments. The full set of variables is given in *Table 4*.

The unloading of the base model showed that correlation analysis was needed to identify redundant variables. High positive association between banks' assets and their debt — 0.859, international reserves and rating of banks — 0.872, reserves and assets of banks — 0.824, between CDS banks and enterprises — 0.793, ruble exchange rate and ACRA index — 0.812, between reserves and exports — 0.870 (*Table 1, Appendix*).

[13] ACRA Financial Stress Index for Russia. URL: https://www.acra-ratings.ru/research/index (accessed on 29.10.2022).

Table 3

Sample of companies for research

	Name of the company	Share of state participation,%	Debt, USD million	Sanctions	ICR < 2 (out of 37 quarters)
Financial institutions	VEB	100	10 337.25	fin 1, fin 2	25
	Sberbank	52	8294.12	fin 1, fin 2	4
	VTB	70	6726.85	fin 1, fin 2	5
	Russian Agricultural Bank	100	500	fin 1, fin 2	21
	Gazprombank	50	1404.73	fin 1, fin 2	9
Enterprises	Gazprom	50	41 804.1	tech	2
	Rosneft	50	15 379.67	fin 2, tech	5
	Inter RAO	63	46.51		21
	RusGidro	70	257.11		0
	RZD	100	6440		5

Source: author's calculations based on Bloomberg Terminal for Q2 2019.

Note: fin 1 (ban on financing or transactions with new debt for a period of more than 14 days), fin 2 (ban on buying securities), tech (supply of technology).

The variance inflation factor (VIF) was calculated to test multicollinearity by the formula:

$$VIF_j = \frac{1}{1-R^2}\, j\epsilon\{2,\ldots,k\}, \quad (3)$$

where R^2 — determinism coefficient in regression factors.

Exclusion from the model of redundant variables (whose index >10) corrected the average VIF, which amounted to 2.86 and 3.38 (*Table 2, Appendix*), i.e. the multicollinearity between model parameters is statistically insignificant.

To improve the predictive force was logarithmically part of the variables (*Table 5*). The null hypothesis of H_0 is that all coefficients for explanatory variables are zero.

Note that the *F*-statistics of the constructed bdebt model (bank data) is 68.24, while the critical value of 1% for this dataset is 1, which rejects the zero hypothesis and the regression model is generally recognized as significant. For the cdebt model (business data), F-statistics are 38.11, which is higher than the critical value of 0.99 and also indicates the importance of the model.

Next, check for heteroskedasticity (no unstable variance of random model errors) in models where:

$$H_0 : \sigma_i^2 = \sigma^2 \text{for} \forall\, i \text{ (homoscedasticity)}, \quad (4)$$

$$H_1 : \exists i,\ j : \sigma_i^2 \neq \sigma_j^2 \text{ (heteroskedasticity)}. \quad (5)$$

The results of the Breusch–Pagan test showed that the value of the calculated statistics $\chi^2 = 5.43$ for *bdebt model* more critical, therefore rejecting the homoscedasticity hypothesis H_0 and requiring further model correction. A similar test for the *cdebt model* showed no heteroskedasticity — the value of statistics $\chi^2 = 2.23$.

INTERPRETATION OF THE RESULTS

Two sectoral models show the relationship between external debt from micro- and macroeconomic factors:

1. *For bank debt (bdebt)* it explains 79.8% (R-squared) volatility. Key variables at 1% level are: credit rating (factor change per standard deviation 1 σ = 7.1 points), which characterizes the financial stability of the

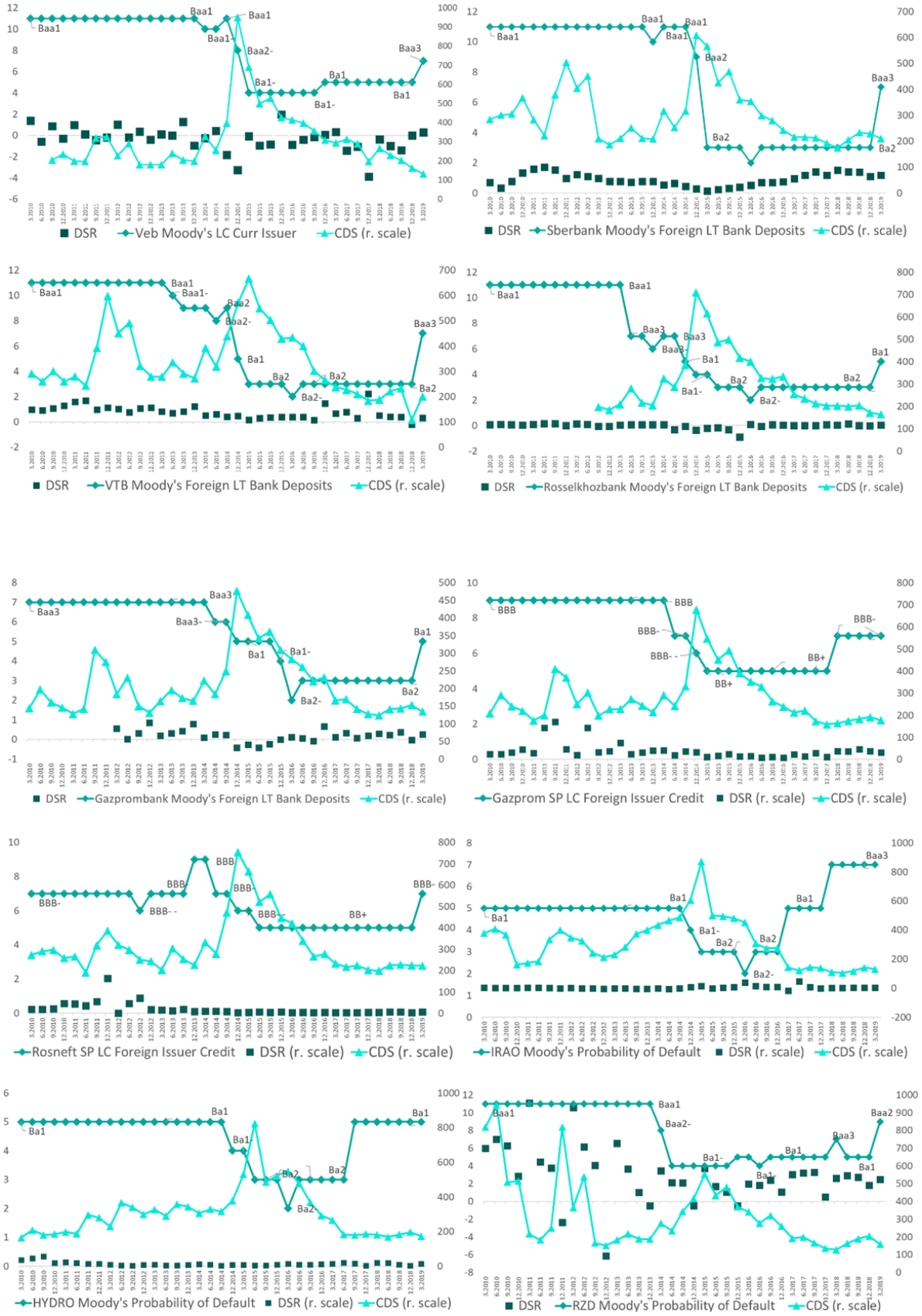

Fig. 4. **Dynamics of DSR, credit rating and CDS for 2010–2019**

Source: author's calculations based on Bloomberg Terminal.

Table 4

Set of regression model variables and their descriptive statistics

Variable	Designation	Measure	Obs	Mean	S. D.	Min	Max
Microeconomic variables (for 10 sample companies)							
Bank debt service ratio	bdsr	points	175	0.92	1.92	−6.156	11.10
Enterprise debt service ratio	cdsr	points	185	0.93	53.54	1	185
Bank credit rating	brating	points	185	6.78	3.43	2	11
Enterprise credit rating	crating	points	185	6.064	2.22	2	11
Bank credit default swap	bcds5y	points	173	291.21	133.35	108.25	949.85
Enterprise credit default swap	ccds5y	points	185	308.15	154.3	105	944
Macroeconomic variables							
Bank external debt	bdebt	bln dollars	185	87.556	25.86	50.607	137.76
Enterprise external debt	cdebt	bln dollars	185	121.02	26.49	81.995	170.87
Foreign assets of banks	bassets	bln dollars	165	217.68	3.08	173.31	288.67
Foreign assets of enterprises	cassets	bln dollars	165	256.58	39.96	180.6	318.63
Financial stress index	acra	points	185	0.988	0.701	0..204	3.858
Reserves of the Bank of Russia	reser	bln dollars	185	582.92	72.6	486.0	698.4
Export	export	bln dollars	185	136.29	25.49	81.906	173.01
Balance of payments	pbalance	bln dollars	185	16.186	11.46	−3.323	39.28
Course change for USD/RUB	rub_vol	%	185	−0.302	0.487	−1.123	1.319

Source: author's calculations in Stata.

bank; foreign assets of the sector are significant (1 σ = 0.3 bln dollars); ruble rate logarithm (1 σ = −7.7 percentage points); two variables, which characterizes foreign exchange inflows — export log (1 σ = −5.1 bln dollars) and balance of payments log (1 σ = 31.7 bln dollars). Less significant variables: at 5% — debt ratio (1 σ = −1.99 points), and at 10% — financial stress index (1 σ = 2.73 points). The logarithm of credit-default swap (1 σ = 1.48 points) remained insignificant in the model, but its exclusion reduces the predicted strength of the model.

2. *For business debt (cdebt)* explains 68.9% (R-squared) volatility. The key variables at 1% were: variables characterizing foreign exchange earnings of enterprises — foreign assets (1 σ = 19 bln dollars), exports (1 σ = −17.18 bln dollars) and balance of payments (1 σ = −5.99 bln dollars); another set of variables assesses uncertainty in the economy — financial stress index (1 σ = 7.1 points), ruble rate logarithm (1 σ = −5.4 percentage points); financial sustainability risks — credit default swap (1 σ = 11.88 points) of the studied enterprise.

Summarizing the results presented, some features of the influence of variables have been identified. In the model for banks, a significant debt service ratio and rating, while for enterprises they do not play a key role, but the dependence on the credit-default swap premium was found. This confirms the H1 and H2 hypotheses for banks and refutes for enterprises. In this case, the CDS variable is only relevant for enterprises, which may be due to its continuous pricing in comparison with some delay of rating change. The ACRA index is less significant for banks, while the ratio and importance for enterprises is higher. Similar situation with international assets — enterprise coefficient greater. The positive balance-of-payments effect on banks' debt volumes and the negative impact on enterprises' debt is anomalous. In general, both built models have good predictability, are stable and recognize the relevance of the set of explanatory variables.

The final equation *for banks* is as follows (i — number of object, t — time):

$$bdebt_t = -12{,}29 - 1{,}039*bdsr_{it} - 2{,}079*brating_{it} + \\ + 0{,}963*bassets_t + 3{,}897*acra_t - 15{,}92* \\ * LN\_rub\_vol_t + 3{,}595*LN\_cds5y_{it} - \\ - 25{,}58*LN\_export_t + 2{,}769*LN\_pbalance_t. \quad (6)$$

The final equation *for business* is as follows:

$$cdebt_t = -195{,}436 - 0{,}00535*bdsr_{it} - \\ - 0{,}711*crating_{it} + 0{,}459*cassets_t + 10{,}17*acra_t - \\ - 11{,}22* LN\_rub\_vol_t + + 0{,}0774*cds5y_{it} - \\ - 0{,}674*export_t - 0{,}523*pbalance_t. \quad (7)$$

CONCLUSIONS AND RECOMMENDATIONS

The analysis showed that domestic companies significantly reduced their dependence on external debt markets and improved their balance sheets. However, the historically unprecedented scale of sanctions requires the achievement of full financial sovereignty. Two main objectives for further action in this regard can be identified: to limit the accumulation of excess debt and to ensure sustainability through the creation of reserves. What measures will reduce risks? IMF and Bank for International Settlements documents pay insufficient attention to the principles of control of corporate liabilities, but on the basis of recommendations for sovereign debt management, we will formulate some proposals.

Loan policy coordination. A medium-term joint development strategy is needed to control external borrowing (for the moment "Main directions of the State debt policy of the Russian Federation" were developed last time in 2016). To do this, it is necessary to formalize the list of systemically significant organizations (primarily non-financial). This activity may be regulated by the Ministry of Finance, but the corporations themselves must clearly plan the details of borrowing — the timing, currency, volumes must comply with the strategy.

Table 5

Assessment of model parameter significance

	(1)	(2)
VARIABLES	**bdebt**	**cdebt**
dsr	−1.039**	−0.005
	(0.513)	(0.020)
rating	−2.079***	−0.711
	(0.531)	(0.662)
assets	0.1***	0.5***
	(0.053)	(0.1)
acra	3.897*	10.17***
	(2.037)	(2.384)
LN_rub_vol	−15.92***	−11.22***
	(3.656)	(4.276)
LN_cds5y	3.595	
	(3.803)	
cds5y		0.077***
		(0.012)
LN_export	−25.58***	
	(9.144)	
export		−0.674***
		(0.102)
LN_pbalance	2.769***	
	(1.000)	
pbalance		−0.523***
		(0.108)
Constant	−12.29	−195.436***
	(48.49)	(26.7)
Observations	143	165
R-squared	0.798	0.689

Standard errors in parentheses

Source: author's calculations in Stata.

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Debt risk monitoring and control of company financial performance: leverage, ratio of net external debt to EBITDA (total debt is recommended to be kept at no more than 3.5), percentage of interest payments in cash flow, ROA, share of short-term debt in total debt, share of net flow in total cash. At the same time, according to the research, control over the debt burden of Russian banks is more important, as it is a trigger of growth or reduction of external debt of the entire economy. Measures to accumulate short-term debt may also be used (a reserve requirement that penalizes such borrowing). The Reserve Bank of India applies such rules, limiting the term and full cost of lending (loan with a repayment period of 3–5 years — 6-month LIBOR + 300 p.p., for a loan with a maturity of 10 years — 66-month LIBOR + 500 p.p., loans of less than three years are prohibited). The Bank has created a list of companies that are allowed to borrow in foreign markets, loan objectives, requirements for hedging foreign exchange risks. According to IMF, these measures significantly balanced the debt portfolio of companies.

Creation a legal restriction both volumes (debt threshold) and external financing instruments. It is important to note that its own debt is not a problem if its growth rate is below the growth rate of profit: over time, the debt-to-GDP ratio may rise, but companies will remain stable enough to service it. Restrictions such as the DSR we used to be aimed at increasing the resilience of borrowers and thus indirectly increase the resilience of lenders.[14]

When thresholds are reached, the regulator may: to establish allowances to risk factors when lending, to suspend the registration of prospectuses of issue of Eurobonds, to ban short positions on currency, to raise the rate of banks' mandatory reserves, to lower the key rate (in case of growth of currency debt, in case of ruble — to raise). Differentiated limits are necessary for organizations without an internal risk management system and low debt servicing capacity. Such time limits may be imposed by government regulations, but their adoption will be constrained by the lobbying power of companies.

Debt "import substitution". Sanctions isolation forces Russia to accelerate investments, but for this it is necessary to realize a qualitatively new "debt economy". In terms of development of instruments of the domestic currency source of refinancing and taking into account the problems with the foreign payment infrastructure, it is proposed to replace foreign debts with Russian capital: assets of the National Welfare Fund and repatriation of surplus foreign assets of the same state-owned companies. At the same time, the revenue of the State in this part will be doubled, and organizations will receive tangible benefits from the reduced rate. Given the ban on the provision of rating services to Russian companies — replacement of the rating process by national agencies.

Integration of stress testing into current activities as a basic procedure, namely: introduction of risk assessment in the process of developing business plans, model risk management policies and scenarios, involvement of management in risk assessment.

Capital controls. Save domestic savings and reduce capital outflows. At the same time, care should be taken to maintain a high level of confidence in the Bank of Russia, crime prevention and "grey" withdrawal schemes, maintain competition in the domestic market and maintain the effectiveness of market mechanisms.

[14] Elements of Effective Macroprudential Policies. IMF-FSB-BIS. 2016. 22 p. URL: https://www.fsb.org/2016/08/elements-of-effective-macroprudential-policies (accessed on 29.10.2022).

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APPENDIX

Table 1

Correlation matrix of model parameters

	bdebt	cdebt	bdsr	cdsr	brating	crating	bassets	cassets	bcds5y	ccds5y	acra	rub_vol	reser	export
bdsr	–0.08	–0.138	1											
cdsr	–0.02	0.0129	–0.059	1										
brating	0.461	0.145	0.145	0.0144	1									
crating	0.273	0.0835	–0.117	–0.016	0.362	1								
bassets	0.859	0.637	–0.003	–0.035	0.672	0.363	1							
cassets	–0.45	–0.150	–0.163	0.0481	–0.755	–0.201	–0.694	1						
bcds5y	0.163	0.230	–0.085	–0.095	–0.023	–0.411	0.163	–0.298	1					
ccds5y	0.315	0.390	–0.153	0.104	–0.051	–0.394	0.272	–0.300	0.793	1				
acra	0.136	0.248	–0.185	0.0221	–0.208	–0.291	0.0805	–0.050	0.700	0.644	1			
rub_vol	0.013	0.120	–0.179	0.0416	–0.272	–0.325	–0.016	–0.031	0.739	0.659	0.812	1		
reser	0.661	0.355	0.113	–0.057	0.872	0.549	0.824	–0.703	–0.127	–0.086	–0.21	–0.299	1	
export	0.423	0.115	0.0592	–0.062	0.757	0.550	0.600	–0.492	–0.222	–0.231	–0.2	–0.330	0.870	1
pbalance	–0.35	–0.427	0.169	–0.028	0.075	0.112	–0.275	–0.022	0.0034	–0.061	–0.01	–0.0042	0.003	0.195

Source: author's calculations in Stata.

Table 2

Correction of multicollinearity using variance inflation factor

VIF	bdebt	VIF	cdebt
LN_export	4.04	reser	9.00
LN_rub_vol	4.01	export	5.87
brating	3.56	LN_rub_vol	3.77
bassets	2.99	cassets	2.89
LN_cds5y	2.89	acra	2.46
acra	2.64	ccds5y	2.44
LN_pbalance	1.68	crating	1.66
bdsr	1.09	pbalance	1.30
		cdsr	1.02
Mean VIF	2.86	Mean VIF	3.38

Source: author's calculations in Stata.

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Bankruptcy Risk Factors of Russian Companies

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ABSTRACT

The bankruptcy of Russian companies in the existing environment has become rather common. Determination of bankruptcy risk factors allows predicting the prospects for business development. The authors set the task to determine the relative influence of individual financial and non-financial factors on the probability of a company's bankruptcy. To study risk factors, the authors analyzed 3184 large Russian companies (with revenues of more than 2 billion rubles per year and more than 250 employees) of various industries operating from 2009 to 2020. The total number of observations is 38,208. For analysis, 30 factors were selected and divided into five groups: profitability, liquidity, turnover, financial stability and general (non-financial) factors. For the study, one of the machine learning methods was used — the random forest method. The sample consists of companies from seven industries, including manufacturing, retail, construction, electric power, mining, agricultural production, and water supply, as well as other industries, which include companies in education, healthcare, agriculture, and hospitality. The analysis was carried out both in aggregate for the entire sample without being distributed by industry, and for samples distributed by manufacturing, retail, and service industries. In the sample as a whole, the tested model in 86% of cases correctly predicted the possibility of a company going bankrupt for the period under review. This result confirmed that machine learning methods (in particular, the random forest algorithm) are highly effective in solving the problem of bankruptcy prediction for a company. Based on the data obtained, the paper concludes that profitability factors have the most significant impact on the probability of bankruptcy for manufacturing and retail companies. For service companies, it is financial stability factors. Solving the problem of determining the bankruptcy risk factors of Russian companies will ensure a reduction in the number of bankrupt enterprises, which, in turn, will contribute to the recovery and development of the national economy.

Keywords: corporate finance; large companies; business; financial analysis; financial stability; bankruptcy prediction; bankruptcy risk factors; machine learning methods; random forest

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INTRODUCTION

The problem of evaluating the performance of companies, as well as forecasting the prospects for business development, is acute for various economic agents. It is important for internal and external users of accounting information to understand what indicators should be focused on in the first place in the financial analysis of a business in order to predict bankruptcy risk.[1] For the Russian market, such an analysis is especially relevant. According to the Center for Macroeconomic Analysis and Short-Term Forecasting (CMASF), since 2016 there has been a steady downward trend in the number of operating organizations in the Russian economy.[2] According to the report of the Central Bank of Russia, the maximum number of bankruptcy reports since 2015 was reached in 2017, exceeding 11,000.[3]

One of the first mathematical models for assessing the bankruptcy risks of companies that have become widespread in practice is the model of E. Altman, proposed in 1968 [1]. The first version of the Altman model was formulated using the method of *multiple discriminant analysis* of 66 American companies, some of which went bankrupt during the observation period, and some continued to operate. The main advantage of the model, which determined its practical significance, is the integral indicator of the financial condition of an enterprise (*Z-score*), developed on its basis, which allows ranking organizations according to the degree of risk of bankruptcy. In later publications, a cross-country analysis of the E. Altman model was carried out and the applicability of the model for various markets was determined [2, 3]. Many models for predicting the bankruptcy of a company that appeared in the 1970s-1980s were methodologically based on the Altman model (see, for example, the model of R. Taffler [4]).

An important stage in the development of models for predicting the bankruptcy of a company was the works of M. Zmijewski [5] and J. Ohlson [6] published in the 1980s. In the M. Zmijewski's work, the probit model was used, and Ohlson's approach was based on the logit model. The method of logistic regression is still used in many domestic and foreign studies on this issue (see, for example, [7–10]).

Modern studies of company bankruptcy are based on advanced methods of statistical data analysis, primarily on *machine learning* methods [11–15]. The main reason for the spread of these methods in the analyses of the risk of bankruptcy of companies is that they allow overcoming the shortcomings of regression models, which are expressed, in particular, in a decrease in the predictive power of these models in the case of a non-linear relationship between variables [7].

Macroeconomic features of country markets, as well as differences in current legislation and accounting standards, inevitably require the adaptation of foreign bankruptcy prediction models to the specifics of a particular country and/or the development of original models based on data of companies in this country. A systematic analysis of the literature conducted in 2018 by A. V. Kazakov and A. V. Kolyshkin, based on more than 40 domestic bankruptcy prediction models [16], demonstrated an average "low" quality of research in this field. The shortcomings of the existing studies, in particular, include the small sample size on which the models' parameters were estimated and the lack of a test sample. A small number of publications about Russian companies

[1] In accordance with Art. 2 of the Bankruptcy Law of the Russian Federation, insolvency (bankruptcy) is "a debtor's inability recognized by an arbitration court to fully satisfy the claims of creditors for monetary obligations, for the payment of severance benefits and (or) for remuneration of persons working or working under an employment contract, and (or) fulfill the obligation to make mandatory payments", the Federal Tax Service of the Russian Federation. URL: https://www.nalog.gov.ru/rn77/taxation/bankruptcy/ (accessed on 17.02.2021).

[2] Fundamental Research Program of the National Research University Higher School of Economics. The bankruptcy of legal entities in Russia: Main trends. 19.01.2021. URL: http://www.forecast.ru/default.aspx (accessed on 25.05.2021).

[3] Monetary Policy Report of the Central Bank of the Russian Federation, July 2021. URL: https://cbr.ru/analytics/dkp/ddcp/longread_3_35/page/ (accessed on 05.04.2021).

that would use modern methods of machine learning should also be noted [7]. Thus, the relevance of research on the issues of the bankruptcy predictions of Russian companies remains.

This study differs from the works existing on the Russian market, in which the bankruptcy risks are analyzed using machine learning methods, in the following parameters. *First*, the focus of most studies of this kind (see, for example, [7, 17–19]) is the problem of comparing the *predictive power* of different models, usually regression models and models based on machine learning. At the same time, this paper aims to address another problem — it determines the *relative influence* of individual financial and non-financial *factors* on the bankruptcy probability of a company. The analysis carried out by the random forest method allows us to rank the considered indicators according to the degree of priority in assessing the bankruptcy risk of the company. *Second,* existing studies either do not imply a comparative intersectoral analysis (i.e., the analysis is carried out on the entire sample) [18, 19], or they study only one industry [7, 17]. In this paper, the analysis is carried out both for the entire sample and for industry subsamples —manufacturing, retail, and service industries. *Third,* an important result of this paper is the determination of the ranges of values of the corresponding indicators characterizing the different degrees of risk of bankruptcy of an enterprise, namely "high", "medium" and "low". This result makes it possible to classify companies in a form convenient for practical use, depending on the degree of probability of their bankruptcy.

Thus, the purpose of this study is to identify the main risk factors for the bankruptcy of Russian companies.

The authors analyzed large Russian companies (with revenues of more than 2 billion rubles a year and more than 250 employees) of various industries. The observation period is 12 years (from 2009 to 2020). The sample included data on 3184 companies, i.e. the total number of observations is 38,208. The main method of analysis is one of the machine learning methods — *the random forest*. More than 30 indicators were analyzed as potential factors of bankruptcy, including non-financial ones (for example, the number of employees or the form of ownership). Financial indicators (factors) were divided into four groups: liquidity, profitability, financial stability, and turnover.

MACHINE LEARNING METHODS IN BANKRUPTCY RESEARCH OF RUSSIAN COMPANIES

In recent years, in research on the analysis of the bankruptcy risk of a company, advanced methods of statistical data analysis, primarily machine learning methods, are increasingly used. Their active use in studies of Russian companies dates back to the 2010s.

The main result of most of the studies carried out is the conclusion that machine learning methods make it possible to obtain more accurate predictions of the company's bankruptcy probability compared to traditional methods of data regression analysis. For example, the study by B.B. Demeshev and A.S. Tikhonova, conducted in 2014, compared the predictive power of various statistical methods, including both traditional and more modern approaches: logit and probit models; models based on discriminant analysis; classification trees and random forest. The sample was limited to data collected from medium and small businesses in 2011–2012. According to the research results, it turned out that the most accurate tool for predicting the bankruptcy of a company is such a machine learning method as a random forest [20].

The study [17] also concluded that machine learning methods are characterized by higher accuracy in predicting the probability of bankruptcy. Its authors, having analyzed 5120 Russian companies in the production and distribution of electricity,

gas, and water for 2009, argue that the most accurate tool for predicting bankruptcy is a neural network, which showed a higher percentage of correct bankruptcy predictions compared to discriminant analysis and a logit model.

A similar conclusion was made in the study by A.M. Karminsky and R.N. Burekhin [7]. The authors compared the predictive power of a large number of models, including various neural network modifications, classification trees, and random forests. The analysis of companies in the Russian construction industry for 2011–2017 showed that in the sample under review, the best results are obtained by an artificial neural network with one hidden layer and four neurons.

In general, studies show that machine learning methods in general and neural networks in particular can significantly increase the efficiency of company bankruptcy risk analysis, but the effectiveness of these methods depends on the quality and availability of the initial data [21–23].

A number of scientific papers are devoted to the development of new algorithms/models for predicting the financial insolvency of Russian companies based on machine learning methods. For example, the study [23] analyzed the financial stability of manufacturing companies using a neural network model. I.V. Arinichev and I.V. Bogdashev, using binary classification trees, built an algorithm for determining the bankruptcy risk of a small business [24]. The study by E. Yu. Makeeva and I.V. Arshavsky [22] focuses on the role of qualitative information in the analysis of the company bankruptcy risk. This information is not directly reflected in the company's financial performance but is present in corporate annual reports. Based on the application of methods of semantic analysis of the company's reporting and an ensemble of artificial neural networks, it was concluded that the predictive ability of the model increases when high-quality information is included in it.

Separately, we note the study of E.A. Fedorova, S.O. Musienko, and F. Yu. Fedorov [19]. This is one of the few papers in which, for Russian small and medium-sized businesses, using machine learning methods, the standard values of indicators appearing in bankruptcy legislation, as well as in foreign studies of the risk of bankruptcy of organizations, are specified. We mainly considered indicators of liquidity and financial stability. The methods of the decision tree, random forest, bagging, and boosting were used. The random forest method showed the best predictive ability.

This study is also devoted to identifying the most significant factors of the bankruptcy of Russian companies and determining their critical values. In contrast to [19], the object of the study is Russian large commercial companies in various industries. A wide range of both financial and non-financial factors of the potential bankruptcy of a company is considered. In accordance with the purpose of the article, the random forest method is used as the main research tool.

RANDOM FOREST METHOD

A random forest is a classification algorithm that consists of many decision trees. This algorithm is used for classification, clustering, feature selection, and anomaly search. The random forest also determines the importance of the factors, i.e. their influence on the classification process. Thus, it becomes possible to arrange the factors in order of priority [25].

Compared to regression models that are relatively sensitive to outliers, random forest is more robust to this problem. Another advantage of the random forest method is its lower susceptibility to overfitting compared to the neural network method [7].

The basic unit of the random forest algorithm is the decision tree. This is a series of questions about the input that can be answered with yes or no. Questions are asked

until the tree comes to a decision. Random forest is a machine learning algorithm, and its main advantage is the ability to process new data that has never been seen before. Therefore, so that the model does not overfit, not one decision tree is used, but a random forest consisting of them. *Fig. 1* shows a conditional example of a random forest. Yellow marks the solutions that the trees come to.

The general principle of the random forest algorithm is that the researcher builds many decision trees (classification trees). Each tree in the random forest returns a prediction of the result, and the result with the most votes becomes the prediction of the forest. The key feature is the low correlation between trees. This effect is due to the fact that different trees answer different "yes" or "no" questions, thereby coming to a result. Some trees may lead to a false result and some to the correct one. Thus, the trees protect each other from individual errors. A large number of weakly correlated trees parsing information together will outperform any of their individual constituents [26].

STAGES OF EMPIRICAL RESEARCH

In accordance with the purpose of the study, the following stages of research were carried out.

At the *first stage*, a preliminary set of quantitative and qualitative variables for analysis was determined. The list of bankruptcy factors of a company included variables from various domestic and foreign studies (see, for example, [1, 6, 27–29]). All variables were divided into five groups: *indicators of profitability, liquidity, turnover, financial stability, and general (non-financial)* indicators. Moreover, in order to avoid the "cannibalization effect", a number of variables were removed, since the analysis of descriptive statistics revealed that they have a high correlation with other variables.

The final composition of variables for the random forest algorithm, taking into account the exclusion of some of the variables, is presented in *Table 1*.

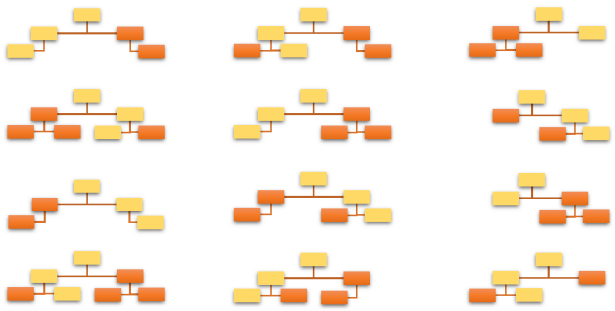

Fig. 1. **Random forest algorithm prototype**

Source: compiled by the authors.

At the *second stage,* using the random forest method, the most significant (important) factors for the sample companies were determined in terms of their impact on the probability of bankruptcy. This was done using the Scikit-learn library, whose algorithms allow you to calculate the relative importance of each factor, i.e. the contribution of each indicator to the prediction. Random Forest uses the Gini index to assess the significance of factors. The obtained values of the estimates of the significance of individual indicators were normalized so that the sum of all estimates was equal to 1. The higher the value of the assessment of the significance of a particular factor, the greater its contribution to the prediction of the company bankruptcy. The significance of features was determined both for the entire sample and for industry subsamples — for manufacturing companies, service companies, and retail companies.

At the *third stage*, the threshold values of indicators were determined, which, according to the results of the analysis of individual industries, turned out to be the most significant for assessing the bankruptcy risk of a company. To do this, we used a visual analysis of a classification model built according to the random forest algorithm using the PDPbox (Python) library. This result allows us to divide companies into three groups according to the value of individual

Table 1

Variables used in the study

Number	Indicator type	Formula	Variable type
1	Profitability	$\frac{EBITDA_{i,p}}{A_{i,p}}$, where $EBITDA_{i,p}$ – earnings before taxes, interest, and depreciation of a company *i* per year *p*; $A_{i,p}$ – the total assets of a company *i* per year *p*	Quantitative
2	Profitability	$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$, where $Retained\ earnings_{i,p}$ – retained earnings of a company *i* per year *p*; $A_{i,p}$ – the total assets of a company *i* per year *p*	Quantitative
3	Profitability	$\frac{EBIT_{i,p}}{Rev_{i,p}}$, where $EBIT_{i,p}$ – earnings before taxes and interest of a company *i* per year *p*; $Rev_{i,p}$ — ototal revenue of a company *i* per year *p*	Quantitative
4	Profitability	$ROE_{i,p} = \frac{NI_{i,p}}{Equity_{i,p}}$, where $ROE_{i,p}$ – return on equity of a company *i* per year *p*; $NI_{i,p}$ — net income of company *i* per year *p*; $Equity_{i,p}$ – equity of a company *i* per year *p*	Quantitative
5	Liquidity	$\frac{CA_{i,p}}{STD_{i,p}}$, where $CA_{i,p}$ – the current assets of a company *i* per year *p*; $STD_{i,p}$ – short-term debt of a company *i* per year *p*	Quantitative
6	Liquidity	$\frac{Cash_{i,p}}{A_{i,p}}$, where $Cash_{i,p}$ – cash of a company *i* per year *p*; $A_{i,p}$ – total assets of a company *i* per year *p*	Quantitative
7	Financial stability	$\frac{FA_{i,p}}{CA_{i,p}}$, where $FA_{i,p}$ – fixed assets of a company *i* per year *p*; $CA_{i,p}$ – current assets of a company *i* per year *p*	Quantitative
8	Financial stability	$\frac{EBITDA_{i,p}}{Int_{i,p}}$, where $EBITDA_{i,p}$ – earnings before taxes, interest, and depreciation of a company *i* per year *p*; $Int_{i,p}$ – interest payable to a company *i* per year *p*	Quantitative

Table 1 (continued)

Number	Indicator type	Formula	Variable type
9	Financial stability	$\frac{WC_{i,p}}{LTD_{i,p}}$, where $WC_{i,p}$ – working capital of a company *i* per year *p*; $LTD_{i,p}$ — long-term debt of a company *i* per year *p*	Quantitative
10	Financial stability	$\frac{STD+LTD_{i,p}}{Equity_{i,p}}$, where $STD+LTD_{i,p}$ – total debt of a company *i* per year *p*; $Equity_{i,p}$ — equity of a company *i* per year *p*	Quantitative
11	Turnover	$\frac{Rev_{i,p}}{\overline{A_{i,p}}}$, where $Rev_{i,p}$ – revenue of a company *i* per year *p*; $\overline{A_{i,p}}$ — average assets of a company *i* per year *p*	Quantitative
12	Turnover	$Inventories\ turnover_{i,p}=\frac{COGS_{i,p}}{Average\ inventories_{i,p}}$, where $COGS_{i,p}$ – cost of a company *i* per year *p*; $Average\ inventories_{i,p}$ – average inventories of a company *i* per year *p*	Quantitative
13	Turnover	$Fixed\ assets\ turnover_{i,p}=\frac{Revenue_{i,p}}{Average\ fixed\ assets_{i,p}}$, where $Revenue_{i,p}$ – revenue of a company *i* per year *p*; $Average\ fixed\ assets_{i,p}$ — average fixed assests of a company *i* per year *p*	Quantitative
14	Turnover	$Accounts\ receivable\ turnover\ period_{i,p}=\frac{Revenue_{i,p}}{Average\ receivables_{i,p}}$, where $Revenue_{i,p}$ – revenue of a company *i* per year *p*; $Average\ receivables_{i,p}$ — average receivables of a company *i* per year *p*	Quantitative
15	Turnover	$\frac{Rev_{i,p}}{WC_{i,p}}$, where $Rev_{i,p}$ — total revenue of a company *i* per year *p*; $WC_{i,p}$ – working capital of a company *i* per year *p*	Quantitative
16	General	$\ln\left(\frac{A_{i,p}}{GPN\ price\ index_p}\right)$, where $A_{i,p}$ – assets of a company *i* per year *p*; $GPN\ price\ index_p$ – GDP price deflator per year *p*	Quantitative

Table 1 (continued)

Number	Indicator type	Formula	Variable type
17	General	$bin_{1,i,p}$ (takes value 1, if $NI_{i,p} + NI_{i-1,p} < 0$ and value 0 otherwise, where $NI_{i,p}$ – net income of a company *i* per year *p*)	Binary
18	General	$bin_{2,i,p}$ (takes value 1, if $Total\ liabilities_{i,p} > Total\ Assets_{i,p}$ and value 0 otherwise, where $Total\ liabilities_{i,p}$ – current debt of a company *i* per year *p*, $Total\ Assets_{i,p}$ – total assets of a company *i* per year *p*)	Binary
19	General	$\frac{NI_{i,p} - NI_{i-1,p}}{\lvert NI_{i,p}\rvert + \lvert NI_{i-1,p}\rvert}$, where $NI_{i,p}$ – net income of a company *i* per year *p*	Quantitative
20–23	General	Total headcount (4 variables: 251–500 people, 501–1000 people, 1001–5000 people, more than 5000 people)	Binary
24–27	General	Type of business operation (4 variables: manufacturing, retail, services, etc.)	Binary
28–31	General	Organizational and legal form (4 variables: LLC, PJSC, JSC, etc.)	Binary
32–36	General	Type of ownership (5 variables: private, foreign, Russian+foreign, state/federal/ municipal property, etc.)	Binary

Source: compiled by the authors according to [1, 6, 27–29].

indicators — with high, medium, and low risks of bankruptcy.

We note that in this paper, the sample was divided into *test* and *training* subsamples. For this purpose, the train_test_split module of the Scikit-learn library was used. With the help of this module, 20% of the test values and 80% of the training values were extracted from all data. In order for the test values to cover different years, the train_test_split function selects 20% of the data for the test sample *randomly*. This splitting of the sample results in the model being trained on one piece of data and tested on another. This avoids the effect of retraining the model and makes sure that the constructed model not only "remembers the answers" in the training set, but also predicts the results on the test part of the set with high accuracy.

SAMPLE

The sample included large Russian companies. According to the Unified Register of Small and Medium Businesses, medium-sized businesses include companies with up to 250 employees and with annual revenue of up to 2 billion rubles.[4] Thus, in this study, companies with revenues of over 2 billion rubles per year and more than 250 employees were analyzed. The SPARK system was used to collect data for 12 years (from 2009 to 2020).[5] The sample included data on 3184 companies. The total number of observations was 38,208. According to the collected data, 68% of the companies

[4] Unified register of small and medium-sized businesses. URL: https://ofd.nalog.ru/about.html?section=conditions (accessed on 11.03.2021).

[5] SPARK database. URL: http://www. spark-interfax.ru/ (accessed on 15.04.2021).

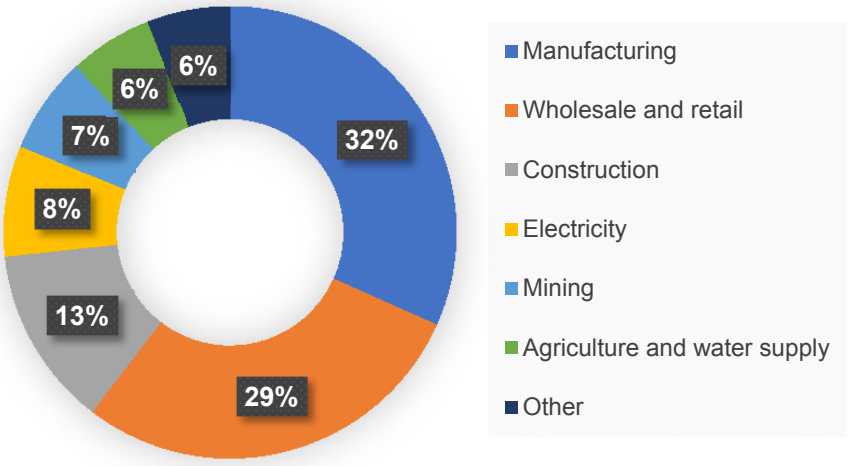

Fig. 2. **Distribution of sample companies by industry**

Source: compiled by the authors.

included in the sample continued operations throughout the entire observation period, and 32% went bankrupt.

The sample of the study included companies in 7 industries: manufacturing, retail, construction, electricity, mining, agriculture, and water supply, as well as other industries, which included companies in education, healthcare, agriculture, hospitality, etc. The diagram in *Fig. 2* shows the distribution of companies by industry.

Fig. 2 shows that the sample contains a high share of companies from the retail sector, as well as the manufacturing industry, which together make up 61% of the entire sample. Construction and electric power companies also account for a significant share.

In order to analyze possible differences in the risk factors for bankruptcy of companies by industry, three large industry groups of companies were identified: manufacturing, retail, and services. Thus, the sample was divided into three approximately equal parts (*Fig. 3*).

The sample mainly includes companies with 1,001 to 5,000 employees — 41%. More than 50% are companies with the legal form of LLC. Most of the companies in the sample are privately owned by citizens of the Russian Federation — 69%. 13% of companies are owned by foreign investors (citizens, states, and legal entities).

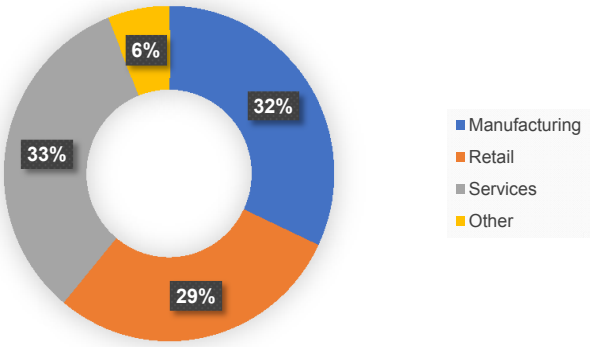

Fig. 3. **Distribution of sample companies by type of business operation**

Source: compiled by the authors.

Descriptive statistics of the studied variables are presented in *Table 2*.

Table 2 indicates that the sample included both profitable and non-profitable companies, i.e. companies with both positive and negative profitability ratios.

RESEARCH RESULTS

The random forest method was used to predict the bankruptcy of companies over the period under review, as well as to determine the factors that most affect the probability of bankruptcy. As for the results, first of all, it should be noted that in 86% of cases the model correctly predicted whether the sample company went bankrupt during the period of observation or whether it continued to

Table 2

Descriptive statistics

Indicator	Type of indicator	Sample average	Standard deviation	Min	Max
$\frac{EBITDA_{i,p}}{A_{i,p}}$	Profitability	0.089	0.145	–1.029	1.213
$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$	Profitability	0.214	0.361	–2.448	1.073
$\frac{EBIT_{i,p}}{Rev_{i,p}}$	Profitability	0.067	0.237	–3.936	2.635
$ROE_{i,p}$	Profitability	0.161	0.765	–10.211	9.333
$\frac{CA_{i,p}}{STD_{i,p}}$	Liquidity	2.115	2.578	0.067	31.779
$\frac{Cash_{i,p}}{A_{i,p}}$	Liquidity	0.049	0.084	0	0.749
$\frac{FA_{i,p}}{CA_{i,p}}$	Financial stability	1.281	2.234	0	24.831
$\frac{EBITDA_{i,p}}{Int_{i,p}}$	Financial stability	33.742	163.636	–336.7	2536
$\frac{WC_{i,p}}{LTD_{i,p}}$	Financial stability	23.457	124.003	–967.833	1513
$\frac{STD+LTD_{i,p}}{Equity_{i,p}}$	Financial stability	6.283	25.514	–273.306	364.871
$\frac{Rev_{i,p}}{A_{i,p}}$	Turnover	1.860	1.679	0	13.919

Table 2 (continued)

Indicator	Type of indicator	Sample average	Standard deviation	Min	Max
$Inventories\ turnover_{i,p} = \frac{COGS_{i,p}}{Average\ inventories_{i,p}}$	Turnover	36.086	148.735	0	1954
$Fixed\ assets\ turnover_{i,p} = \frac{Revenue_{i,p}}{Average\ fixed\ assets_{i,p}}$	Turnover	40.239	174.057	0.001	2595
$Accounts\ receivable\ turnover\ period_{i,p} = \frac{Revenue_{i,p}}{Average\ receivables_{i,p}}$	Turnover	9.020	12.493	0	138.983
$\ln\left(\frac{A_{i,p}}{GPN\ price\ index_p}\right)$	General	17.884	1.524	9.158	25.654
$\frac{NI_{i,p} - NI_{i-1,p}}{\lvert NI_{i,p}\rvert + \lvert NI_{i-1,p}\rvert}$	General	0.003	0.605	–1	1

Source: compiled by the authors.

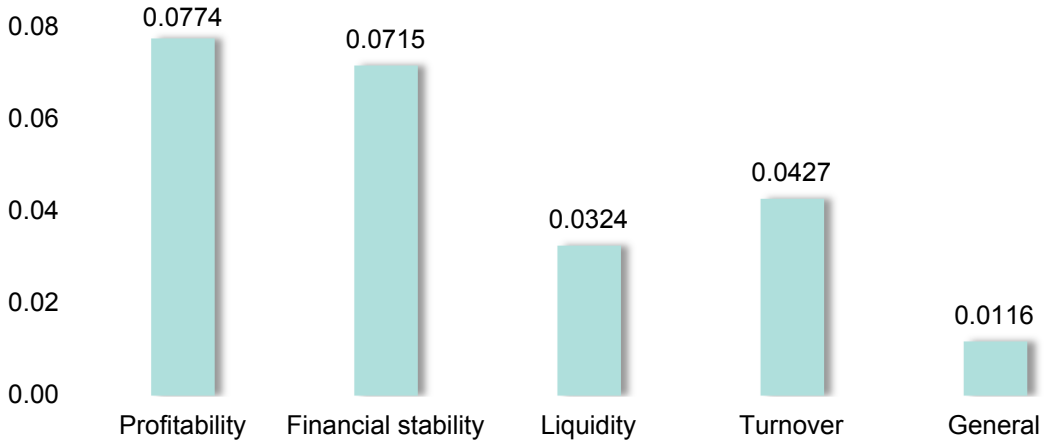

Fig. 4. **Evaluation of the importance of groups of bankruptcy risk factors according to the random forest algorithm**

Source: compiled by the authors based on the research results.

Table 3

Evaluation of the importance of bankruptcy risk factors for the whole sample according to the random forest algorithm

Number	Type of indicator	Designation	Type of variable	Importance
1	Profitability	$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$	Quantitative	0.235
2	Financial stability	$\frac{STD+LTD_{i,p}}{Equity_{i,p}}$	Quantitative	0.141
3	General	$\ln\left(\frac{A_{i,p}}{GPD_p}\right)$	Quantitative	0.112
4	Turnover	$\frac{Rev_{i,p}}{WC_{i,p}}$	Quantitative	0.073
5	Financial stability	$\frac{FA_{i,p}}{CA_{i,p}}$	Quantitative	0.052
6	Turnover	$Accounts\ receivable\ turnover\ period_{i,p} = \frac{Revenue_{i,p}}{Average\ receivables_{i,p}}$	Quantitative	0.051
7	Turnover	$Inventories\ turnover_{i,p} = \frac{COGS_{i,p}}{Average\ inventories_{i,p}}$	Quantitative	0.046
8	Liquidity	$\frac{Cash_{i,p}}{A_{i,p}}$	Quantitative	0.039
9	Profitability	$\frac{EBITDA_{i,p}}{A_{i,p}}$	Quantitative	0.037
10	General	ПАО	Binary	0.034
11	Turnover	$\frac{Rev_{i,p}}{\overline{A_{i,p}}}$	Quantitative	0.028
12	Profitability	$ROE_{i,p}$	Quantitative	0.027
13	Liquidity	$\frac{CA_{i,p}}{STD_{i,p}}$	Quantitative	0.026

Table 3 (continued)

Number	Type of indicator	Designation	Type of variable	Importance
14	Financial stability	$\frac{WC_{i,p}}{LTD_{i,p}}$	Quantitative	0.022
15	Turnover	$Fixed\ assets\ turnover_{i,p} = \frac{Revenue_{i,p}}{Average\ fixed\ assets_{i,p}}$	Quantitative	0.015

Source: compiled by the authors based on the research results.

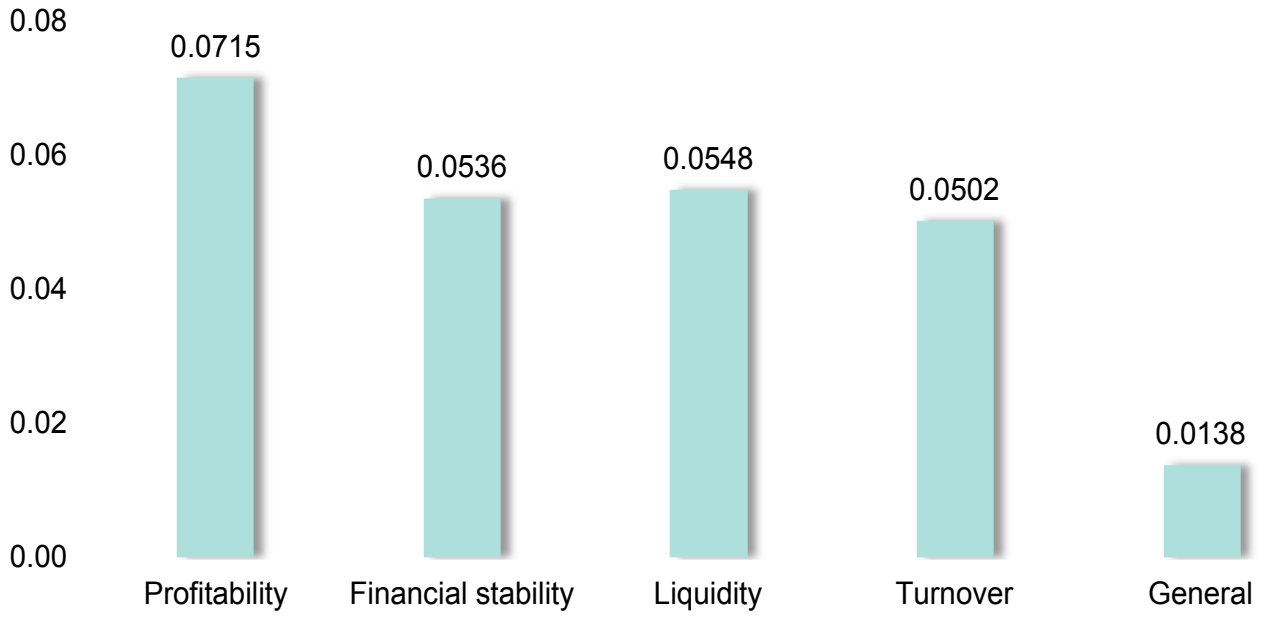

Fig. 5. **Evaluation of the importance of groups of bankruptcy risk factors according to the random forest algorithm for manufacturing companies**

Source: compiled by the authors based on the research results.

operate. This percentage can be considered quite high since in a number of domestic studies the prediction accuracy of machine learning methods varies from 73 to 90% [8, 31].

Further, using the Gini index, the significance of each of the five considered groups of indicators for predicting bankruptcy for the entire sample was assessed. *Fig. 4* presents a graph showing the average value of the indicator of each category. Since each group had a different number of indicators, to evaluate the importance of the indicators of each group, the average influence of the factors of each group on the probability of bankruptcy was calculated. To do this, the overall evaluation of the importance of factors belonging to a particular group was divided by the number of factors of this group in the model.

Fig. 4 shows that the most significant categories of indicators in terms of predicting the probability of bankruptcy of Russian

Table 4

Evaluation of the importance of bankruptcy risk factors for the whole sample according to the random forest algorithm for manufacturing companies

Number	Type of indicator	Designation	Type of variable	Importance
1	Profitability	$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$	Quantitative	0.182
2	Liquidity	$\frac{Cash_{i,p}}{A_{i,p}}$	Quantitative	0.089
3	Financial stability	$\frac{STD+LTD_{i,p}}{Equity_{i,p}}$	Quantitative	0.088
4	Turnover	$Inventories\ turnover_{i,p} = \frac{COGS_{i,p}}{Average\ inventories_{i,p}}$	Quantitative	0.082
5	Turnover	$Accounts\ receivable\ turnover\ period_{i,p} = \frac{Revenue_{i,p}}{Average\ receivables_{i,p}}$	Quantitative	0.067
6	General	$\ln\left(\frac{A_{i,p}}{GPD_p}\right)$	Quantitative	0.061
7	Turnover	$\frac{Rev_{i,p}}{\overline{A_{i,p}}}$	Quantitative	0.047
8	Financial stability	$\frac{FA_{i,p}}{CA_{i,p}}$	Quantitative	0.045
9	Profitability	$\frac{EBIT_{i,p}}{Rev_{i,p}}$	Quantitative	0.042
10	Profitability	$ROE_{i,p}$	Quantitative	0.032
11	Profitability	$\frac{EBITDA_{i,p}}{A_{i,p}}$	Quantitative	0.03
12	Turnover	$Fixed\ assets\ turnover_{i,p} = \frac{Revenue_{i,p}}{Average\ fixed\ assets_{i,p}}$	Quantitative	0.029

Table 4 (continued)

Number	Type of indicator	Designation	Type of variable	Importance
13	Financial stability	$\frac{WC_{i,p}}{LTD_{i,p}}$	Quantitative	0.028
14	Turnover	$\frac{Rev_{i,p}}{WC_{i,p}}$	Quantitative	0.025
15	General	ПАО	Binary	0.023
16	General	Russian + foreign ownership	Binary	0.02
17	Liquidity	$\frac{CA_{i,p}}{STD_{i,p}}$	Quantitative	0.019
18	General	Headcount 501–1000	Binary	0.019
19	General	Headcount 251–500	Binary	0.014
20	General	АО	Binary	0.01

Source: compiled by the authors based on the research results.

companies are indicators of profitability and financial stability. The evaluation of their importance is almost twice as high as the evaluation of the importance of liquidity and turnover indicators.

The relative influence of individual indicators on the probability of bankruptcy is given in *Table 3*. This and subsequent tables present the most significant factors, the total importance of which according to the Gini index is 0.9.

Table 3 shows that the total weight of the indicators included in the profitability and financial stability groups is almost 53%, which confirms the need to take these indicators into account when predicting bankruptcy. The relative influence of one indicator in these groups is 8 and 7%, respectively. It should be emphasized that in the classical Altman model, most of the indicators are related to profitability and financial stability [1]. Our result is also consistent with the study by A. M. Karminsky and R. N. Burekhin, who showed that indicators of financial stability and liquidity are the most significant for predicting the bankruptcy of a company in the Russian market [7]. B. B. Demeshev in 2014, analyzing the construction industry in Russia, also emphasized the importance of the profitability indicator, which in his work was calculated as the ratio of earnings before interest and taxes to the total assets of the company [20].

It is also interesting that "general" indicators (for example, the number of employees, form of ownership, etc.) turned out to be insignificant when predicting the probability of bankruptcy. It should be noted that non-financial indicators turned out to be insignificant in some other studies of Russian companies. This, in particular, suggests that "the large size and long period of operation of the company in the market cannot guarantee stability in the Russian market" [7].

The results for the subsample of manufacturing companies are similar to the

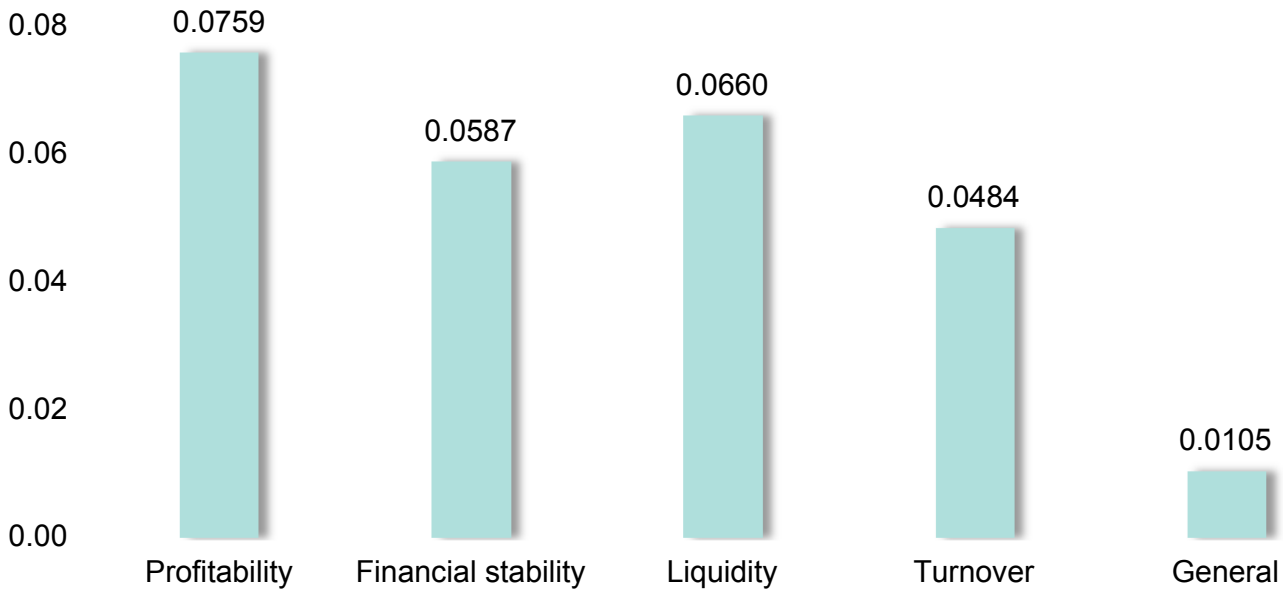

Fig. 6. **Evaluation of the importance of groups of bankruptcy risk factors according to the random forest algorithm for retail companies**

Source: compiled by the authors based on the research results.

Table 5

Evaluation of the importance of bankruptcy risk factors according to the random forest algorithm for retail companies

Number	Type of indicator	Designation	Type of variable	Importance
1	Profitability	$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$	Quantitative	0.219
2	Financial stability	$\frac{WC_{i,p}}{LTD_{i,p}}$	Quantitative	0.082
3	Liquidity	$\frac{Cash_{i,p}}{A_{i,p}}$	Quantitative	0.079
4	General	$ln\left(\frac{A_{i,p}}{GPD_p}\right)$	Quantitative	0.075
5	Turnover	$Accounts\ receivable\ turnover\ period_{i,p} = \frac{Revenue_{i,p}}{Average\ receivables_{i,p}}$	Quantitative	0.064
6	Financial stability	$\frac{FA_{i,p}}{CA_{i,p}}$	Quantitative	0.062

Table 5 (continued)

Number	Type of indicator	Designation	Type of variable	Importance
7	Turnover	$Inventories\,turnover_{i,p} = \frac{COGS_{i,p}}{Average\,inventories_{i,p}}$	Quantitative	0.059
8	Liquidity	$\frac{CA_{i,p}}{STD_{i,p}}$	Quantitative	0.053
9	Turnover	$\frac{Rev_{i,p}}{\overline{A_{i,p}}}$	Quantitative	0.05
10	Turnover	$\frac{Rev_{i,p}}{WC_{i,p}}$	Quantitative	0.048
11	Financial stability	$\frac{STD + LTD_{i,p}}{Equity_{i,p}}$	Quantitative	0.032
12	Profitability	$\frac{EBITDA_{i,p}}{A_{i,p}}$	Quantitative	0.029
13	Profitability	$ROE_{i,p}$	Quantitative	0.028
14	Profitability	$\frac{EBIT_{i,p}}{Rev_{i,p}}$	Quantitative	0.027

Source: compiled by the authors based on the research results.

results for the entire sample (*Fig. 5*). Again, the most significant groups of indicators in terms of predicting bankruptcy are the groups of profitability and financial stability. However, the role of liquidity and turnover indicators is also significant.

Table 4 shows the importance of individual indicators in predicting the bankruptcy of manufacturing companies.

Table 4 shows that the ratio of retained earnings to assets and financial leverage is still among the most significant indicators. Foreign researchers also emphasize the importance of the indicator of the ratio of retained earnings to assets, since retained earnings demonstrate the size of funds remaining after settlements with all capital providers [31].

As for retail companies, among the considered groups of indicators, profitability ranks first in importance in predicting bankruptcy (*Fig. 6*). The value of liquidity indicators is enhanced in comparison with manufacturing companies, which generally corresponds to the specifics of retail companies.

Table 5 presents the importance of individual indicators in predicting the bankruptcy of retail companies.

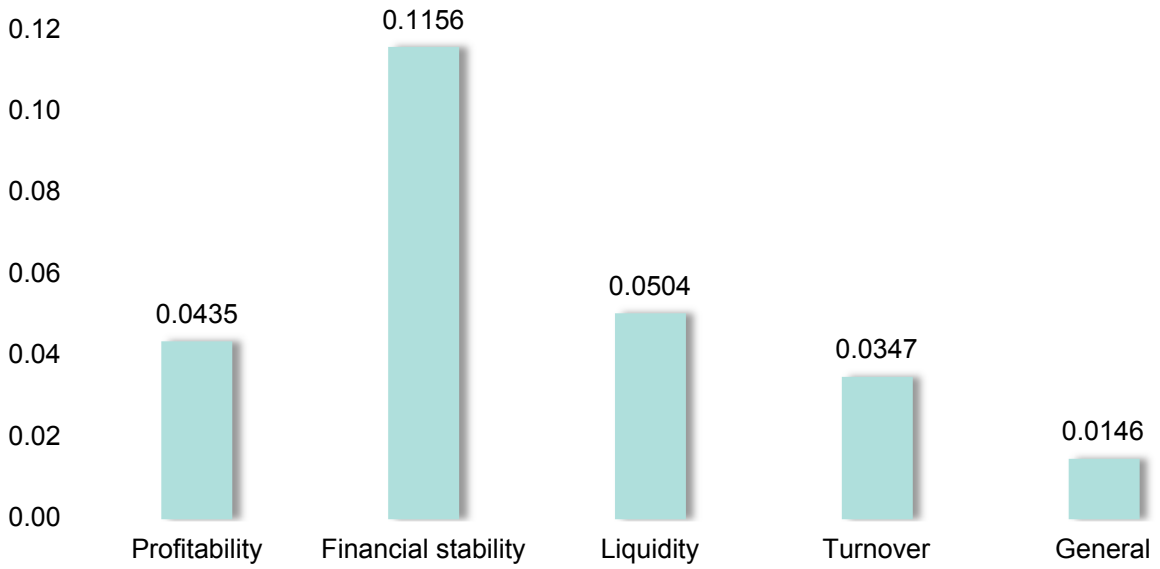

Fig. 7. **Evaluation of the importance of groups of bankruptcy risk factors according to the random forest algorithm for service companies**

Source: compiled by the authors based on the research results.

Table 6

Evaluation of the importance of bankruptcy risk factors according to the random forest algorithm for service companies

Number	Type of indicator	Designation	Type of variable	Importance
1	Financial stability	$\frac{FA_{i,p}}{CA_{i,p}}$	Quantitative	0.165
2	Financial stability	$\frac{STD+LTD_{i,p}}{Equity_{i,p}}$	Quantitative	0.133
3	General	$\ln\left(\frac{A_{i,p}}{GPD_{p}}\right)$	Quantitative	0.087
4	Profitability	$\frac{EBIT_{i,p}}{Rev_{i,p}}$	Quantitative	0.077
5	General	ПАО	Binary	0.059
6	Turnover	$Inventories\,turnover_{i,p} = \frac{COGS_{i,p}}{Average\,inventories_{i,p}}$	Quantitative	0.058
7	Liquidity	$\frac{Cash_{i,p}}{A_{i,p}}$	Quantitative	0.052

Table 6 (continued)

Number	Type of indicator	Designation	Type of variable	Importance
8	Financial stability	$\frac{WC_{i,p}}{LTD_{i,p}}$	Quantitative	0.049
9	Liquidity	$\frac{CA_{i,p}}{STD_{i,p}}$	Quantitative	0.048
10	Profitability	$\frac{EBITDA_{i,p}}{A_{i,p}}$	Quantitative	0.041
11	Turnover	$Accounts\ receivable\ turnover\ period_{i,p} = \frac{Revenue_{i,p}}{Average\ receivables_{i,p}}$	Quantitative	0.039
12	Profitability	$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$	Quantitative	0.029
13	Profitability	$ROE_{i,p}$	Quantitative	0.028
14	Turnover	$\frac{Rev_{i,p}}{\overline{A_{i,p}}}$	Quantitative	0.027

Source: compiled by the authors based on the research results.

The results of *Table 5* indicate that the first three places in the list of the most important indicators in terms of predicting bankruptcies are occupied by profitability (0.218), financial stability (0.082), and liquidity (0.079), respectively.

In the service sector, among the groups of indicators under review, the financial stability ratios are most significant in predicting bankruptcy, with a large margin from other groups of indicators (*Fig. 7*).

Table 6 shows the importance of individual indicators in predicting the bankruptcy of service companies.

According to *Table 6*, for companies in the service sector, the indicator of the ratio of fixed assets to current assets (0.165) has the greatest significance in predicting bankruptcy. The indicator of the ratio of debt and equity financing also has a high significance (0.133). The indicator of financial leverage has a significant impact on the probability of bankruptcy, with an increase in the level of debt, the company risks reducing its financial stability [32].

In addition to the presented results, threshold values of financial indicators were obtained, delimiting intervals characterized by different degrees of bankruptcy risk. To do this, we used a visual analysis of a classification model built according to the random forest algorithm using the PDPbox (Python) library. The library allows you to build partial dependence plots or PDP, which reflect the assessment of the influence of individual variables on the classification result. The PDP

Table 7

Intervals of indicator values characterized by different degrees of company bankruptcy risk

Indicator	Interval of indicator values		
	With high bankruptcy risk	With medium bankruptcy risk	With low bankruptcy risk
Entire sample			
$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$	Below 0.087	From 0.087 to 0.156	Above 0.156
$\frac{STD+LTD_{i,p}}{Equity_{i,p}}$	Below 2.4 Above 10.9	From 2.4 to 10.9	–
$\frac{Rev_{i,p}}{WC_{i,p}}$	Below 0.2	From 0.2 to 1.8	Above 1.8
$\frac{Cash_{i,p}}{A_{i,p}}$	Below 0.003	From 0.003 to 0.02	Above 0.02
Manufacturing companies			
$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$	Below 0.04	From 0.04 to 0.28	Above 0.28
$\frac{Cash_{i,p}}{A_{i,p}}$	Below 0.002	From 0.002 to 0.005	Above 0.005
$\frac{STD+LTD_{i,p}}{Equity_{i,p}}$	Below 2.5 Above 8	From 2.5 to 8	–
$Accounts\ receivable\ turnover\ period_{i,p} = \frac{Revenue_{i,p}}{Average\ receivables_{i,p}}$	Below 1.89	From 1.89 to 4.73	Above 4.73
Retail companies			
$\frac{Retained\ earnings_{i,p}}{A_{i,p}}$	Below 0.12	From 0.12 to 0.27	Above 0.27
$\frac{WC_{i,p}}{LTD_{i,p}}$	Below –0.5	From –0.5 to 1.6	Above 1.6

Table 7 (continued)

Indicator	Interval of indicator values		
	With high bankruptcy risk	With medium bankruptcy risk	With low bankruptcy risk
$\frac{Cash_{i,p}}{A_{i,p}}$	Below 0.0004	From 0.0004 to 0.004	Above 0.004
$Accounts\ receivable\ turnover\ period_{i,p} = \frac{Revenue_{i,p}}{Average\ receivables_{i,p}}$	Below 0.13	From 0.13 to 2.72	Above 2.72
Service companies			
$\frac{Fixed\ assets_{i,p}}{Current\ assets_{i,p}}$	Below 0.01	From 0.01 to 0.73	Above 0.73
$\frac{EBIT_{i,p}}{Rev_{i,p}}$	Below 0.134	From 0.134 to 0.323	Above 0.323
$Inventories\ turnover_{i,p} = \frac{COGS_{i,p}}{Average\ inventories_{i,p}}$	Below 3.4	From 3.4 to 11.8	Above 11.8
$\frac{Cash_{i,p}}{A_{i,p}}$	Below 0.001	From 0.001 to 0.01	Above 0.01

Source: compiled by the authors based on the research results.

is a broken line. Although the random forest model does not indicate the direction of the relationship of features with the classification result, this can be seen on the PDP plots using signs similar to the signs in front of the coefficients in regression models.

When analyzing financial insolvency, PDPbox helps to trace the relationship between one bankruptcy factor in the classification model and the possible bankruptcy of the company. The set of admissible values of the attribute is divided into three areas — values characterized by "high", "medium" and "low" bankruptcy risk, respectively. The areas correspond to qualitatively different groups of financial condition. For division into areas, an empirical method (elbow method) is used, which allows you to find "critical" points on the RDP. These points (as well as the regions themselves) are listed in the table for each object separately.

Visually, on the PDP plots of the dependence of the probability of bankruptcy on the value of the factor, one can observe a noticeable change in the "curvature". Starting from a certain value of the factor, the probability of bankruptcy significantly decreases or increases. Such a change in

"curvature" is analyzed using the values of the cosines of the angles between the links of the PDP. To determine the threshold values that form the boundaries of the intervals that define qualitatively different groups, two nodes with the largest cosine of the angle are selected.

Table 7 shows the intervals of the values of the indicators of each of the groups that turned out to be the most important for predicting bankruptcy, depending on the degree of bankruptcy risk.

The results presented in *Table 7* allow getting an idea of what intervals of values of financial indicators are characterized by different risks of bankruptcy for the company. This result allows us to classify companies depending on the degree of probability of their bankruptcy. To obtain more detailed conclusions, it is advisable to conduct a similar analysis for individual sectors/subsectors of the Russian economy.

CONCLUSIONS

Assessing the probability of a company going bankrupt and identifying the bankruptcy risk factors are extremely important for understanding business prospects in any industry. Predicting the probability of bankruptcy of a company is traditionally done using mathematical models, usually based on econometric methods or machine learning methods. These models are adapted to the specifics of the markets of individual countries, which involves testing the model on data collected from a sample of companies in the respective country.

Recent research shows that machine learning methods provide higher accuracy in predicting the probability of a company going bankrupt compared to econometric methods. At the same time, in most studies on Russian companies based on machine learning methods, the predictive ability of various models is compared, while relatively little attention is paid to the analysis of individual factors of company bankruptcy.

As part of this study, we solved the problem of assessing the relative influence of individual factors on the probability of bankruptcy of large Russian companies in various industries using one of the machine learning methods, the random forest algorithm. The indicators for 3184 companies from 2009 to 2020 were considered. *For the entire sample*, the tested model correctly predicted the possibility of a company going bankrupt in 86% of cases over the period under review. This result confirmed that machine learning methods are *highly effective* (and, in particular, the random forest algorithm) in solving the problem of bankruptcy prediction for a company.

The study also showed that the bankruptcy risk factors of companies significantly depend on their industry affiliation:

For *manufacturing companies*, first of all, attention should be paid to a group of profitability indicators. For example, according to the results, the bankruptcy risk increases significantly when the ratio of retained earnings to assets is less than 4%.

For *retail companies*, it is necessary, first of all, to focus on liquidity and profitability indicators. The ratio of cash to assets must not be less than 0.04%, and the ratio of retained earnings to assets must not be less than 12%.

For *service companies*, indicators of financial stability are a priority in terms of predicting the probability of bankruptcy. In particular, a low risk of bankruptcy is observed when the ratio of fixed assets to current assets exceeds 73%.

Thus, the paper not only identifies factors that significantly affect the probability of bankruptcy of Russian companies in various industries but also determines the "threshold" values of these indicators, at which the risk of bankruptcy increases significantly.

The research results can be used by both internal (management, board of directors) and external (analysts, creditors, etc.) stakeholders to determine the current financial condition of the company, as well as forecast business development prospects.

Possible directions for further research include an in-depth analysis of the factors of bankruptcy of small and medium-sized Russian enterprises. Also, in order to obtain more detailed conclusions, it is advisable to analyze the bankruptcy factors for individual sectors/sub-sectors of the Russian economy with machine learning methods. The solution and identification of the bankruptcy risk factors of Russian companies should lead to a reduction in the number of bankrupt enterprises, which, in turn, will contribute to the recovery and development of the national economy.

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D.A. Shchuchkin — modeling using machine learning methods.

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Financial Methods for Equating with Some Categories of the Organization's Obligations to its Own Funds

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ABSTRACT

The implementation of financial and analytical procedures is an important stage of making appropriate management decisions in the implementation of economic activities. During the financial analysis of the organization's activities can determine such indicators as the level of financial stability, solvency, liquidity of the company, its market value and other important indicators, without knowledge of which it is difficult to make adequate and effective management decisions. **The purpose of the study** is to determine the financial instruments of equating certain categories of an organization's liabilities to its own funds within the framework of financial and analytical procedures. During the research, the author used such **methods** as content analysis of sources, analysis, synthesis, generalization, scientific abstraction, analogy. The author shows that the interpretation of the concept of "obligation" from the point of view of various areas of economic science (accounting, audit, taxation, valuation, financial analysis, etc.) can have different meanings. The author analyzed a number of normative legal acts and the practice of applying retraining (equating) obligations to own funds. As a possibility of equating obligations, the author considers subordinated borrowed funds; long-term borrowed funds and long-term accounts payable; minimum regulatory accounts payable arising as a result of a gap in the terms of accrual and payment (fixed liabilities); debt and accounts payable to affiliated entities; certain elements of deferred income; certain elements of reserves future expenses and other equated to own funds of obligations. **It is concluded** that individual liabilities, considered by accounting science and jurisprudence as liabilities, from a financial point of view (in certain situations, taking into account the relevant goals and objectives of financial analytical procedures), can be equated to the organization's own funds.

Keywords: liabilities; own funds; borrowed capital; bankruptcy; valuation activities, imaginary liabilities

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INTRODUCTION

In different directions of scientific knowledge there are situations when the same term has various meanings, and in some situations use different terms and concepts that define the same phenomenon or event. This article is devoted to the analysis of requalification tools with the subsequent equation from the financial point of view of individual elements of the organization's liabilities to own funds. Individual liabilities (depending on the purpose of the financial analytical procedures) can be defined as own funds or as borrowed capital (liabilities).

Financially, all liabilities of the organization are divided into two parts:

- borrowed capital;
- own capital (and equivalent sources).

Borrowed capital is formed from different categories of liabilities, which from an accounting point of view are determined on the basis of principles defined by legal science.

Jurisprudence defines the liabilities as the responsibilities of the subjects (debtor) "to act in favor of another person (creditor), such as: transfer of property, perform work, provide a service, contribute to joint activity, pay money, etc., or to refrain from a certain act, and the creditor has the right to require the debtor to perform its obligation".[1] Labilities also include valuation liabilities as well as other liabilities not related to the organization's own funds.[2]

In this article the issues of equating liabilities from a financial point of view to the organization's own funds are considered. The results of research can be used in the course of financial analysis, financial analytical procedures, including in the course of business valuation. Fair and reliable valuation of economic entities is important in modern economic relations, promotes the adoption of competent administrative decisions and promotes the development of the capital market, including at the international level [1].

The goal of the research is to improve financial and analytical procedures by developing and proposing to the active use of tools to equate individual categories of liabilities of the organization to its own funds.

The following objectives have been achieved within the framework of the research:

- researched the concept of "liabilities" and its derivative economic categories;
- analyzed and summarized the main possible elements of transformation (equating) of liabilities to the organization's own funds;
- reviewed and described all the main categories of liabilities, which, from a financial point of view, can be equated to the organization's own funds;
- conclusions on the feasibility of using (depending on the goals and objectives of the financial analytical procedures produced) tools to equate individual categories of liabilities of the organization with its own funds.

Expediency of introduction tools to equate individual categories of an organization's liabilities with its own resources arises from the fact that existing and actively used methodologies for implementing financial and analytical procedures (calculation of

[1] Civil Code of the Russian Federation (part one) No. 51 from 30.11.1994 (art. 307).

[2] Letter from the Russian Ministry of Finance No. 07–01–06/188 from 14.01.2015 (On the procedure of formation of reserves of doubtful debts by the organization, as well as write-off of accounts receivable for which the limitation period has expired, other debts, unrealistic for recovery); Bank of Russia's Regulation No.508 from 03.12.2015 "Industry standard for reserve accounting — estimated liabilities and contingent liabilities of non-credit financial organizations" (registered in the Ministry of Justice No. 40550 from 12.01.2016); International Accounting Standard (IAS) 37 "Estimated liabilities, contingent liabilities and contingent assets" (by the order of the Russian Ministry of Finance No.217 from 28.12.2015); Federal Accounting Standard for public sector organizations "Reserves. Disclosure of information about contingent liabilities and contingent assets", approved by the Order of the Russian Ministry of Finance No.124 from 30.05.2018 (registered in the Ministry of Justice No. 51491 from 29.06.2018) etc.

net assets, determination of bankruptcy signs, valuation of the company, analysis of the financial stability of the organization in order to make a decision on crediting, insurance or leasing, etc.) describe the same financial approaches. According to the author, depending on the goals and objectives of the financial procedures, it is advisable to use different principles of financial analysis. In particular, when determining the amount of net assets (or own funds) of individual categories of economic entities should be guided by normative legislative acts, and in the implementation of business valuation, it is useful to use information on all economic benefits and financial liabilities, including informal assets and informal liabilities. And in such financial procedures (for the purpose of valuation the business or making an economically sound management decision) it is acceptable and appropriate to use the broader boundaries of financial science, including applying the tools described in this research (assimilation of liabilities to own funds).

The results of these studies will also be relevant in the financial analysis of commercial and non-profit organizations [2]. The principles described in this research should also be applied to financial analysis of bankrupt or liquidating entities when individual liabilities are undergone significant transformation and transformed [3]. Individual research findings can be used to determine the collateral value of shares or shares in the authorized capital of companies [4].

There is much research on financial sustainability and adequacy of own funds (taking into account legal and regulatory frameworks and financial and analytical procedures) [5–8].

RESEARCH PART

The term "liabilities" is widely used in various fields of economic science (accounting, management accounting, audit, taxation, valuation activities, financial analysis, etc.), however, depending on the goals, tasks and principles of the financial and economic procedures, the definition of liabilities may have different principles [9].

The definition of liabilities for accounting, auditing, taxation and separate legal and regulatory documents is clearly defined.[3] However, the accounting liabilities of the various accounting systems [for example, Russian Accounting Standards (RAS) and International Financial Reporting Standards (IFRS)] will have different definitions.

For individual financial procedures (implementation of financial analysis of the activity of the organization, determination of market value of the operating business, construction of managerial accounting, etc.) separate liability categories that are equivalent under accounting rules and jurisprudence can be equated (financially) to the organization's own funds. Similar liabilities (equivalent to own funds) are reasonable from the point of view of financial analytical procedures, to consider as imaginary liabilities.

Imaginary liabilities of the organization — borrowed, credit and other accounts payable of the organization to the budget, extrabudgetary funds, individuals and/or legal entities, that recorded in the balance sheet of the organization and recognized in the calculation of the net

[3] Order of the Russian Ministry of Finance No. 84 from 28.08.2014 "On approval of the Procedure of Net Assets Valuation" (registered in the Ministry of Justice No. 34299 from 14.10.2014); Resolution of the Government of the Russian Federation No.673 from 11.06.2018 "On approval of the Rules for calculation of own funds of the developer, who has the right to attract funds of citizens and legal entities for the construction (creation) of apartment buildings on the basis of the agreement of participation in equity construction under the Federal Act "Participation in the equity construction of apartment buildings and other real estate objects and amendments to some legislative acts of the Russian Federation"; Bank of Russia's Regulation No. 646 from 04.07.2018 "On the method of identification of own funds (capital) of credit organizations ("Basel III")" (registered in the Ministry of Justice No. 52122 from 10.09.2018).

assets or equity of the organization but not actually available in the organization. Imaginary liabilities that are recorded in accounting but do not meet the test of reality should be excluded from the liability when determining the value of the company. Liabilities equivalent to own funds are also, from a financial point of view, imaginary (informal) liabilities of the organization [9].

Liabilities equivalent to own funds — these are liabilities, determined by such rules of law and accounting rules, but equated to the own funds (equity) of the organization from a financial point of view in determining financial sustainability, establishing the value of operating business, and other financial and analytical procedures.

The basis of the instruments for equating individual categories of liabilities to own funds is the reclassification of liabilities into informal (in this case, imaginary) liabilities, based on the economic nature of the phenomena, taking into account the principle of priority of substance over form.

Consider each category of liabilities that can be financially equivalent to own funds.

Subordinated borrowed funds (regardless of the form: loans, borrowed deposits, issued bonds)

Current legislation provides that subordinated borrowed funds may be raised (and used as sources equivalent to the organization's own funds) only by credit organizations, including banking groups and insurance companies. Under certain conditions, subject to the restrictions established by law, subordinated borrowing funds are equal to the own funds of the entity that raised subordinated borrowed funds regardless of the form of borrowing (loans, deposits, bonds), although with signs of borrowed funds (the principle of payment, urgency and return). The procedure for obtaining subordinated borrowed funds, as well as the conditions and limitations of equating these liabilities to own funds are detailed in the current legislation that regulator banking and insurance activities.[4]

The bankruptcy law also allocates subordinated borrowed funds, equating them (in terms of priority of debt repayment) with the funds of owners (participants, shareholders) of the bankrupt entity.[5]

As an indirect confirmation of this idea, let us say that the bankruptcy law provides for the conversion of liabilities on subordinated loans into stocks (shares) in the share (authorized) capital for insurance and credit organizations..[6]

The existence of the proximity of subordinated debt liabilities to shares, shares in societies is also mentioned in the scientific literature [10–12].

From an economic point of view, subordinated borrowed funds are liabilities because they have all the attributes of borrow-credit funds: all borrow-credit funds are raised on the principles of urgency, payment and repayment. However, current norms of the Russian legislation under certain conditions and restrictions make it possible to classify these borrowed funds as own, equating subordinated borrowed

[4] Law of the Russian Federation No. 4015–1 from 27.11.1992 "On the organization of insurance business in the Russian Federation " (art. 4.3); Federal Law No. 395–1 from 02.12.1990 "On Banks and Banking Activities " (art. 25.1); Bank of Russia Regulation No. 646 from 04.07.2018 "On the method of identification of own funds (capital) of credit organizations ("Basel III")" (Registered in the Ministry of Justice No. 52122 from 10.09.2018); Regulation of the Central Bank of the Russian Federation No. 215 "On the method of identification of own funds (capital) of credit organizations"; Bank of Russia Regulation No. 729 from 15.07.2020 "On the method of determining own funds (capital) and mandatory standards, supplements to capital adequacy standards, numerical values of mandatory standards and the size (limits) of open currency positions of banking groups" (Registered in the Ministry of Justice No. 60292 from 07.10.2020).

[5] Federal Law No. 127 from 26.10.2002 "On Insolvency (Bankruptcy)" (p. 4. art. 184.10 — in relation to insurance organizations; art. 189.95 — in relation to credit institutions); "The methodology for establishing requirements of creditors and maintaining the register requirements of creditors of a liquidated credit organization" (approved by the decision of the Board of GC "Deposit Insurance Agency" from 07.09.2006, protocol No. 54).

[6] Federal Law No. 127 from 26.10.2002 "On Insolvency (Bankruptcy)" (art. 184.3–1 — in relation to insurance organizations; art. 189.34 — in relation to credit institutions).

funds with equity of credit and insurance organizations. This practice (assimilation of subordinated debt to equity) is also present in other countries.

According to the author, taking into account the principle of equating subordinated borrowed funds with own funds in relation to credit and insurance organizations, this tool, for the purposes of separate financial analytical procedures, can be extended not only to credit and insurance organizations, but also to other economic entities.

Long-term borrowed funds and long-term accounts payable

Individual scientists argue that long-term debt is based on principles other than accounting science. Long-term liabilities (credits, calculations under concession agreements, calculations under leasing contracts) can, financially, be equated with the organization's own funds [13].

This practice came into the domestic science from foreign experience of financial analysis. The idea that long-term credits and loans are equal to sources of own funds is also found in legal documents.[7]

Minimum regulatory account payable as a result gap in the timeline to accrual and payment

Some researchers use the term "sustainable liability", which is financially equivalent to own funds. Sustainable liabilities are constantly in circulation of the enterprise, used to finance its business activities, but it does not own [14]. Sustainable liabilities include both the statutory minimum accounts payable due to the maturity gap and ongoing payments of a continuing nature [for example: the debt overhang of wages and contributions to extrabudgetary funds (pension fund, mandatory health insurance fund, social insurance fund); current debt to suppliers for systematic (monthly) deliveries; current debt on the tax budget] equivalent to own funds [15–17].

And in legal documents there is the idea that sustainable accounts payable is equal to the own funds of an economic entity.[8]

Debt and accounts payable to affiliates

Modern scientific thinking, regulatory sources and the current judicial practice (particularly in bankruptcy cases) have proven the reasonableness and reasonableness (in some cases) of transforming liabilities to affiliates (interdependent) in the economic equivalent of own (and equivalent) funds. There has been a trend in judicial practice, based on the analysis of the case, to remove obligations to affiliates from the debtor's creditor registry, considering and classifying obligations to affiliated persons as obligations of the owner (shareholder, participant) additionally capitalized the activities of society.

Economically, company's own funds — is the amount of the debt of the organization to the owners (owners) of the company, i.e. the value of all assets at market prices less all third-party liabilities, including salary obligations, taxes and duties, to suppliers, customers, credit and debt and other liabilities [18]. In view of this economic principle, debt to owners (and/or affiliates) is, from a financial point of view, considered as a source of financing equivalent to own resources.

Selected elements of future income

A liability such as future-period income may relate to both own funds and liability.

[7] Order of Federal Agency for Insolvency (Bankruptcy) under the State Property Committee of the Russian Federation No. 31 from 12.08.1994 "On approval of the Methodical Regulations on assessment of financial condition of enterprises and establishment of unsatisfactory balance sheet structure" (p. 5.3.).

[8] "Typical Method of Development of Techpromfinplan of Production Association (Plant), Enterprises" (approved by the State Plan of the USSR No. 125 from 19.10.1977 № 125). Moscow: "Economy"; 1979.

"Liabilities assumed include all liabilities of the organization except for future income recognized by the organization in relation to the receipt of State aid as well as in relation to the donation of property".[9] Future income derived from State aid and donated property is recognized by the organization's own funds (is not a financial liability), and other future income is not an element of own funds and should be qualified as a liability on of society.

In the author's view, for the purposes of financial analytical procedures, future income should be classified as own (equivalent) funds or liabilities based on their economic essence.

There is no doubt that the future income generated in the accounting of the organization (accordingly reflected in accounting records) should be taken as a liability of the company when accounting for the contributions of shareholders in equity construction is financially expedient.

Future income accruing to the organization in the form of the amount of insurance compensation received by the organizations to cover losses and losses from insurance events with fixed assets, as well as the funds obtained under the terms of non-recoverable, regardless of the source of payment, given the economic nature of the phenomenon, it is advisable to equate with the organization's own funds.

Individual reserve elements of upcoming costs

Estimated liabilities (as part of established reserves) may be considered as the organization's own funds in some cases. In relation to reserves, such an idea appears in the Conceptual Framework for Financial Reporting ("reserves may be established if national tax laws provide for exemption from or reduction in tax liabilities on contributions to such reserves. Information on the availability and size of such legal, regulatory and tax reserves may be relevant to decision-making by users of financial information. Such reserves are transfers of retained earnings, not expenditures").[10]

Individual reserves are not liabilities in financial terms and are to be equated with the organization's own funds. For example, the formed reserves for major repairs of fixed assets, from an accounting perspective, is an estimated liability, but the organization will only use the reserve in the future. In case of determination of the market value of the operating business in the form of determination of the value of the organization by means of estimation procedures, determination of the market value of fixed assets at the date of assessment in the technical condition, where these assets are in the current (not repaired) condition. Thus, the current [operational but not repaired (for which there is a provision)] status of fixed assets has already been taken into account in estimating the value of an established company, i.e. existing provision for major maintenance of fixed assets, from an economic point of view, should be excluded from the liabilities and equated to the organization's own funds, as does not require outflow of the organization's resources at the moment (on the valuation date). Accordingly, fixed assets major maintenance reserve is not a liability (financially). Real estate valuation is based on existing rules and regulations [19]. And the valuation has already identified all factors affecting the value of assets [20]. The valuation itself is based on actual wear and tear (all depreciation) and does not take into account the existence (or absence of) built-up reserves for major repairs. When

[9] Order of the Russian Ministry of Finance No. 84 from 28.08.2014 "On approval of the Procedure for determining the value of net assets" (registered in the Ministry of Justice No. 34299 from 14.10.2014).

[10] Conceptual framework for financial reporting (the document was not published). The text of the document follows the publication on the site. URL: http://minfin.ru/ (accessed on 29.01.2018).

it comes time to use this reserve, the spent funds for fixed assets overhaul from the created reserve will increase the value of fixed assets (repaired fixed assets, all other things being equal, cost more than the same fixed assets before repair). In this case, the reserve "will flow" into the increase in the value of the assets and, conditionally speaking, will not affect the change in the value of the organization. That is why the individual reserves (taking into account the theoretical example considered) are not liabilities in their economic essence, i.e. are assumed liabilities and are to be equated with the organization's own funds. Similarly, a reserve for land reclamation should not be included in the liability but should be accounted for in its own funds.

The current state of fixed assets has already been taken into account in estimating the value of the operating company, i.e. the reserve for major repairs of fixed assets, from an economic point of view, should be excluded from the liabilities and equated to the organization's own funds.

The idea that the organization's reserves are (economically) a redistribution of previously obtained profits and are not liabilities is indirectly confirmed, in the author's view, in relation to bankrupt entities (in bankruptcy proceedings), since all liabilities of the debtor are established and approved by the arbitration court, and the outflow of cash on the reserves formed in the account is not provided for by the current legislation regulating relations in the course of bankruptcy.

A similar position is appropriate during the liquidation of the organization. In some cases, during liquidation of a company, the term of use of reserves (the date when the necessity of liquidation of estimated liabilities arose) may not come (estimated reserve life may be significantly later than liquidation completion date). An example of such is production costs reserve for preparatory work due to seasonal production (no activity planned for next season); reserve of warranty repair and warranty service (no claims for warranty repairs and warranty service until the completion is not expected or claims will be significantly lower than the formed reserve). In such cases, it would be useful to define the reserves for the future expenses as equivalent to own resources.

The formation of reserves, the order of their creation, use and reversal ("zeroing" due to the lack of need in full or in part) is regulated not only (and not so much) by legal and regulatory documents, but also the internal document of the entity — accounting policy [21].

The organization independently, according to its own goals, chooses one of several ways of accounting procedures, provided for by the current legislation.[11]

In any case, when analyzing the estimated liabilities, it is necessary to consider the economic essence of each analyzed phenomenon, to take into account the goals and objectives of financial analytical procedures and to identify certain liabilities in the form of own funds or liabilities, based on their economic nature.

The list of liabilities (from an accounting perspective) that are worth assimilating to own funds (financially, in separate analytical procedures) is not exhaustive. The author shows the main principles of the respective transformational processes of equating liabilities with own funds (financially).

CONCLUSION

In view of the above, the author concludes, based on the results of the research, that the individual liabilities considered by the accounting science and jurisprudence as liabilities, financially (in certain situations, taking into account the respective goals and tasks of the financial analytical procedures) can be equated with the own funds of the organization.

[11] Regulations on Accounting "Accounting Policy of the Company" (PBU 1/2008), approved by Order of the Russian Ministry of Finance No. 106 from 06.10.2008.

As can be seen from these studies, liabilities that are financially equivalent to own funds may consist of the following elements:

- subordinated borrowed funds (regardless of the form: loans, borrowed deposits, issued bonds);
- long-term borrowed funds and long-term accounts payable;
- minimum regulatory account payable as a result gap in the timeline to accrual and payment;
- debt and accounts payable to affiliates;
- selected elements of future income;
- individual reserve elements of upcoming costs;
- other liabilities equivalent to own funds.

Financially, all elements of the liabilities must be considered taking into account the economic essence of each phenomenon under analysis, must necessarily take into account the goals and objectives of the financial analytical procedures and identify certain liabilities in the form of own funds or liabilities, based on their economic nature.

The active implementation of this tool of equating individual categories of liabilities of the organization to its own funds will allow more competent, adequate and reasonable determination of the boundaries of financial and analytical procedures depending on the goals and objectives of the latter. The use of this tool will contribute to the development of financial thinking in modern conditions of development and transformation of economic relations in today's society.

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Approbation of the Averaged Method of Chain Substitutions for Three- and Four- Multiples and Multiplicative-Multiples Factor Models

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ABSTRACT

The **aim** of the present study is to present the results of the approbation of the methodology of the averaged method of chain substitutions for three and four-multiple and multiplicative-multiple factor models and to systematize in tabular form all mathematical expressions developed so far to determine the individual factor influences by types of factor models. The **relevance** of the research is caused by the disadvantages and the limited applicability of the methods of deterministic factor analysis developed so far, which is one of the areas of financial and economic analysis. The **scientific novelty** of the research is the new mathematical expressions developed by the author for determining the individual factor influences according to the methodology of the averaged method of chain substitutions for three and four multiple and multiplicative-multiple factor models. Previous and new mathematical expressions according to the averaged method of chain substitutions are systematized by types of factor models in tabular form. The **main conclusion** is that the averaged method of chain substitutions has complete universality of application for all types of factor models and is characterized by accuracy and unambiguity of the results obtained for quantification of individual factor influences.

Keywords: deterministic factor analysis; mathematical methods; averaged method of chain substitutions; economic analysis

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INTRODUCTION

Deterministic factor analysis (DFA) is one of the directions of financial and economic analysis. DFA is aimed at accurate and unambiguous determination of quantitative influences that affect changes of participating factor variables in mathematically deterministic (determinable) factor models on absolute change of the result indicator.

The type of factor model is determined by the type of mathematical dependence describing the relationship between the resulting indicator (P) and participating factor variables ($a,b,c,\ldots$), by many authors factors for brevity.

The following types of factor models are identified in DFA practice:

- additive — $P=a+b+\ldots$;
- multiplicative — $P=a*b*\ldots$;
- multiple (relative) — $P=\frac{a}{b}$,

$$P=\frac{a}{\frac{b}{c}},\quad P=\frac{\frac{a}{b}}{c},\quad P=\frac{\frac{a}{b}}{\frac{c}{d}};$$

- mixed (combination) models — are a combination of additive, multiplicative and multiple models and can be: multiplicative-multiple, additive- multiple or additive-multiplicative-multiple models.

The distribution of absolute change of the resulting indicator (ΔP) by factor variables is based on the work of a number of Russian and foreign authors, namely: S. M. Yugenburg [1], A. Humal [2], A. D. Sheremet [3], A. D. Sheremet, G. G. Dei and V. N. Shapovalov [4], V. E. Adamov [5], V. Fedorova and Yu. Egorov [6], M. I. Bakanov and A. D. Sheremet [7], S. V. Chebotarev [8], N. P. Lyubushin [9], N. Sh. Kremer [10], K. N. Lebedev [11], V. A. Prokofiev, V. V. Nosov, T. V. Salomatina [12], G. V. Savitskaya [13], S. A. Ross, R. W. Westerfield and J. F. Jaffe [14], G. Foster [15], D. R. Emery, J. D. Finnerty and J. D. Stowe [16], J. J. Wild, L. A. Bernstein, K. R. Subramanyam [17], R. Brealey, S. Myers, F. Allen [18], V. Mitev [19] and others.

In DFA, the following methods are most used to quantify the influence of individual factors in a mathematically deterministic factor model: differential; coefficients; chain substitution; absolute differences; relative differences; equity participation; simple addition of an indelible balance; weighted finite differences; logarithmic; factor splitting; integral; index.

Each of the DFA methods has developed methodology, specific applicability, opportunities, advantages and disadvantages. All are described in detail in the scientific and educational literature in the field of DFA. Unfortunately, the above methods do not solve the accurate and unambiguous distribution of the so-called "indelible balance" between the influence of factor variables.

Integrated and chain substitution methods are most commonly used in DFA. The essence, methodology, applicability, accuracy, advantages and disadvantages of both methods are presented in detail in the scientific and educational literature.

Chain substitution method has absolute versatility of application for all possible types of factor models, but does not provide accurate and unambiguous results, since the influence of individual factors depends on the sequence of substitutions of factor variables in the construction of factor chains. This is the only and insurmountable disadvantage of the chain substitution method, namely — the ambiguous results for individual factor influences when changing the order of the factor variables substitution. This disadvantage leads to the need to rank the factor variables, namely: it is necessary to accurately determine which of the factors involved in the factor model is primary, which is secondary, which is third in order, etc., which creates considerable difficulties for managers and financial analysts.

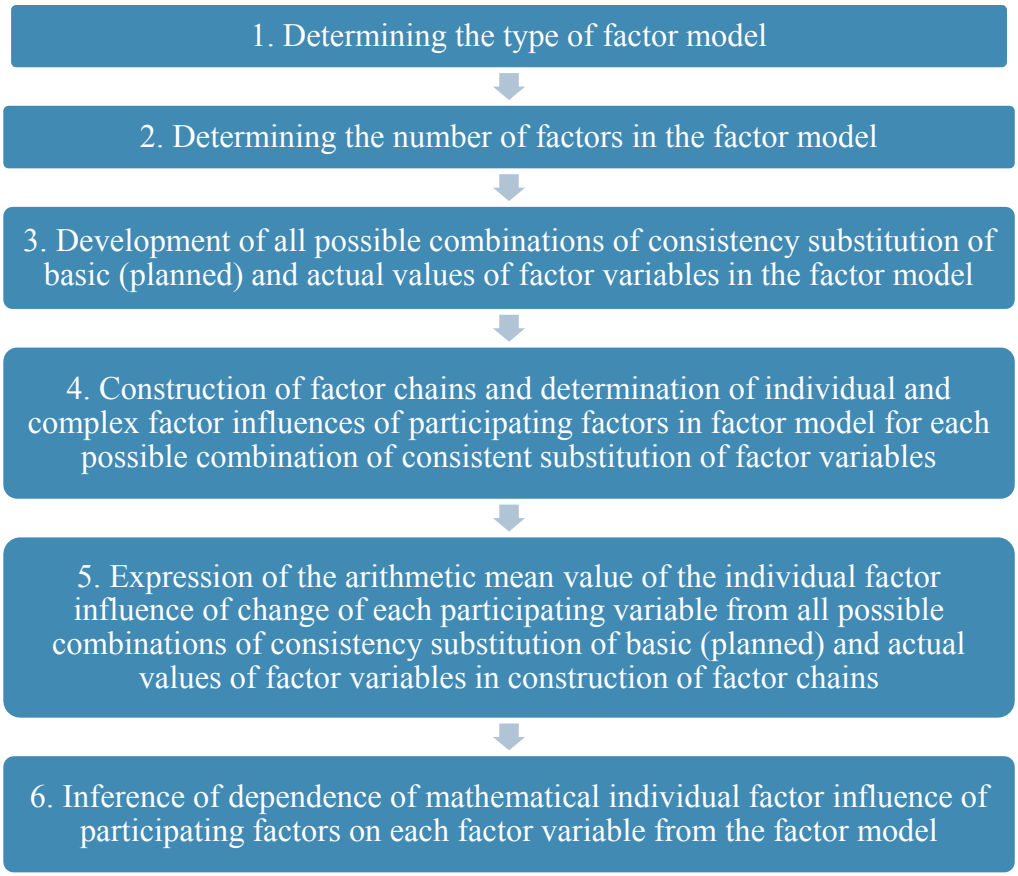

Fig. **Stages of the averaged method of chain substitutions**

Source: Mitev V. [20].

Integrated method developed by a group of Russian scientists — A.D. Sheremet, G.G. Dei, V.N. Shapovalov in 1971. It was developed for a limited number of types of factor models, namely: for all multiplicative ($P=a*b*\ldots$) and for a limited number of multiple and additive-multiple: $P=\frac{a}{b}$; $P=\frac{a}{b+c+\ldots}$, where: P — resulting indicator in factor model; a,b,c etc. are the participating factor variables in the factor model.

As described in [20, p. 97]: " In multiplicative factor models, the integral method gives accurate and unambiguous results, but for a limited number of multiples and additive-multiples models, the accurate of the results is compromised by using the function of natural logarithm in mathematical expressions to determine the influence of the factor a, i.e. factor in the numerator of the factor model, and then determine the influence of other factors in the factor models ($b,c,\ldots$), as they are a function of no longer very clearly defined influence of the factor a ».

Two preceding articles in Bulgarian [20, 21] present the methodology, essence, advantages, disadvantages and results of the developed new DFA method, namely: "average method of chain substitution". It has absolute versatility of application for all types of factor models, accurate and unambiguous results obtained to quantify the individual factor influence of factors involved in factor models.

The aims of this research — are present the results of testing the methodology of the average method of chain substitution for the three-, four- multiples and multiplicative factor models and systematize in tabular form all mathematical expressions

Table 1

New formulas for determining the individual factor influences by the averaged method of chain substitutions

Factor model	Influence of the factor a, $\Delta P_{(a)}$	Influence of the factor b, $\Delta P_{(b)}$	Influence of the factor c, $\Delta P_{(c)}$	Influence of the factor d, $\Delta P_{(d)}$
Multiple (relative) factor models				
$P=\frac{a}{\frac{b}{c}}=\frac{a*c}{b}$	$\frac{\Delta a}{6}\left(\frac{2c_0+c_1}{b_0}+\frac{2c_1+c_0}{b_1}\right)$	$\frac{1}{6}\left(\begin{matrix}\frac{2(a_1c_1+a_0c_0)+a_1c_0+a_0c_1}{b_1}\\ -\frac{2(a_1c_1+a_0c_0)+a_1c_0+a_0c_1}{b_0}\end{matrix}\right)$	$\frac{\Delta c}{6}\left(\frac{2a_0+a_1}{b_0}+\frac{2a_1+a_0}{b_1}\right)$	-
$P=\frac{\frac{a}{b}}{c}=\frac{a}{b*c}$	$\frac{1}{6}\left(\frac{2\Delta a}{b_0c_0}+\frac{2\Delta a}{b_1c_1}+\frac{\Delta a}{b_1c_0}+\frac{\Delta a}{b_0c_1}\right)$	$\frac{1}{6}\left(\begin{matrix}\frac{2a_1+a_0}{b_1c_1}-\frac{2a_0+a_1}{b_0c_0}\\ +\frac{2a_0+a_1}{b_1c_0}-\frac{2a_1+a_0}{b_0c_1}\end{matrix}\right)$	$\frac{1}{6}\left(\begin{matrix}\frac{2a_1+a_0}{b_1c_1}-\frac{2a_0+a_1}{b_0c_0}\\ +\frac{2a_0+a_1}{b_0c_1}-\frac{2a_1+a_0}{b_1c_0}\end{matrix}\right)$	-
$P=\frac{\frac{a}{b}}{\frac{c}{d}}=\frac{a*d}{b*c}$	$\frac{\Delta a}{12}\left(\begin{matrix}\frac{3d_0+d_1}{b_0c_0}+\frac{3d_1+d_0}{b_1c_1}\\ +\frac{d_0+d_1}{b_0c_1}+\frac{d_0+d_1}{b_1c_0}\end{matrix}\right)$	$\frac{1}{12}\left(\begin{matrix}\frac{3a_1d_1+a_0d_0+a_1d_0+a_0d_1}{b_1c_1}\\ -\frac{3a_0d_0+a_1d_1+a_1d_0+a_0d_1}{b_0c_0}\\ +\frac{3a_0d_0+a_1d_1+a_1d_0+a_0d_1}{b_1c_0}\\ -\frac{3a_1d_1+a_0d_0+a_1d_0+a_0d_1}{b_0c_1}\end{matrix}\right)$	$\frac{1}{12}\left(\begin{matrix}\frac{3a_1d_1+a_0d_0+a_1d_0+a_0d_1}{b_1c_1}\\ -\frac{3a_0d_0+a_1d_1+a_1d_0+a_0d_1}{b_0c_0}\\ +\frac{3a_0d_0+a_1d_1+a_1d_0+a_0d_1}{b_0c_1}\\ -\frac{3a_1d_1+a_0d_0+a_1d_0+a_0d_1}{b_1c_0}\end{matrix}\right)$	$\frac{\Delta d}{12}\left(\begin{matrix}\frac{3a_0+a_1}{b_0c_0}+\frac{3a_1+a_0}{b_1c_1}\\ +\frac{a_0+a_1}{b_0c_1}+\frac{a_0+a_1}{b_1c_0}\end{matrix}\right)$
Multiplicative-multiple models				
$P=\frac{a*b}{c}$	$\frac{\Delta a}{6}\left(\frac{2b_0+b_1}{c_0}+\frac{2b_1+b_0}{c_1}\right)$	$\frac{\Delta b}{6}\left(\frac{2a_0+a_1}{c_0}+\frac{2a_1+a_0}{c_1}\right)$	$\frac{1}{6}\left(\begin{matrix}\frac{2(a_1b_1+a_0b_0)+a_1b_0+a_0b_1}{c_1}\\ -\frac{2(a_1b_1+a_0b_0)+a_1b_0+a_0b_1}{c_0}\end{matrix}\right)$	-
$P=\frac{a*b*c}{d}$	$\frac{\Delta a}{12}\left(\begin{matrix}\frac{3b_0c_0+b_1c_0+b_0c_1+b_1c_1}{d_0}+\\ \frac{3b_1c_1+b_1c_0+b_0c_1+b_0c_0}{d_1}\end{matrix}\right)$	$\frac{\Delta b}{12}\left(\begin{matrix}\frac{3a_0c_0+a_1c_0+a_0c_1+a_1c_1}{d_0}+\\ \frac{3a_1c_1+a_1c_0+a_0c_1+a_0c_0}{d_1}\end{matrix}\right)$	$\frac{\Delta c}{12}\left(\begin{matrix}\frac{3a_0b_0+a_1b_0+a_0b_1+a_1b_1}{d_0}+\\ \frac{3a_1b_1+a_1b_0+a_0b_1+a_0b_0}{d_1}\end{matrix}\right)$	$\frac{1}{12}\left(\begin{matrix}\frac{3(a_0b_0c_0+a_1b_1c_1)+a_1b_1c_0+}{a_1b_0c_1+a_1b_0c_0+a_0b_1c_1+}\\ \frac{a_0b_1c_0+a_0b_0c_1}{d_1}+\\ \frac{3(a_0b_0c_0+a_1b_1c_1)+a_1b_1c_0+}{a_1b_0c_1+a_1b_0c_0+a_0b_1c_1+}\\ +\frac{a_0b_1c_0+a_0b_0c_1}{d_0}\end{matrix}\right)$

Source: author's development.

developed so far to determine the influence of individual factors in different types of factor models.

RESEARCH METHODS AND METHODOLOGY OF THE AVERAGE METHOD OF CHAIN SUBSTITUTION

The following methods were used: critical analysis; synthesis; dialectic method; combinatorics; averaging method; average method of chain substitution.

The main steps of the methodology of the average method of chain substitution are presented on *Figure*.

The essence of the methodology of the average method of chain substitution is based on the derivation of all mathematical expressions to determine the influence of individual factors by the method of chain substitution for each possible combination of the sequence of basic (planned) substitution and actual values of factor variables in the analytic factor model. The number of possible combinations is $N=n!$, where n — number of participating factor variables in the factor model. The resulting mathematical expressions for the influence of individual factors are averaged as they are summed and divided by the number of possible combinations of the sequence of substitution of factor variables ($N=n!$). The resulting mathematical expression for the influence of an individual factor is subjected to mathematical transformations and reduction by inferring simplified analytical dependencies for quantifying the influence of a variable factor on the absolute change of a resulting indicator. This procedure applies to each factor variable of the analytic factor model.

Averaging received mathematical expressions to determine the influence of individual factors by chain substitution for each possible combination of order of substitution of factor variables in the

Table 2

Systematization of factor models and formulas for determining the individual factor influences by the averaged method of chain substitutions

Factor model	Influence of the factor a, $\Delta P_{(a)}$	Influence of the factor b, $\Delta P_{(b)}$	Influence of the factor c, $\Delta P_{(c)}$	Influence of the factor d, $\Delta P_{(d)}$
Multiplicative factor models				
$P = a * b$	$\frac{\Delta a}{2}(b_0 + b_1)$	$\frac{\Delta b}{2}(a_0 + a_1)$	–	–
$P = a * b * c$	$\frac{\Delta a}{3}\left(b_0.c_0 + b_1.c_1 + \frac{b_1.c_0 + b_0.c_1}{2}\right)$	$\frac{\Delta b}{3}\left(a_0.c_0 + a_1.c_1 + \frac{a_1c_0 + a_0.c_1}{2}\right)$	$\frac{\Delta c}{3}\left(a_0.b_0 + a_1.b_1 + \frac{a_1.b_0 + a_0.b_1}{2}\right)$	–
$P = a * b * c * d$	$\frac{\Delta a}{4}(b_0.c_0.d_0 + b_1.c_1.d_1) + \frac{\Delta a}{12}\begin{pmatrix} b_1.c_0.d_0 + b_0.c_1.d_0 + \\ b_0.c_0.d_1 + b_1.c_1.d_0 + \\ b_1.c_0.d_1 + b_0.c_1.d_1 \end{pmatrix}$	$\frac{\Delta b}{4}(a_0.c_0.d_0 + a_1.c_1.d_1) + \frac{\Delta b}{12}\begin{pmatrix} a_1.c_0.d_0 + a_0.c_1.d_0 + \\ a_0.c_0.d_1 + a_1.c_1.d_0 + \\ a_1.c_0.d_1 + a_0.c_1.d_1 \end{pmatrix}$	$\frac{\Delta c}{4}(a_0.b_0.d_0 + a_1.b_1.d_1) + \frac{\Delta c}{12}\begin{pmatrix} a_1.b_0.d_0 + a_0.b_1.d_0 + \\ a_0.b_0.d_1 + a_1.b_1.d_0 + \\ a_1.b_0.d_1 + a_0.b_1.d_1 \end{pmatrix}$	$\frac{\Delta d}{4}(a_0.b_0.c_0 + a_1.b_1.c_1) + \frac{\Delta d}{12}\begin{pmatrix} a_1.b_0.c_0 + a_0.b_1.c_0 + \\ a_0.b_0.c_1 + a_1.b_1.c_0 + \\ a_1.b_0.c_1 + a_0.b_1.c_1 \end{pmatrix}$
Multiple (relative) factor models				
$P = \frac{a}{b}$	$\frac{1}{2}\left(\frac{\Delta a}{b_0} + \frac{\Delta a}{b_1}\right)$	$\frac{1}{2}\left(\frac{a_1 + a_0}{b_1} - \frac{a_1 + a_0}{b_0}\right)$	–	–
$P = \frac{\frac{a}{b}}{c} = \frac{a * c}{b}$	$\frac{\Delta a}{6}\left(\frac{2c_0 + c_1}{b_0} + \frac{2c_1 + c_0}{b_1}\right)$	$\frac{1}{6}\begin{pmatrix} \frac{2(a_1c_1 + a_0c_0) + a_1c_0 + a_0c_1}{b_1} \\ -\frac{2(a_1c_1 + a_0c_0) + a_1c_0 + a_0c_1}{b_0} \end{pmatrix}$	$\frac{\Delta c}{6}\left(\frac{2a_0 + a_1}{b_0} + \frac{2a_1 + a_0}{b_1}\right)$	-
$P = \frac{\frac{a}{b}}{c} = \frac{a}{b * c}$	$\frac{1}{6}\left(\frac{2\Delta a}{b_0c_0} + \frac{2\Delta a}{b_1c_1} + \frac{\Delta a}{b_1c_0} + \frac{\Delta a}{b_0c_1}\right)$	$\frac{1}{6}\begin{pmatrix} \frac{2a_1 + a_0}{b_1c_1} - \frac{2a_0 + a_1}{b_0c_0} \\ +\frac{2a_0 + a_1}{b_1c_0} - \frac{2a_1 + a_0}{b_0c_1} \end{pmatrix}$	$\frac{1}{6}\begin{pmatrix} \frac{2a_1 + a_0}{b_1c_1} - \frac{2a_0 + a_1}{b_0c_0} \\ +\frac{2a_0 + a_1}{b_0c_1} - \frac{2a_1 + a_0}{b_1c_0} \end{pmatrix}$	-
$P = \frac{\frac{a}{b}}{\frac{c}{d}} = \frac{a * d}{b * c}$	$\frac{\Delta a}{12}\begin{pmatrix} \frac{3d_0 + d_1}{b_0c_0} + \frac{3d_1 + d_0}{b_1c_1} \\ +\frac{d_0 + d_1}{b_0c_1} + \frac{d_0 + d_1}{b_1c_0} \end{pmatrix}$	$\frac{1}{12}\begin{pmatrix} \frac{3a_1d_1 + a_0d_0 + a_1d_0 + a_0d_1}{b_1c_1} \\ -\frac{3a_0d_0 + a_1d_1 + a_1d_0 + a_0d_1}{b_0c_0} \\ +\frac{3a_0d_0 + a_1d_1 + a_1d_0 + a_0d_1}{b_1c_0} \\ -\frac{3a_1d_1 + a_0d_0 + a_1d_0 + a_0d_1}{b_0c_1} \end{pmatrix}$	$\frac{1}{12}\begin{pmatrix} \frac{3a_1d_1 + a_0d_0 + a_1d_0 + a_0d_1}{b_1c_1} \\ -\frac{3a_0d_0 + a_1d_1 + a_1d_0 + a_0d_1}{b_0c_0} \\ +\frac{3a_0d_0 + a_1d_1 + a_1d_0 + a_0d_1}{b_0c_1} \\ -\frac{3a_1d_1 + a_0d_0 + a_1d_0 + a_0d_1}{b_1c_0} \end{pmatrix}$	$\frac{\Delta d}{12}\left(\frac{3a_0 + a_1}{b_0c_0} + \frac{3a_1 + a_0}{b_1c_1} + \frac{a_0 + a_1}{b_0c_1} + \frac{a_0 + a_1}{b_1c_0}\right)$
Multiplicative-multiple models				
$P = \frac{a}{b * c}$	$\frac{1}{6}\left(\frac{2\Delta a}{b_0c_0} + \frac{2\Delta a}{b_1c_1} + \frac{\Delta a}{b_1c_0} + \frac{\Delta a}{b_0c_1}\right)$	$\frac{1}{6}\begin{pmatrix} \frac{2a_1 + a_0}{b_1c_1} - \frac{2a_0 + a_1}{b_0c_0} \\ +\frac{2a_0 + a_1}{b_1c_0} - \frac{2a_1 + a_0}{b_0c_1} \end{pmatrix}$	$\frac{1}{6}\begin{pmatrix} \frac{2a_1 + a_0}{b_1c_1} - \frac{2a_0 + a_1}{b_0c_0} \\ +\frac{2a_0 + a_1}{b_0c_1} - \frac{2a_1 + a_0}{b_1c_0} \end{pmatrix}$	–
$P = \frac{a * b}{c}$	$\frac{\Delta a}{6}\left(\frac{2b_0 + b_1}{c_0} + \frac{2b_1 + b_0}{c_1}\right)$	$\frac{\Delta b}{6}\left(\frac{2a_0 + a_1}{c_0} + \frac{2a_1 + a_0}{c_1}\right)$	$\frac{1}{6}\begin{pmatrix} \frac{2(a_1b_1 + a_0b_0) + a_1b_0 + a_0b_1}{c_1} \\ -\frac{2(a_1b_1 + a_0b_0) + a_1b_0 + a_0b_1}{c_0} \end{pmatrix}$	-
$P = \frac{a}{b * c * d}$	$\frac{\Delta a}{12}\begin{pmatrix} \frac{3}{b_0.c_0.d_0} + \frac{3}{b_1.c_1.d_1} \\ +\frac{1}{b_1.c_0.d_0} + \frac{1}{b_1.c_0.d_0} \\ +\frac{1}{b_0.c_1.d_1} + \frac{1}{b_0.c_1.d_0} \\ +\frac{1}{b_1.c_0.d_1} + \frac{1}{b_0.c_0.d_1} \end{pmatrix}$	$\frac{1}{12}\begin{pmatrix} \frac{3.a_1 + a_0}{b_1.c_1.d_1} - \frac{3.a_1 + a_0}{b_0.c_1.d_1} \\ +\frac{3.a_0 + a_1}{b_1.c_0.d_0} - \frac{3.a_0 + a_1}{b_0.c_0.d_0} \\ +\frac{a_0 + a_1}{b_1.c_1.d_0} - \frac{a_0 + a_1}{b_0.c_1.d_0} \\ +\frac{a_0 + a_1}{b_1.c_0.d_1} - \frac{a_0 + a_1}{b_0.c_0.d_1} \end{pmatrix}$	$\frac{1}{12}\begin{pmatrix} \frac{3.a_1 + a_0}{b_1.c_1.d_1} - \frac{3.a_0 + a_1}{b_0.c_0.d_0} \\ +\frac{3.a_0 + a_1}{b_1.c_0.d_0} - \frac{3.a_1 + a_0}{b_0.c_1.d_0} \\ +\frac{a_0 + a_1}{b_1.c_1.d_0} - \frac{a_0 + a_1}{b_0.c_0.d_0} \\ +\frac{a_0 + a_1}{b_1.c_0.d_1} - \frac{a_0 + a_1}{b_0.c_1.d_1} \end{pmatrix}$	$\frac{1}{12}\begin{pmatrix} \frac{3.a_1 + a_0}{b_1.c_1.d_1} - \frac{3.a_0 + a_1}{b_0.c_0.d_0} \\ +\frac{3.a_0 + a_1}{b_0.c_0.d_1} - \frac{3.a_1 + a_0}{b_1.c_1.d_0} \\ +\frac{a_0 + a_1}{b_0.c_1.d_1} - \frac{a_0 + a_1}{b_1.c_0.d_0} \\ +\frac{a_0 + a_1}{b_1.c_0.d_1} - \frac{a_0 + a_1}{b_0.c_1.d_0} \end{pmatrix}$
$P = \frac{a * b * c}{d}$	$\frac{\Delta a}{12}\left(\frac{3.b_0c_0 + b_1c_0 + b_0c_1 + b_1c_1}{d_0} + \frac{3.b_1c_1 + b_1c_0 + b_0c_1 + b_0c_0}{d_1}\right)$	$\frac{\Delta b}{12}\left(\frac{3.a_0c_0 + a_1c_0 + a_0c_1 + a_1c_1}{d_0} + \frac{3.a_1c_1 + a_1c_0 + a_0c_1 + a_0c_0}{d_1}\right)$	$\frac{\Delta c}{12}\left(\frac{3.a_0b_0 + a_1b_0 + a_0b_1 + a_1b_1}{d_0} + \frac{3.a_1b_1 + a_1b_0 + a_0b_1 + a_0b_0}{d_1}\right)$	$\frac{1}{12}\begin{pmatrix} \frac{3(a_0b_0c_0 + a_1b_1c_1) + a_1b_1c_0 + a_1b_0c_1 + a_1b_0c_0 + a_0b_1c_1 + a_0b_1c_0 + a_0b_0c_1}{d_1} + \\ \frac{3(a_0b_0c_0 + a_1b_1c_1) + a_1b_1c_0 + a_1b_0c_1 + a_1b_0c_0 + a_0b_1c_1 + a_0b_1c_0 + a_0b_0c_1}{d_0} \end{pmatrix}$
$P = \frac{a * b}{c * d}$	$\frac{\Delta a}{12}\begin{pmatrix} \frac{3.b_0 + b_1}{c_0d_0} + \frac{3.b_1 + b_0}{c_1d_1} \\ +\frac{b_0 + b_1}{c_0d_1} + \frac{b_0 + b_1}{c_1d_0} \end{pmatrix}$	$\frac{\Delta b}{12}\left(\frac{3.a_0 + a_1}{c_0d_0} + \frac{3.a_1 + a_0}{c_1d_1} + \frac{a_0 + a_1}{c_0d_1} + \frac{a_0 + a_1}{c_1d_0}\right)$	$\frac{1}{12}\begin{pmatrix} \frac{3.a_1b_1 + a_0b_0 + a_1b_0 + a_0b_1}{c_1d_1} \\ -\frac{3.a_0b_0 + a_1b_1 + a_1b_0 + a_0b_1}{c_0d_0} \\ +\frac{3.a_0b_0 + a_1b_1 + a_1b_0 + a_0b_1}{c_1d_0} \\ -\frac{3.a_1b_1 + a_0b_0 + a_1b_0 + a_0b_1}{c_0d_1} \end{pmatrix}$	$\frac{1}{12}\begin{pmatrix} \frac{3.a_1b_1 + a_0b_0 + a_1b_0 + a_0b_1}{c_1d_1} \\ -\frac{3.a_0b_0 + a_1b_1 + a_1b_0 + a_0b_1}{c_0d_0} \\ +\frac{3,a_0b_0 + a_1b_1 + a_1b_0 + a_0b_1}{c_0d_1} \\ -\frac{3,a_1b_1 + a_0b_0 + a_1b_0 + a_0b_1}{c_1d_0} \end{pmatrix}$

factor model means, that the probability of occurrence of each possible consistency of substitutions of factor variables — is the same. Here we get a result that allows the same probability of occurrence of each possible combination of substitution consistency of factors in construction of factor chains. There is no need to rank the factors involved in the factor model, resulting in unambiguous results for factor influences.

Table 2 (continued)

Factor model	Influence of the factor a, $\Delta P_{(a)}$	Influence of the factor b, $\Delta P_{(b)}$	Influence of the factor c, $\Delta P_{(c)}$	Influence of the factor d, $\Delta P_{(d)}$
Multiplicative-multiple models				
$P=\frac{a}{b+c}$	$\frac{1}{6}\left(\frac{2\Delta a}{b_0+c_0}+\frac{2\Delta a}{b_1+c_1}+\frac{\Delta a}{b_1+c_0}+\frac{\Delta a}{b_0+c_1}\right)$	$\frac{1}{6}\left(\frac{2a_1+a_0}{b_1+c_1}+\frac{2a_0+a_1}{b_1+c_0}-\frac{2a_1+a_0}{b_0+c_1}-\frac{2a_0+a_1}{b_0+c_0}\right)$	$\frac{1}{6}\left(\frac{2a_1+a_0}{b_1+c_1}+\frac{2a_0+a_1}{b_0+c_1}-\frac{2a_1+a_0}{b_1+c_0}-\frac{2a_0+a_1}{b_0+c_0}\right)$	–
$P=\frac{a}{b-c}$	$\frac{1}{6}\left(\frac{2\Delta a}{b_0-c_0}+\frac{2\Delta a}{b_1-c_1}+\frac{\Delta a}{b_1-c_0}+\frac{\Delta a}{b_0-c_1}\right)$	$\frac{1}{6}\left(\frac{2a_1+a_0}{b_1-c_1}+\frac{2a_0+a_1}{b_1-c_0}-\frac{2a_1+a_0}{b_0-c_1}-\frac{2a_0+a_1}{b_0-c_0}\right)$	$\frac{1}{6}\left(\frac{2a_1+a_0}{b_1-c_1}+\frac{2a_0+a_1}{b_0-c_1}-\frac{2a_1+a_0}{b_1-c_0}-\frac{2a_0+a_1}{b_0-c_0}\right)$	–
$P=\frac{a+b}{c}$	$\frac{1}{2}\left(\frac{\Delta a}{c_0}+\frac{\Delta a}{c_1}\right)$	$\frac{1}{2}\left(\frac{\Delta b}{c_0}+\frac{\Delta b}{c_1}\right)$	$\frac{1}{2}\left(\frac{a_1+a_0+b_1+b_0}{c_1}-\frac{a_1+a_0+b_1+b_0}{c_0}\right)$	–
$P=\frac{a-b}{c}$	$\frac{1}{2}\left(\frac{\Delta a}{c_0}+\frac{\Delta a}{c_1}\right)$	$\frac{1}{2}\left(\frac{b_0-b_1}{c_0}+\frac{b_0-b_1}{c_1}\right)$	$\frac{1}{2}\left(\frac{a_1+a_0-b_1-b_0}{c_1}+\frac{b_1+b_0-a_1-a_0}{c_0}\right)$	–
$P=\frac{a+b}{c+d}$	$\frac{1}{6}\left(\frac{2\Delta a}{c_0+d_0}+\frac{2\Delta a}{c_1+d_1}+\frac{\Delta a}{c_0+d_1}+\frac{\Delta a}{c_1+d_0}\right)$	$\frac{1}{6}\left(\frac{2\Delta b}{c_0+d_0}+\frac{2\Delta b}{c_1+d_1}+\frac{\Delta b}{c_0+d_1}+\frac{\Delta b}{c_1+d_0}\right)$	$\frac{1}{6}\left[\frac{2(a_1+b_1)+(a_0+b_0)}{c_1+d_1}-\frac{2(a_0+b_0)+(a_1+b_1)}{c_0+d_0}+\frac{2(a_0+b_0)+(a_1+b_1)}{c_1+d_0}-\frac{2(a_1+b_1)+(a_0+b_0)}{c_0+d_1}\right]$	$\frac{1}{6}\left[\frac{2(a_1+b_1)+(a_0+b_0)}{c_1+d_1}-\frac{2(a_0+b_0)+(a_1+b_1)}{c_0+d_0}+\frac{2(a_0+b_0)+(a_1+b_1)}{c_0+d_1}-\frac{2(a_1+b_1)+(a_0+b_0)}{c_1+d_0}\right]$
$P=\frac{a-b}{c-d}$	$\frac{1}{6}\left(\frac{2\Delta a}{c_0-d_0}+\frac{2\Delta a}{c_1-d_1}+\frac{\Delta a}{c_0-d_1}+\frac{\Delta a}{c_1-d_0}\right)$	$-\frac{1}{6}\left(\frac{2\Delta b}{c_0-d_0}+\frac{2\Delta b}{c_1-d_1}+\frac{\Delta b}{c_0-d_1}+\frac{\Delta b}{c_1-d_0}\right)$	$\frac{1}{6}\left[\frac{2(a_1-b_1)+(a_0-b_0)}{c_1-d_1}-\frac{2(a_0-b_0)+(a_1-b_1)}{c_0-d_0}+\frac{2(a_0-b_0)+(a_1-b_1)}{c_1-d_0}-\frac{2(a_1-b_1)+(a_0-b_0)}{c_0-d_1}\right]$	$\frac{1}{6}\left[\frac{2(a_1-b_1)+(a_0-b_0)}{c_1-d_1}-\frac{2(a_0-b_0)+(a_1-b_1)}{c_0-d_0}+\frac{2(a_0-b_0)+(a_1-b_1)}{c_0-d_1}-\frac{2(a_1-b_1)+(a_0-b_0)}{c_1-d_0}\right]$
$P=\frac{a+b}{c-d}$	$\frac{1}{6}\left(\frac{2\Delta a}{c_0-d_0}+\frac{2\Delta a}{c_1-d_1}+\frac{\Delta a}{c_0-d_1}+\frac{\Delta a}{c_1-d_0}\right)$	$\frac{1}{6}\left(\frac{2\Delta b}{c_0-d_0}+\frac{2\Delta b}{c_1-d_1}+\frac{\Delta b}{c_0-d_1}+\frac{\Delta b}{c_1-d_0}\right)$	$\frac{1}{6}\left[\frac{2(a_1+b_1)+(a_0+b_0)}{c_1+d_1}-\frac{2(a_0+b_0)+(a_1+b_1)}{c_0+d_0}+\frac{2(a_0+b_0)+(a_1+b_1)}{c_1+d_0}-\frac{2(a_1+b_1)+(a_0+b_0)}{c_0+d_1}\right]$	$\frac{1}{6}\left[\frac{2(a_1+b_1)+(a_0+b_0)}{c_1-d_1}-\frac{2(a_0+b_0)+(a_1+b_1)}{c_0+d_0}+\frac{2(a_0+b_0)+(a_1+b_1)}{c_0-d_1}-\frac{2(a_1+b_1)+(a_0+b_0)}{c_1-d_0}\right]$
$P=\frac{a-b}{c+d}$	$\frac{1}{6}\left(\frac{2\Delta a}{c_0+d_0}+\frac{2\Delta a}{c_1+d_1}+\frac{\Delta a}{c_0+d_1}+\frac{\Delta a}{c_1+d_0}\right)$	$\frac{1}{6}\left(-\frac{2\Delta b}{c_0+d_0}-\frac{2\Delta b}{c_1+d_1}-\frac{\Delta b}{c_0+d_1}-\frac{\Delta b}{c_1+d_0}\right)$	$\frac{1}{6}\left[\frac{2(a_1-b_1)+(a_0-b_0)}{c_1-d_1}-\frac{2(a_0-b_0)+(a_1-b_1)}{c_0-d_0}+\frac{2(a_0-b_0)+(a_1-b_1)}{c_1-d_0}-\frac{2(a_1-b_1)+(a_0-b_0)}{c_0-d_1}\right]$	$\frac{1}{6}\left[\frac{2(a_1-b_1)+(a_0-b_0)}{c_1+d_1}-\frac{2(a_0-b_0)+(a_1-b_1)}{c_0+d_0}+\frac{2(a_0-b_0)+(a_1-b_1)}{c_0+d_1}-\frac{2(a_1-b_1)+(a_0-b_0)}{c_1+d_0}\right]$
$P=\frac{a}{b+c+d}$	$\frac{\Delta a}{12}\left(\frac{3}{b_0+c_0+d_0}+\frac{3}{b_1+c_1+.d_1}+\frac{1}{b_1+c_0+d_0}+\frac{1}{b_1+c_1+d_0}+\frac{1}{b_0+c_1+d_1}+\frac{1}{b_0+c_1+d_0}+\frac{1}{b_0+c_0+d_1}+\frac{1}{b_1+c_0+d_1}\right)$	$\frac{1}{12}\left(\frac{3.a_1+a_0}{b_1+c_1+d_1}-\frac{3.a_1+a_0}{b_0+c_1.d_1}+\frac{3.a_0+a_1}{b_1+c_0+d_0}-\frac{3.a_0+a_1}{b_0+c_0+d_0}+\frac{a_0+a_1}{b_1+c_1+d_0}-\frac{a_0+a_1}{b_0+c_1+d_0}+\frac{a_0+a_1}{b_1+c_0+d_1}-\frac{a_0+a_1}{b_0+c_0+d_1}\right)$	$\frac{1}{12}\left(\frac{3.a_1+a_0}{b_1+c_1+d_1}-\frac{3.a_0+a_1}{b_0+c_0+d_0}+\frac{3.a_0+a_1}{b_0+c_1+d_0}-\frac{3.a_1+a_0}{b_1+c_0+d_0}+\frac{a_0+a_1}{b_1+c_1+d_0}-\frac{a_0+a_1}{b_1+c_0+d_0}+\frac{a_0+a_1}{b_0+c_1+d_1}-\frac{a_0+a_1}{b_0+c_0+d_1}\right)$	$\frac{1}{12}\left(\frac{3.a_1+a_0}{b_1+c_1+d_1}-\frac{3.a_0+a_1}{b_0+c_0+d_0}+\frac{3.a_0+a_1}{b_0+c_0+d_1}-\frac{3.a_1+a_0}{b_1+c_1+d_0}+\frac{a_0+a_1}{b_0+c_1+d_1}-\frac{a_0+a_1}{b_0+c_1+d_0}+\frac{a_0+a_1}{b_1+c_0+d_1}-\frac{a_0+a_1}{b_1+c_0+d_0}\right)$
$P=\frac{a+b+c}{d}$	$\frac{1}{2}\left(\frac{\Delta a}{d_0}+\frac{\Delta a}{d_1}\right)$	$\frac{1}{2}\left(\frac{\Delta b}{d_0}+\frac{\Delta b}{d_1}\right)$	$\frac{1}{2}\left(\frac{\Delta c}{d_0}+\frac{\Delta c}{d_1}\right)$	$\frac{1}{2}\left(\frac{a_1+a_0+b_1+b_0+c_1+c_0}{d_1}-\frac{a_1+a_0+b_1+b_0+c_1+c_0}{d_0}\right)$

Source: author's development.

The assumption of the average method of chain substitution is as follows. The period under analysis is examined discretely, i.e. in two moments T_0 and T_1 (the beginning of the base or planning period and the end of the reporting period), and the change of factor variables during the period $T_0 - T_1$ happen at the same time, i.e. the resulting indicator (P) in the interval of variation ($\Delta P = P_1 - P_0$) changes at a constant speed, i.e. direct. This assumption is similar to the integral method, the third variant of the simple addition of an indelible balance and the weighted finite differences methods.

TESTING OF THE AVERAGE METHOD OF CHAIN SUBSTITUTION FOR THREE- AND FOUR- MULTIPLES AND MULTIPLICATIVE-MULTIPLES FACTOR MODELS

Table 1 presents the new mathematical expressions obtained to determine the influence of individual factors using the average method of chain substitution for three- and four- multiples and multiplicative models.

When determining mathematical expressions for individual factor influences in three- and four- multiples factor models, it is necessary to lead the factor model to a simplified form of multiplicative factor model, as shown in the first three rows of the first column in *Table 1*. Otherwise, direct application of the average method of chain substitution will lead to erroneous mathematical expressions about individual factor influences, participating in the factor model.

The average method of chain substitution method was tested in MS Excel by assigning quantitative values to the base (planned) and actual values of the factor variables. During testing, a number of combinations of input values of factor variables were used to confirm the correctness of the obtained results of the derived mathematical expressions to determine individual factor influences of factor models presented in *Table 1*.

SYSTEMATIZATION OF FACTOR MODELS AND RECEIVED MATHEMATICAL EXPRESSIONS ABOUT FACTOR INFLUENCES BY AN AVERAGE METHOD OF CHAIN SUBSTITUTION

Table 2 presents in table form the systematization of factor models and derived formulas by average method of chain substitution to determine the influence of individual factors. Systematization is performed by types of factor models, namely: multiplicative; multiple; multiplicative-multiple and additive- multiple.

Table 2 shows that for factor models that contain more than two factor variables, the mathematical expressions obtained by the average method of chain substitution are significantly complicated to determine the influence of individual factors, i.e. as the number of factor variables (n) increases, mathematical expressions become more complex to determine the influence of individual factors. This disadvantage of the method is easily overcome by using predefined templates in spreadsheets or MS Excel.

CONCLUSION

The average method of chain substitution has the versatility of the chain substitution method and is characterized by the accuracy achieved by the integral method in multiplicative factor models for which both methods produce the same results. The average method of chain substitution has absolute accuracy as opposed to the integral method in a limited range of multiple and additive- multiple models developed for it. Therefore, the developed method is characterized by the following advantages over other DFA methods, namely: full versatility of types of factor models, accurate and unambiguity of the obtained results.

The mathematical expressions presented in *Table 2* for determining the influence of individual factors for multiplicative, multiple, additive-multiple and multiplicative-multiple factor models composed of two-, three- and four-factor variables are characterized by accurate, unambiguity and significantly expand the practical applicability of the average method of chain substitution in the practice of financial and economic analysis.

Methodology of the average method of chain substitution can also be used to determine the influence of individual factors and more complex factor models

describing the relationship between the participating of factor variables and the resulting indicator. Certainly, the increase in the number of factor variables in the factor model leads to an increase in the number of combinations of consistency substitutions basic (planned) and actual values of factor variables in the construction of factor chains and the subsequent determination of the influence of individual factors. This significantly complicates, but does not make it virtually impossible to deduce mathematical expressions for the effects of individual factors on the change of the resulting indicator in five or more factor models, but it is a very laborious process, which will lead to more complex mathematical expressions to determine the influence of individual factors. This is the only but insurmountable disadvantage of the average method of chain substitution.

The average method of chain substitution can be easily applied to obtain mathematical expressions to quantify the influence of individual factors on change resulting indicator and for other mixed factor models not presented in *Table 2*.

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ORIGINAL PAPER

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Modern Financial Tools' Impact on Public Financial Management: The Case of Egypt

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ABSTRACT

The purpose of this study is to **examine** the managerial impacts of applying modern public financial management (MPFM) tools in financial reform programs on the efficiency of public financial management (PFM) in developing countries, considering the case of the Egyptian reform program implemented during 2005–2015. **Applying** MPFM tools could improve the efficiency of PFM in developing countries if institutional factors are available to ensure their successful implementation in reform programs. The study adopted a descriptive-analytical **method** to describe the managerial impact of applying MPFM tools in the financial reform experiences in developing countries. It **employed** a case study approach on the Egyptian reform experiment to estimate the correlation between applying modern financial tools and the managerial efficiency of PFM assessed through three elements: operational efficiency, allocative efficiency, and financial discipline. The practical study used the IBM SPSS package and MS-Excel to process the data. The **results** found a positive correlation between the application of modern financial tools and the rate of improvement in the efficiency of PFM in the Egyptian reform program. The study **developed** a specific model for a deeper understanding of the impacts of MPFM tools on the efficiency of PFM. The model **highlighted** a strong positive correlation between the successful application of modern PFM tools and the efficiency of PFM and **underscored** that the availability of the required real-time financial information about governmental revenue and more control over public spending led to achieving financial discipline.

Keywords: modern public financial management tools; public financial management; financial reform programs; developing countries; Egypt; financial discipline; allocation efficiency; operational efficiency

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INTRODUCTION

Public financial management (PFM) efficiency is one of the main objectives for developing countries seeking financial stability. However, public finance management in these countries carries challenges owing to outdated financial systems, slow paper procedures, and legacy administrative tools. This leads to inefficiency in allocating and operating public financial resources and an imbalance of financial discipline. Therefore, these countries seek to apply advanced solutions to modernize PFM systems by implementing financial reform programs (FRPs) adopting modern methodologies and methods to achieve PFM efficiency.

Consistent with this approach, international financial institutions since the mid-1980s have developed new public financial management systems based on information and communication technology (ICT) to improve the PFM efficiency — modern public financial management (MPFM) tools. The most important of these were the Treasury Single Account System (TSA), Government Financial Management Information System (GFMIS), and Government E-Payment System (GPS) The World Bank (WB) and International Monetary Fund (IMF) have contributed significantly to designing and formulating these modern financial tools.

Since the mid-1990s, WB and IMF experts [1] have published many studies and research indicating that these modern tools are advanced technological systems that can create an appropriate administrative work environment. These systems facilitate the organization and flow of financial information on government activities and provide technological capabilities enabling governments to achieve the required efficiency in operating and allocating resources and conducting financial discipline that may lead to PFM efficiency improvement. Moreover, international financial institutions encouraged developing countries to apply FRP to implement MPFM tools and provided financial and technical support to use these tools, reform public finance, and improve PFM efficiency [2].

Following the multiple recommendations issued by international financial institutions regarding the advantages of MPFM tools, developing countries have

responded diligently, applied FRP, and implemented MPFM. However, a literature review analyzing the results of these countries' reform experiences indicates that the results varied and were inconsistent with these recommendations.

Research problem

Although many developing countries have followed the recommendations issued by international financial institutions, particularly from the WB and IMF, emphasizing the importance of applying MPFM tools in FRP and improving PFM efficiency, many developing countries have committed to using these MPFM tools since the beginning of this century. However, the results of the reform programs were varied and did not always succeed in applying or improving PFM efficiency. Conversely, developing countries faced many challenges and failures during the application and use of these MPFM tools. A discrepancy in the results emphasized why studying the application mechanism of MPFM in FRPs in developing countries more in-depth to identify the factors leading to successful application in some countries. Additionally, by building a more specific model that can enhance the mechanisms of applying these modern tools in the future, we hope this model can help to avoid the causes of failure experienced by other countries and benefit from these lessons.

Study question

What are the impacts of the application of MPFM tools on FRP in developing countries on PFM efficiency considering its three elements — operational efficiency, allocative efficiency, and financial discipline — and how can the outcomes of this application be improved?

Significance of the study

The study highlights the implementation of MPFM tools in FRP. It defines success and failure institutional factors in the application and lessons learned from application experiences in some developing countries. Additionally, the study introduced a model that may explain the relationship between applying a specific modern financial tool and a specific element of PFM efficiency. The model applied a field study on the Egyptian reform program applied during 2005–2015 to measure the impact of the application and use of these modern tools on the FRP and PFM efficiency in Egypt.

LITERATURE REVIEW

We identify how studies and research addressed new concepts of MPFM tools and their applications in FRPs in developing countries and PFM efficiency. Here, the author monitored two main trends. The first trend is the literature focused on the concept of MPFM tools, while the second focused on how these tools are implemented in FRPs in developing countries. However, according to chronological order, the most important of these studies are the following:

A. Chowdhury [3] analysed the management of financial sector reform policies. They found some improvements in competition and efficiency due to the reform process. However, efficiency was lacking, and bias was present in the loan distribution and diversion of resources away from the rural sector and obstruction of loan recovery owing to political intervention. Our study concluded the importance of using MPFM tools to achieve efficiency in resource management by providing information that can earn equity and equality of distribution.

I. Pattanayak and S. Fainboim [1], studying the importance of applying new MPFM tools, highlighted the concept of TSA and described its features, discussed design issues, implementation conditions, and how can address fragmented government banking arrangements. Our study reached a group of results: fragmented governmental structures hindered cash management efficiency. TSA aims to ensure effective total control over governmental cash balances. Strengthening monetary resources by implementing TSA helps avoid governmental borrowing. Paying a substantial interest fee helps finance government agency expenses.

R.P. Jr. Beschel and M. Ahern [4] conducted extensive research for assessing the PFM reform process in the Middle East and North Africa region. They aimed to understand the type of fiscal reforms implemented during the first decade of the current century, specifically how these countries deal with PFM problems and the tools they used to manage FRP. They found that, in this region, it is the presence of individual leadership with a reform vision. This was key in the application of FRPs with MPFM tools. However, this success depended on the existence of this charismatic individual, and his capabilities enabled it to succeed.

A. Lawso [5] evaluated public financial management reform in Burkina Faso, Ghana, and Malawi in 2001–2010. Through a comprehensive assessment of the

FRP implemented in those countries by the African Development Bank, the Swedish Development Agency, and the Danish International Development Agency, they answered the following questions: Why and where do PFM reforms work? Where and how can donors support effective PFM reform contributing to the results? Our study concluded that financial reform results are good when strong commitment exists at the political and technical levels. Additionally, the reform application and design models are well designed to fit the context and use modern tools in the reform process.

A. Muhammed [6] sought to analyze the positive and negative aspects of reforming PFM in Ethiopia and Tanzania. It focuses on the systematic treatment of weaknesses in financial control. The study then found successful financial reforms in Ethiopia and Tanzania, and all reform paths were selective. Reform procedures in Ethiopia have focused on several aspects, such as reforming existing systems, focusing on the legal framework, reports, and budgeting, establishing strong manual controls on commitments of the procurement systems, and mechanization of operations. In Tanzania, FRP has focused on using ICT and MPFM tools.

S.K. Aitaa [7] examined the efficiency of GFMIS implementation and found that many institutions in Uganda use different financial transaction systems. Conversely, some financial transactions are performed outside the GFMIS. After implementing the system, the performance of financial management has improved, and the financial reporting process has improved timing and accuracy; the percentage of applying the system has increased from 47% to 50%. Although the system can solve some problems, concerns regarding plans that face many challenges in system implementation (e.g., frequent system and network downtime, insufficient training for users, power outages, and inefficient computers) are increasing. In addition to role the misallocation affecting the implementation of the operations of the GFMIS and the operational constraints of the system, the study found that the GFMIS in Uganda did not achieve the expected results entirely because of weak human resources technological capabilities.

W.A. Abdulaziz [8] highlighted the impact of the application of the GFMIS on the PFM efficiency in Egypt. This study sought to determine the reasons for poor PFM efficiency in Egypt attributable to traditional methods in public budget preparation that suffered from a lack of transparency and disclosure in governmental transactions. They concluded that the application of MPFM tools, such as the GFMIS, may help agencies and ministries conduct PFM functions efficiently by raising accuracy level in budget estimates, improving self-control, taking preventive measures, controlling financial operations, and providing financial information related to the preparation of financial plans and budgeting.

Comments on Literature Review

The author produced the following results: confirming the hypothesis that the application of MPFM tools was not successful in all application experiences; however, its impacts vary based on country-specific conditions. To achieve success, it is imperative to consider key institutional factors. This study focuses on these institutional factors to clarify them. Most of the studies tackled the application of a single tool and its impact on only one element of PFM efficiency. Multiple tools have not been studied either holistically or simultaneously. Measuring impact and analyzing the results of MPFM tools was applied in general, without linking or determining the effect of a particular device on a specific dimension or element of PFM efficiency.

Realizing this dispersion in the measurement and analysis of the impact of MPFM tools on PFM, we present a new theoretical framework for the compound application of MPFM tools simultaneously and measuring its effects on the PFM efficiency. We designed a proposed model for the relationship between each of the three MPFM tools for each of the three dimensions of PFM efficiency in the application phase (implementation of FRP) and then in the use phase (managing PFM). Thus, it measures the direct impact of each specific modern financial tool on the related dimension concerned with the PFM efficiency, which is designed to achieve this particular goal. We aggregated the values of the averages of the results to estimate the total combined effect of the MPFM tools on the FRP and PFM efficiencies. The author has applied this proposed model to the experience of FRP implemented by Egypt during 2005–2015 to verify the validity of the model through a questionnaire completed by Egyptian Ministry of Finance employees who applied these MPFM tools in Egypt. This model attempted to measure the degree of correlation between the application of MPFM tools and PFM efficiency. Details of the model and field study results are obtained after presenting the

theoretical framework of MPFM tools and how they are applied in FRP.

MPFM TOOLS

MPFM tools generally refer to automating the financial operations of the public budget, treasury, and payment units in PFM by implementing modern and comprehensive technological applications, leading to the transformation of PFM paper-based work environments to electronic bases. MPFM was built based on work rules and procedures and developed by international financial institutions (e.g., WB and IMF). Moreover, they have been designed and established as foundations and business processes since the beginning of the 1980s.[1]

MPFM tools are vital in tracking financial events, recording all transactions, summarizing information, supporting reporting and policy decisions, and incorporating ICT elements, personnel, procedures, controls, and data. MPFM tools are generally built around a core treasury system supporting essential budget execution functions (e.g., accounts payable and receivables, commitment and cash management, general ledger and financial reporting, debt management, and public investment management modules). MPFM tools require a large technological project implementation in the form of FRP, which ends with the availability of these tools for PFM to achieve efficiency [9]. The essential MPFM tools and how they are implemented in FRP are as follows:

TSA is a unified structure of government bank accounts enabling consolidation and optimum utilization of government cash resources providing the government with a consolidated view of monetary resources. The country's financial resources are pooled with the central bank to demonstrate the true picture of the state balance of revenues and expenditures, with a careful and transparent follow-up of cash flows for achieving the rational management of the country's fiscal resources [1].

TSA advantages: IMF highlights that this financial tool is one of the most important MPFM tools. It is used to "improve the management of government resources in financial reform processes" and is critical for pooling and managing government cash resources. Therefore, in countries with multiple banking arrangements for government resources, implementing this tool should be prioritized in the financial reform agenda for their overall role in reducing borrowing costs and maintaining and managing limited financial resources efficiently and effectively. However, applying this system requires professional, technical, and political will in countries that have used traditional systems of financial reform for a very long time. Challenges and difficulties in technological infrastructure make it more difficult in developing countries. The planning and implementation of TSA are also some of the essential factors in application success [10].

GFMIS is a set of solutions to automate public financial operations. Moreover, it unified and integrated accounting and information systems linking all governmental organizations to support informed decision-making. The system considers the ERP or back-office system for the government; it is not in direct contact with citizens, but is used by governmental employees for internal transactions and budgeting processes. Moreover, it assists in prioritization, implementation, and reporting expenditures and monitoring and reporting revenues, leading to PFM efficiency and equity [11]. GFMIS can also be identified as a set of process mechanization solutions that enable governments to plan, implement, and monitor the budget.

Advantages of GFMIS: Countries can acquire many benefits from implementing GFMIS. According to the United States Agency for International Development

The essential advantages of system implementation are the following [12]:

- Inclusiveness: All government financial transactions were recorded. Moreover, it allows tracking economic events and presents them in a normative form.
- Flexibility: Customized to work according to the needs and specifications of the government environment wherein it is installed.
- Integration: By combining all the needs of government financial information into a single integrated platform.

GFMIS components: The system comprised of two main components: *the core systems,* a set of modules that must exist to make the system functioning, and called treasury systems or budget execution systems. The general ledger system represents the heart of the system. It records all the accounting processes and restrictions conducted on the system and contains a chart of accounts, which

[1] International Monetary Fund. Fiscal Monitor — Public Expenditure Reform. Washington: Making Difficult Choices. 2014;11–17.

is its backbone. *Sub-Systems*: It is the other modules that may be part of the system or exist in an external autonomous system but require an interface to the GFMIS through a process of integration, such as collection, debt management, and asset management systems [13].

GPS: Payment system is the set of means, procedures, and rules for transferring funds between members participating within the system following an agreement between all members participating in the system and the system operator. Transfer of funds using a technical infrastructure should be done following the agreed technology. Modern economies currently have three types of payment systems. In the banking payment system, banks make payments. The non-banking payment system uses public networks, such as the Internet or private networks of payment providers. The government e-payment system, a system newly introduced by the WB and IMF, is a new government channel for collecting revenues and paying government liabilities to the beneficiaries [14].

Advantages of GPS: Governments implementing GPS accelerate payment and collection operations in budget units, facilitate the management of transfers to budget units and vice versa for budget operations, reduce cash in circulation and provide advanced channels for the government to collect revenues and pay its obligations securely. GPS is critical as it created an integration that was missing between government strategic plans at the MoF and the real cash balances available in government accounts. Moreover, it enhanced the efficiency of government financial information, wherein each payment to or from the government accounts is recorded with a unique identification number [15].

FRP is a specific plan with a time frame based on scientific rules, designed by setting clear goals to be implemented according to an identified period before initiating implementation. The extent to which the plan achieves, what has been targeted, is monitored to ensure that the required activities are implemented in specified times and at the estimated cost and to work on correcting any deviations that may occur for any reason. FRPs typically have specific goals or goals, such as reducing the public budget deficit at the end of the program to 3% of GDP. There must be a mechanism to measure the extent to which the program achieves the goal (objectives) for which it was implemented. FRP's importance originates from the potential to drive economic growth, and evidence indicates that if FRP succeeds in achieving its goals (e.g., financial discipline), it leads to better economic outcomes. Many studies have highlighted that the FRP could raise economic growth by about three-quarters of the percentage point in developed countries, particularly in the ten years following FRP [16].

Challenges of applying FRP in developing countries

Typically, developing countries face many challenges due to their historical circumstances when applying FRP. Therefore, studies have asserted that the fundamentals of reform should be established. A "preparation process" for the reform climate must be implemented well before applying FRP based on MPFM tools. The rush to implement MPFM tools in an undeveloped environment often fails the reform process. The application process and reform program being implemented are likely subject to the risk of political volatility, which may affect the reform process outcome. Conversely, studies analyzing the results of the reform experiments in developing countries over a quarter-century found that completing the basic requirements is crucial [17].

On the other hand and according to C. Dener et al. [11], FRP must be implemented through a long-term strategic framework for a comprehensive financial reform state strategy and not a government program. At the same time, N.M. Alsharari and M.A.E.-A. Youssef [18] found that the long period of the reform program implementation must be subject to and followed up by independent bodies directly (e.g., state audit and control) to ensure continuity of application over time the event of political changes. The pavement of the legal environment for FRPs is crucial, and developing countries must adopt the necessary laws to support the reform process.

APPLICATIONS OF MPFM TOOLS IN INTERNATIONAL EXPERIENCE

These applications are evident from the analysis of some incidents of applying MPFM tools in developing countries that can produce several lessons for benefiting both successful backgrounds and failure experiences in either way, which will be presented in the following examples.

Applying MPFM tools in Iraq

Iraq applied FRP based on MPFM tools on two occasions. The first in 2003 was when USAID implemented MPFM tools in Iraq to attempt to modernize Iraq's PFM and

comply with IMF requirements so that Iraq could qualify for IMF assistance and cancel debts from the Paris Club by May 2007. GFMIS was implemented in 132 nationwide spending units, accounting for more than 80% of government spending. In June 2007, USAID ended the program after five civil service consultants were abducted, among other difficulties encountered in adapting the systems for the Iraqi government. Despite applying MPFM tools in FRP, the first FRP failed to achieve real reform of the PFM. This reform experience was not completed due to several political problems encountered during the reform process and systems application. However, with the persistent imbalance in the public expenditure structure favouring operating expenses, Iraq was forced in 2014 to eliminate technical aid from the WB to start a new reform program with MPFM tools. To avoid the failures of 2003, a supportive environment was created through the Government of Iraq's commitment to prepare and implement the GFMIS, updating TSA. A step toward modernizing public investment management systems and operating public procurement to create a more transparent and efficient government system that can provide better services while creating a viable environment by laying the groundwork before beginning the financial reform process and enhancing a sense of real ownership the project. Although the second FRP is still ongoing, it faces many challenges due to Iraq's current political circumstances.[2]

Applying MPFM tools in South Africa

At the beginning of 2005, applying MPFM tools became a unified financial and administrative system in nine South African regions. According to C.J. Hendriks [19] MPFM tools took seven years before application, and the project was finally implemented as a priority initiative led by the National Treasury Authority to review and develop information technology. The project was aimed to enhance government expenditure management integrity and provide performance reports to ensure effective service and PFM efficiency. FRP began by implementing GFMIS with the modernization and interdependence of existing financial management systems. South Africa was guided by reasoning and rationality in the application, especially in choosing the "application approach". Our choice was between a phased implementation or comprehensive application of all system components once and debugging regularly, compared to an extensive application system with high risks that can lead to complete project failure. South Africa adopted a phased approach, which improved PFM efficiency.

Applying MPFM tools in Guatemala

In 1997, Guatemala launched three FRPs with the World Bank's support to enhance PFM efficiency. The first financial reform modernization project was established under the "Integrated Public Financial Reform Program", or SIAF I. Following the implementation of two additional reform programs under SIAF II and SIAF III. Our reform aimed to integrate all government units of the new system and add new capabilities to increase budget cycle efficiency, enhance transparency and accountability, and automate the collection of basic information at various government levels. The main principle of the system focused on the transition to centralized control and the development of basic budget and treasury functions. Guatemala's MoF developed a management unit called SIGES for supporting entities in implementing administrative processes (e.g., purchasing goods and services, recording inventory movements, and debt management). Guatemala's fiscal reform programs are implemented through an internal national strategy based on a combination of local cadres and capabilities and international expertise only as a consultant, especially in project management and organization of work procedures. This reform approach has prevailed in most FRPs in Latin American countries [9].

Lessons learned from applying MPFM tools in international experiences

After two decades of financial reforms in developing countries using MPFM tools, targeted improvement in PFM has not been successful in all the reform experiences implemented despite a commitment by applying modern tools. Moreover, this failure may result from all or some of the following factors [8]:

- The application of MPFM tools was partial and dispersed.

[2] World Bank. Iraq Public Expenditure and Institutional Assessment, Volume 2: Public Expenditure and Financial Accountability Assessment, Public Financial Management Report. Washington, D.C.: The World Bank. 2008;15–25. URL: http://elibrary.worldbank.org/doi/book/10.1596/28210 (accessed on 02.12.2022).

- The implemntation was conducted in a sequential rather than a parallel manner.
- Missing the integration mechanism in the scope of the project.
- A particular tool was applied to fix a specific financial defect without considering the integrated implementation of a comprehensive FRP based on MPFM.

FIELD STUDY FOR EGYPTIAN FRP 2005–2015

To identify how MPFM tools affect the efficiency of FRP and PFM, practically and more thoroughly, the author conducted a field study for Egyptian FRP using MPFM tools implemented during 2005–2015. The study sought to measure the degree of correlation between the application of MPFM tools and efficiency of FRP and PFM in the Egyptian case, particularly on the following details of the field study:

Study hypothesis

From a literature review, the author found that there are two basic stages in the reform process, as follows [21]:

- *Application phase*: This stage implements new technological systems within the FRP framework leading to improved FRP efficiency.
- *Usage phase:* After completing FRP implementation and using MPFM tools in PFM, which improves PFM efficiency.

Study model

The following relationship between the study variables was also monitored (*Fig.*):

- The *Independent variable* is the "application of MPFM tools" implemented independently to improve FRP efficiency. Within the scope of the study, it includes three tools: TSA, GFMIS, and GPS.
- *The dependent variable* is the "PFM efficiency", which is affected by the use of MPFM tools that have been implemented in FRP. The PFM efficiency can be identified by measuring the improvement in the following three dimensions or three dependent PFM sub-variables as follows [20]:
- *Operational efficiency* means providing a specific level of public services with the least financial resources while achieving the best possible services.
- *Allocative efficiency:* This refers to the allocation of public revenues according to public priorities and the efficiency of government programs, and the continuation of funding government activities of the highest priority in light of any decline that may occur in government flows and liquidity.
- *Fiscal discipline:* This generally means that total government spending does not exceed its amount in the general budget. The fiscal deficit does not exceed a certain percentage of GDP.

Field study questions

To what extent did the application of MPFM tools improve the efficiency of FRP and the PFM efficiency in Egypt?

Branching off from the main question, the following three sub-questions:

- How did the application of TSA improve the results of FRPs and achieve the ***operational efficiency*** of public financial resources in Egypt?
- To what extent did the implementation of GFMIS improve the results of the FRP and achieve the ***allocation efficiency*** of financial resources in Egypt?
- What is the impact of applying GPS on the results of FRPs and on achieving government ***financial discipline*** in Egypt?

Study methodology

This study utilized a descriptive-analytical methodology to describe the general information and analyze the responses of the study sample members regarding whether efficiency was achieved in managing FRP due to the application of MPFM tools and their perceived level of achieving efficiency PFM. We calculated the averages and standard deviations and compared the average responses of the sample members. Their assessment of the efficiency level achieved compared to the default average was [3] degrees (average of Likert scale five). The impact of applying each financial reform axis in FRP on PFM was analyzed and presented separately. The combined effect of using the three MPFM tools on the efficiency of FRP and PFM was then calculated. The degree of correlation was measured between the application of MPFM tools and the PFM efficiency.

Study limitations and data collection tool design

The questionnaire form used the five-point Likert scale in the questionnaire and included the following parts (*Table 1*):

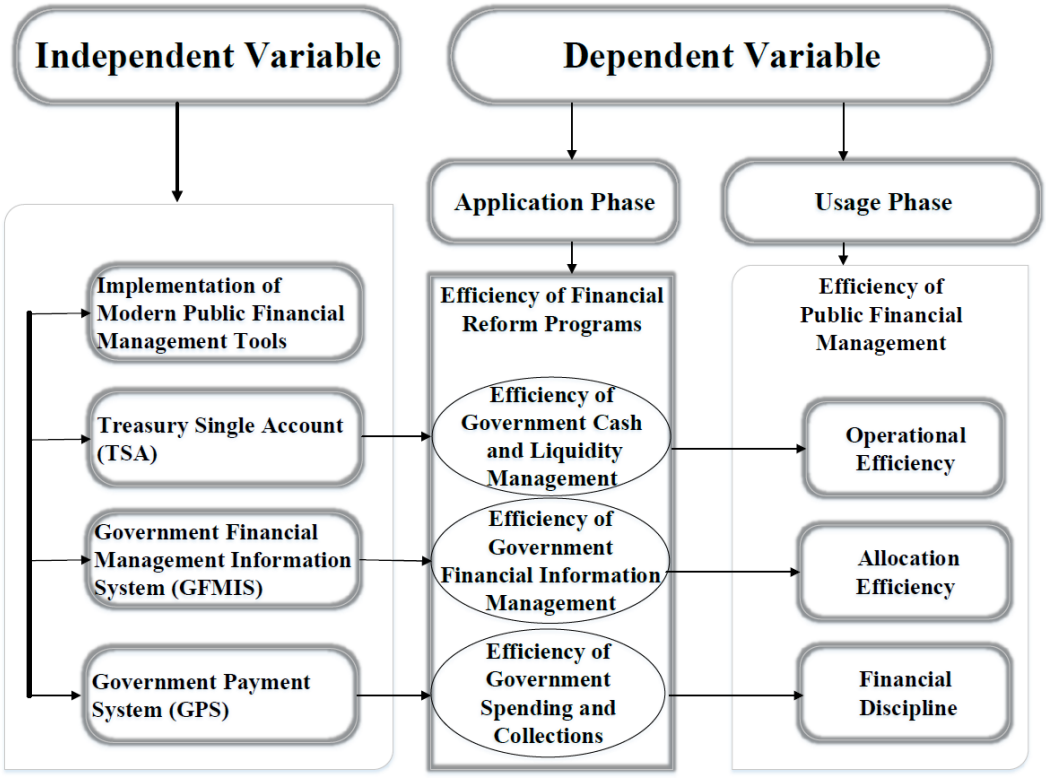

Fig. **Study model depicting hypothesized relationships among variables**

Source: author's original design.

The *first part* included seven phrases addressing the sample demographic characteristics.

The *second part* included thirty phrases to collect data from the study population on their opinion regarding the application and use of MPFM tools.

The study sample included employees of the Egyptian Ministry of Finance (2600 employees), and data were collected from July 11, 2021 to October 27, 2021 (*Table 2, 3*). Our sample was calculated according to the following formula [22]:

$$n = \frac{x^2 NP(1-P)}{D^2(N-1)+X^2P(1-P)} = \frac{(1.96)^2 \times 2600 \times 0.5 \times (1-0.5)}{(0.05)^2 \times (2600)+(1.96)^2 \times 0.5 \times (1-0.5)} = 335.$$

Here, n is the sample size, N is the size of the study population, P is the percentage of the maximum availability of characteristics to be studied in any community, D is the degree of accuracy reflected in the allowable error, and X2 is the standard degree (the value of the Ka2 test) corresponding to the confidence coefficient, which is 95% at a degree of freedom = 1. Hence, the corresponding standard degree is 1.96.

Data ***analysis methods:*** The author used the following statistical methods:

- ***Cronbach's alpha coefficient*** was used to estimate the stability of the internal consistency of the study tool.
- ***Frequencies and percentages***: Learn about the distribution of respondents, depending on demographic factors.
- ***Averages and standard deviations***: To obtain the answers of the sample respondents on passages for the study tool.
- ***Pearson's correlation coefficient determines*** the nature and strength of the relationship between the independent and dependent variables.

***Stability of the study tool*:** To ensure validity and reliability of the questionnaire and reach a high level of internal honesty in the study and identify the ability of the questionnaire to measure these variables and test their suitability for collecting data and information. The author has subjected the study tool to several tests, including Cronbach's alpha coefficient for internal consistency. *Table 4* shows that the stability coefficients by Cronbach's

Table 1

Distribution of degrees, percentages, estimation, and ranking of the five-point Likert scale

Degree	Percentages	Evaluation	Rank
From 1 to less than 1.8	From 20% to less than 36%	Do not agree entirely	Very low
From 1.8 to less than 2.6	From 36% to less than 52%	Do not agree	Low
From 2.6 to less than 3.4	From 52% to less than 68%	Neutral	Average
From 3.4 to less than 4.2	From 68% to less than 84%	Agree	High
From 4.2 to 5	From 84% to 100	Highly agree	Very high

Source: prepared by the author.

Table 2

Sampling method and determining study sample size and response rate

Random probability sampling method	Sampling method
Simple random sample	Sample type:
335 single	Sample volume:
350 forms	Number of questionnaire forms distributed:
327 forms	Number of survey forms retrieved:
93.4%	Response rate
307 forms	Number of valid questionnaire forms:
Egyptian MoF Towers — Headquarters	Sampling location:
July 11, 2021, till October 27 2021	Time frame of the study:

Source: prepared by the author.

Table 3

Distribution of respondents depending on demographic factors

Item	Level	Redundancy	Percentage
Qualifications	Bachelor's degree	219	71%
	High diploma	9	3%
	Master's degree or MBA	64	21%
	PhD	15	5%
	Total	307	100%
Position	Researcher C	73	24%
	Researcher B	67	22%
	Researcher A	97	32%
	General manager	70	23%
	Total	307	100%
Years of experiences	Less than 10 years	73	24%
	From 10 to 20 years	134	44%
	More than 20 years	99	32%
	Total	307	100%

Source: prepared by the author based on SPSS V. 26 output.

alpha ranged for TSA between 0.744 and 0.854, for GFMIS 0.739–0.858, and GPS 0.794–0.856 to the phrase.

The stability of the questionnaire's axes was also ensured by the split-half and Getman methods in the following table. *Table 5* shows the axial stability coefficients by the Cronbach's alpha, the split-half, and the Getman. Moreover, it shows that the values of the stability coefficients using the alpha Cronbach and split-half methods are high (greater than 0.8), indicating the stability of the scale.

FINDINGS

Impact of application MPFM tools on Egyptian FRP 2005–2015 efficiency

The following three (*Tables 6–8*) present the responses of the study sample to the impact of applying TSA, GFMIS, and GPS on Egyptian FRP efficiency (2005–2015), while (*Table 9*) presents aggregate responses of the study sample as follows:

The total arithmetic mean value of the axes of applying MPFM tools in Egyptian FRP has reached (4.43 out of 5) with a 0.640 standard deviation (*Table 9*). This average falls within the fifth category of the five-point Likert scale (4.2 to 5). There is a high percentage of agreement among the sample members that the application of MPFM tools in Egyptian FRP 2005–2015 has achieved very good results and achieved high efficiency FRP results. This category refers to a highly available option, and this percentage indicates that study sample responses were very high.

Impacts of usage of MPFM tools on the efficiency of Egyptian PFM

The following (*Tables 10–12*) show the responses of the study sample to the impact of the usage of TSA, GFMIS, and GPS on the use of MPFM in PFM in Egypt after FRP.

Answer on the main study question

To what extent has the application of MPFM tools improved the efficiency of FRP implemented in Egypt from 2005 to 2015 and then achieved PFM efficiency? The total arithmetic mean value of the axes of using MPFM tools in PFM reached (4.22 out of 5), with a 0.650 standard deviation (*Table 13*). This average falls within the fifth category of the five-point Likert scale (4.2 to 5). This category refers to a highly available option. There is a high percentage of agreement among the sample members that use MPFM tools in PFM has achieved very high efficiency. This percentage indicates that the responses of the study sample were very high.

Answer to the sub-questions

- How did applying TSA improve the results of FRPs and achieve the ***operational efficiency*** of public financial resources in Egypt? ***TSA*** succeeded in achieving the operational efficiency of public financial resources by 82.8% by providing the required information in real-time, increasing its ability to control resources, improve investment returns, reduce expenses, improve government liquidity management, improve oversight, and correct operations errors immediately.
- To what extent did implementing GFMIS improve the FRP results and achieve the ***allocation efficiency*** of financial resources in Egypt? ***GFMIS*** represented a quantum leap in achieving the allocative efficiency of public financial resources by 84.6% by recording all expenditure items in the budget of the system. Moreover, it allowed classification according to their importance and allocating the resources to items of strong importance while providing flexibility in responding to emergencies.

What is the impact of applying GPS on the results of FRPs and on achieving government ***financial discipline*** in Egypt? ***GPS*** succeeded, with an 86.2% success rate in improving in the most important element of financial discipline, wherein total government spending does not exceed the amounts specified in the budget. GPS controlled public spending completely; hence, units may not spend any amount unless it is included in the budget.

Analysis of the correlation degree between the study variables

A strong (positive) correlation relationship with statistical significance exists between the independent (using MPFM tools) and dependent variables (PFM efficiency) at the macro level (*Table 14*), as well as at the sub-axis level and dimensions. Table 14 shows the Pearson correlation matrix between each ax of MPFM tools and the corresponding dimension in PFM. This correlation ranged between (0.521 and) at its minimum and (0.826) at its maximum values, respectively. Therefore, the greater the success rate of applying MPFM tools during the implementation of FRP, the greater the improvement rate in the PFM efficiency.

Table 4

Reliability coefficients (Cronbach's alpha) for all study paragraphs

1st Axe: TSA		2nd Axe: GFMIS		3rd Axe: GPS	
Item Number	(Cronbach's alpha) coefficient	Item Number	(Cronbach's alpha) coefficient	Item Number	(Cronbach's alpha) coefficient
1	0.854	10	0.803	21	0.802
2	0.844	11	0.813	22	0.847
3	0.802	12	0.810	23	0.839
4	0.843	13	0.809	24	0.794
5	0.767	14	0.804	25	0.856
6	0.805	15	0.827	26	0.846
7	0.817	16	0.848	27	0.817
8	0.839	17	0.831	28	0.844
9	0.744	18	0.739	29	0.854
		19	0.858	30	0.824
		20	0.816	21	

Source: prepared by the author based on SPSS V. 26 output and MS-Excel.

Table 5

Axial stability coefficients by Cronbach's alpha, split-half, and Getman

MPFM Axes	No of Phrases	Alpha stability coefficient	Split half coefficient	Getman's stability coefficient
1st Axe: TSA	9	0.869	0.814	0.897
2nd Axe: GFMIS	11	0.877	0.813	0.897
3rd Axes: GPS	10	0.871	0.815	0.897
Total stability	30	0.887	0.828	0.906

Source: prepared by the author based on SPSS V. 26 output and MS-Excel.

CONCLUSION

The application of MPFM tools in FRP forms the most recent trends in PFM reform practices in developing countries. It has many benefits, such as automating work procedures and effective control over public finances, enhancing transparency and accountability, transforming the work environment from paper- to electronic-based, and automating the business process. This allows financial policymakers to centralize government spending and good management of public financial resources and maintain financial discipline, which achieves PFM.

The technical implementation of MPFM tools is challenging and requires the development of country specific solutions to meet a number of functional and technical requirements associated with the FRP vision. If reforms were assessed properly and a time action plan was developed with realistic sequencing of reform activities tend to produce more effective results in FRP.

The success of applying MPFM tools requires the provision of a set of basic factors, including laying the foundations of reform, creating a suitable climate for reform, and providing the necessary resources, especially human resources. The fundamental causes of failure are

Table 6

Responses of the study sample to the impact of applying TSA on Egyptian FRP efficiency 2005–2015

Phrase No.	Phrase	Mean	Standard deviation	Percentage	Rank
8	TSA application led to the provision of sufficient information in real time on government financial revenues	4.23	0.748	84.60	V. High
9	TSA application led to an improvement in the ability of MoF to control disbursement from government accounts and control budget units	4.21	0.727	84.20	V. High
10	TSA applications have reduced the need to maintain cash reserves	4.06	0.743	81.20	High
11	TSA application led to improved control during budget execution and flexibility in change in expenditure items according to urgent changes	4.18	0.740	83.60	High
12	TSA application led to a reduction in implementation errors and the possibility of correction	4.17	0.723	83.40	High
Overall average of the impact of applying TSA on Egyptian FRP efficiency		4.17	0.730	83.40	High

Source: prepared by the author based on SPSS V. 26 output and MS-Excel.

Table 7

Responses of the study sample to the impact of applying GFMIS on the efficiency of Egyptian FRP 2005–2015

Phrase No.	Phrase	Mean	Standard deviation	Percentage	Rank
17	GFMIS application led to the provision of sufficient information, which raised the level of accuracy in the estimates of the budget	4.47	0.561	89.40	V. High
18	GFMIS application led to efficient financial resource allocation decisions according to its relative importance	4.35	0.647	87.00	V. High
19	GFMIS application resulted in saving time and effort in the regulation of government financial revenues	4.34	0.683	86.80	V. High
20	GFMIS application led to raising the efficiency of monetary planning	4.27	0.662	85.40	V. High
21	GFMIS application led to regulation of government procurement and the rationalization of public spending	4.02	0.720	80.40	High
Overall average of the impact of applying GFMIS on the efficiency of Egyptian FRP		4.29	0.550	85.80	V. High

Source: prepared by the author based on SPSS V. 26 output and MS-Excel.

Table 8

Responses of the study sample to the impact of applying GPS on the efficiency of Egyptian FRP 2005–2015

Phrase No.	Phrase	Mean	Standard deviation	Percentage	Rank
28	GPS application led to the rapid collection of government fees and dues	4.30	0.612	86.00	V. High
29	GPS application led to the efficient collection government revenues	4.22	0.731	84.40	V. High
30	GPS application reduced the difference between the book proceeds and the actual government revenue proceeds	4.23	0.721	84.60	V. High
31	GPS application enabled the inclusion of government revenues in the government account on the same value working day	4.36	0.612	87.20	V. High
32	GPS application achieved accuracy and speed in paying government dues to beneficiaries and suppliers using transfers	4.12	0.668	82.40	High
Overall average of the impact of GPS application on FRP		4.23	0.660	84.92	V. High

Source: prepared by the author based on SPSS V. 26 output and MS- Excel.

Table 9

Aggregate responses of the study sample to the three-axis phrases related to the impact of the application of MPFM tools on Egyptian FRP 2005–2015

Axes of applying MPFM tools in FRP	Mean	Standard deviation	Percentage	Valuation
1st Axe: TSA	4.17	0.730	83.40	V. High
2nd Axe: GFMIS	4.89	0.550	97.8	V. High
3rd Axe: GPS	4.23	0.660	84.80	V. High
Total MPFM impact	4.43	0.640	88.66	V. High

Source: prepared by the author based on SPSS V. 26 output and Microsoft Excel.

political changes that occur during the application. Further, obstacles such as a lack of capacity, commitment, and institutional and technical challenges pose a risk to the successful implementation of MPFM tools.

The most important value that MPFM tools have achieved is providing detailed and immediate "information and data" about financial operations. Using this structured information led to the identification of input quantity, the measurement of an output quantity, and the adjustment of using ratios to prevent wastage of financial resources. Thus, controlling the inputs and outputs and identifying and measuring the extent to which they have achieved an efficiency in PFM is possible [23].

The application and use of MPFM tools in Egyptian cases led to a high-efficiency rate in managing Egyptian FRP 2005–2015. Additionally, a high improvement rate in the PFM efficiency reaches 84.5%. These ratios are particular for the Egyptian case FRP 2005–2015. The rate of improving PFM efficiency differs per country depending on the circumstances and environment of the application and the context of reform.

Table 10

Responses of the study sample to the impact of TSA usage in PFM

Phrase No.	Phrase	Mean	Standard deviation	Percentage	Rank
13	TSA usage led to improved efficiency of government payments and reduced idle government balances in commercial banks	4.19	0.703	83.80	High
14	TSA usage led to reduced commissions and interest paid by government and its bodies for its accounts side of the commercial banks	4.10	0.804	82	High
15	TSA usage led to improving financial settlements efficiency and reducing outstanding restrictions, which reduced the risks of operations	4.09	0.708	81.80	High
16	TSA usage significantly improved government cash management through the concentration of dispersed balances in one bank account at the central bank	4.19	0.704	83.80	High
Overall average of the impact of using TSA on Egyptian PFM		4.14	0.720	82.8	High

Source: prepared by the author based on SPSS V. 26 output and MS- Excel.

Table 11

Responses of the study sample to the impact of the usage of GFMIS

Phrase No.	Phrase	Mean	Standard deviation	Percentage	Rank
22	GFMIS usage succeeded in raising efficiency of budget preparation and implementation process through the automation of work procedures	4.42	0.590	88.40	V. High
23	GFMIS usage helped expedite the preparation of the final account for the general budget	4.28	0.605	85.60	V. High
24	GFMIS contributed to raising financial claim payment efficiency to beneficiaries and suppliers on their due dates	4.10	0.702	82.00	V. High
25	GFMIS led to improvement of self-monitoring and reduced errors	4.16	0.676	83.20	V. High
26	GFMIS promoted transparency by providing data. Statistics on the budget for all concerned parties	4.21	0698	84.20	High
27	Generally, GFMIS usage has resulted in enhanced institutional performance in PFM	4.25	0.685	85.00	V. High
Overall average of the impact of using GFMIS on the PFM efficiency		4.23	0.650	84.73	V. High

Source: prepared by the author based on SPSS V. 26 output and MS- Excel.

Table 12

Responses of the study sample to the impact of GPS usage

Phrase No.	Phrase	Mean	Standard deviation	Percentage	Rank
33	GPS usage has led to improving government cash management and reducing the risk of moving the money	4.43	0.557	88.60	V. High
34	GPS usage contributed to reducing government transactions cost	4.21	0.610	84.20	V. High
35	GPS has succeeded in improving managing government liquidity and reducing the need to borrow	4.22	0.587	84.40	V. High
36	GPS usage has improved the ability of the MoF to control and monitor the disbursement of government dues	4.37	0.584	87.40	V. High
37	Integrate GPS with TSA led to more efficiency and effectiveness in the government finance department	4.35	0.592	87.00	High
Overall average of the impact of using GPS on PFM		4.31	0580	86.30	V. High

Source: prepared by the author based on SPSS V. 26 output and MS- Excel.

Table 13

Aggregate responses of the study sample to the three axes phrases related to using of MPFM tools on Egyptian PFM efficiency

Impact of using MPFM tools on Egyptian PFM	Mean	Standard deviation	Percentage	Valuation
Operational efficiency	4.14	0.720	82.80	V. High
Allocation efficiency	4.23	0.650	84.73	V. High
Financial discipline	4.31	0.580	86.30	V. High
Total MPFM impact	4.22	0.650	84.40	V. High

Source: prepared by the author based on SPSS V. 26 output and MS- Excel.

Table 14

Pearson correlation matrix between the use of each axes of MPFM tools and the correspondent dimension in PFM

Study variables		Dependent variable			
		Operational Efficiency	Allocation Efficiency	Financial Discipline	PFM efficiency
Independent variable	TSA	0.807**	0.509**	0.521**	0.610**
	GFMIS	0.617**	0.826**	0.722**	0.720**
	GPS	0.525**	0.609**	0.771**	0.630**

Source: prepared by the author based on spss v26 output and microsoft excel.

(**) indicates that the correlation is significant at the significance level (α = 0.01).

Limitations and future scope

Given the scope of the article and the nature of the data available, it is not possible to address the many important questions about the MPFM tool implementation in developing countries. The analysis is limited to the data and information within the Egypt case study, not without recognizing the importance of other country experiments. To that end, future studies might usefully explore the significantly higher failure rate for financial reforms using MPFM in the Middle East and Africa.

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Financial Technology Adoption — A Case of Indian MSMEs

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ABSTRACT

Micro, small, and medium enterprises (MSME) are the backbone of every economy. Financial inclusion of MSMEs is essential for any country aspiring to economic development. Innovative solutions offered by fintech companies can support the financial inclusion of MSMEs. Digital payments, alternative loans, insurance, investments, regulatory, and robo-advisory services are just a few of the services that fintech companies provide to MSMEs. The **purpose** of this study-is to examine the role of financial technology on registered micro, small, and medium enterprises in India. The **objective** of the study is to reveal the behaviour of MSMEs towards financial technology acceptance and show how various demographic variables of owners/managers influence the acceptance of financial technology in the case of MSMEs.. The **methodological basis** of the study is a management survey of 117 MSMEs in India. The questionnaire had 25 questions; measurement items used in the questionnaire were derived from previous studies carried out in developing countries. The results were processed and tested for significance using modern econometric methods such as the Kruskal-Wallis H test, and the Mann-Whitney U test. The **result** of the study indicates that the financial technology acceptance rate among the MSME sector is high as maximum MSMEs consider themselves moderate financial technology adopters. MSMEs have a high understanding of different financial services provided by fintech companies. Prior Experience of the owner/manager, brand familiarity, government support, and behavioural variables such as perceived ease of use, perceived usefulness, trust, and satisfaction was proved to be effective while adopting financial technology services whereas, demographic variables such as gender, age, education level of owner/manager was found to be ineffective. The study **concludes** that fintech companies are providing quality services by acting as a single window, supporting the financial needs of MSMEs at low interest rates, simplified processes and lower transaction costs. MSMEs are using fintech products and services as a key part of their financial management, with increasing adoption there is a growing opportunity for fintech companies, incumbents, and non-financial organisations. The result of the study contributes to the novel understanding of the acceptance and preference of the MSME sector towards financial technology.

Keywords: financial management by small businesses; financial technology; Indian MSMEs; fintech companies; fintech products; financial technology adoption; behavioural factors

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INTRODUCTION

Financial technology, often known as "Fintech", has revolutionized the banking industry's ecosystem around the world [1]. The global FinTech market value is estimated to be approximately 7301.78 billion US$ as of 2020 and projected to grow at a CAGR of 26.87%, as per Statista Research Department.[1] India's FinTech sector is expected to reach from US$ 50 billion in 2021 to US$ 150 billion by 2025. Fintech service providers have aided in the unbundling of banking into core activities such as payment settlement, maturity transformation, risk-sharing, and capital allocation [2]. According to the RBI bulletin,[2] roughly 19% of Fintech companies in India were in the digital payments area as of August 2020. Digital lending came in second with 17 percent, and WealthTech came in third with 14 percent. In 2020, India has about 2,200 Fintech enterprises and start-ups, making it the world's second largest Fintech hub behind the United States.

There is no global definition for the term "Fintech", as definitions of Fintech vary widely across the globe. Depending on which side of the industry you come from, Fintech means quite different things to different people. Fintech is defined as an industry that uses

[1] Statista Research Department Report on Fintech Jun 7, 2022. URL: https://www.statista.com/topics/2404/fintech/ (accessed on 10.03.2022).

[2] RBI Bulletin: FinTech: The Force of Creative Disruption dated: 11.11.2020. URL: https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/7FINTECHEED4C43FC31D43C9B9D7F8F31D01B08E.PDF (accessed on 02.10.2021).

technology to make financial institutions and the delivery of financial services more efficient, although there is no universally agreed-upon definition. Fintech is a process that combines "finance and technology together". Internet banking, mobile payments, crowdfunding, peer-to-peer financing, Robo-Advisory, online identity, and other incremental and disruptive advances are examples [3]. There are many financial needs of customers that can be fulfilled using Fintech services.

FINANCIAL TECHNOLOGY PROVIDES BASIC FORMS OF FINANCIAL SERVICES

- **Banking and Payment:** This includes online foreign exchange, digital banking, payment processors, and mobile point of sale (mPOS) payment machines and readers.
- **Financial Management:** This includes online billing and invoice management tools, online cash flow and liquidity management tool, and Online bookkeeping and payroll tools.
- **Financing:** This includes online lending platforms, online marketplaces, aggregators, and brokers. Online equity (including equity crowdfunding), debt securities, online invoice financing, and dynamic discounting.
- **Insurance:** This comprises peer-to-peer insurance, usage-based insurance, and insurance premium comparison sites.

According to the EY global Fintech adoption index, India's fintech adoption has increased to 87% in 2019 from 52% in 2017. Fintech aims to improve the accessibility of financial services for both individuals and enterprises. Fintech improves clients' experiences by connecting them to the digital world, making them more efficient, cost-effective, and seamless. Fintech has changed the ecosystems of all businesses. Today, all banking transactions are usually digital, Banks, financial institutions, and lenders can provide loans and advances easily and quickly using just their mobile phones because of Fintech [3]. Today, Fintech is used in all sectors of the economy, which includes the MSME sector also. The definition of the MSME sector is also different in different nations. In India, MSME is defined as per (MSMED) Act, 2006 where a micro-enterprise, where the investment in plant and machinery or equipment does not exceed one crore rupees[3] and turnover does not exceed five crore rupees, a small enterprise, where the investment in plant and machinery or equipment does not exceed ten crore rupees and turnover does not exceed fifty crore rupees; and a medium enterprise, where the investment in plant and machinery or equipment does not exceed fifty crore rupees and turnover does not exceed two hundred and fifty crore rupees.[4] Micro, Small, and medium-sized enterprises (MSMEs) are increasingly using Fintech services across the globe. The Global SME adoption rate is 25%. In India, Fintech Services are adopted by the MSME sector at a very fast pace. MSME firms are a distinct customer category, with requirements that differ from those of consumers and major organizations.

The study involves understanding the knowledge of MSMEs about Financial Technology and ascertaining the MSME behavior towards Financial Technology acceptance as the needs and working of this sector are very different. The study will also ascertain the impact of different demographic variables such as Age, Education, Experience, and Gender of Owners/Managers on Financial Technology acceptance. According to [4], the human capital of an MSME i.e., owner/manager is a significant determinant in predicting the financing preferences of MSMEs. Also, human capital can be measured using three variables, namely age, education, and experience [5] The significance of personal features of MSME owners/managers has also been explained by [6]. They realized that gender, education, and ethnicity are the most important factors influencing MSME financial decisions.

These days, the MSME sector is spending a huge amount on technology development and up-gradation. Given the growing importance of these recent changes in India's MSMEs, the current study poses the following research questions:

- Identifying MSMEs' knowledge of financial technology.
- To ascertain the MSMEs' behavior towards financial technology acceptance.

[3] 1 INR = 0.760 RUBLES. 1 CRORE = 7,602,470 RUBLES URL: https://www.xe.com/currencyconverter/ (accessed on 10.08.2021).

[4] MSME. Annual Report 2020–21. Ministry of Micro, Small, and Medium Enterprises; 2021 URL: https://msme.gov.in/sites/default/files/MSME-ANNUAL-REPORT-ENGLISH%202020–21.pdf (accessed on 03.02.2022).

• To analyze the impact of different demographic variables on the behavior of MSMEs towards acceptance of financial technology.

This research will not only add to the scientific community's body of knowledge, but it will also be significant for the following reasons: First, this study adds to the limited research on India's MSMEs. Second, this study will demonstrate the MSME sector's preference for and acceptance of financial technology. Third, this is one of the first studies to examine MSME attitudes about financial technology acceptance by incorporating different factors influencing the attitudes of individuals and organizations.

We believe that this study can significantly advance knowledge on financial technology and small company technology adoption in general by examining the most important elements influencing MSMEs' willingness to use financial technology services. The role of financial technology is discussed in recent literature (*Table 1*), but the adoption of financial technology services has received less academic attention because it is new in context, which is another way that this study makes progress. This study is the first step in creating an all-encompassing, integrated plan to explain why Indian MSMEs are adopting fintech services. This study is one of a kind since it blends MSMES with fintech, despite the fact that earlier research has stressed the significance and function of fintech.

The next section contains a summary of the relevant research. The third section provides an overview of the variables, developed instruments, and procedures used for the study. The study's analysis and findings are detailed in section four. The conclusion and implications of the outcome were presented in the concluding part.

LITERATURE REVIEW

Micro, small, and medium enterprise of India

Micro, small, and medium enterprises (MSMEs) are a critical part of an economy given their significant contributions towards the gross domestic product, tax revenue, and employment [7, 8] but access to external finance is difficult for them [9]. Unlike major firms, which can raise funds through global financial markets, most MSMEs must rely entirely on domestic banking institutions to obtain credit. This is because huge corporations have greater financial and technical resources than micro, small, and medium enterprises (MSMEs) [10], which results in MSMEs seeking alternative financing channels outside the traditional banking industry and capital markets to satisfy their increasing financing needs [11]. Further, the small business sector continues to suffer from acute skills shortages, which makes the process of obtaining finance more difficult. Also, access to finance is frequently identified as a critical barrier to growth for MSMEs [12]. A growing body of literature has highlighted the extent to which MSMEs are credit constrained across developing countries, emphasizing the importance of relieving this constraint to achieve higher growth. Creating opportunities for MSMEs in emerging markets is also a critical step toward economic development and poverty reduction. Also, sophisticated technology and innovation are highly important for private firms [13].

Fintech

FinTech, which stands for financial technology, generally refers to financial innovations made possible by technology. All the major companies are utilising this technology edge, from "start-ups" to "big techs" to established financial institutions. Financial technology (Fintech) and innovations in traditional business models can take advantage of the credit gap [14]. The services offered by Fintech to micro, small, and medium-sized enterprises (MSMEs) give them new perspectives and opportunities for company financing [15]. If MSMEs adopt financial technology-driven solutions in their day-to-day work, then it will accelerate their growth rapidly. Financial technology can be used in many ways, not just for accessing finance. Financial activities such as taking insurance, doing financial planning, making invoices and investments, etc. are way easier with financial technology. Fintech companies offered various types of services such as digital payments, alternate lending, insurance, investments, regulatory and robo-advisory [15]. As seen in (*Table 2*), fintech is currently active in several financial areas. Also, technology-driven changes in business models will accelerate the growth of Asia's MSMEs [15]. By modernizing inefficient processes and reducing the role of costly intermediaries, financial

Table 1

Summary of Prior Studies discussing Role of Financial Technology

Organization	Discussion
World Bank Group[a]	This report highlights the consumer risk associated with the use of Fintech Services
T&A[b]	Different business models of Fintech are discussed which is feasible as per the Indian Market.
Esya Centre[c]	Digital Infrastructure of India is discussed along Skills, Awareness, Literacy level of consumer is also highlighted. Trust & Privacy concerns of using Fintech are highlighted.
ADBI[d]	This report discusses how digitalization increases access to finance in India
RBSA Advisory[e]	Current and Future Landscape of Fintech sector in India; factors impacting Fintech sector of India

Source: compiled by the authors.

Notes: [a] World Bank. Consumer Risks in Fintech: New Manifestations of Consumer Risks and Emerging Regulatory Approaches. World Bank; 2021 Apr. URL: https://documents1.worldbank.org/curated/en/515771621921739154/pdf/Consumer-Risks-in-Fintech-New-Manifestations-of-Consumer-Risks-and-Emerging-Regulatory-Approaches-Policy-Research-Paper.pdf (accessed on 15.01.2022);

[b] T&A Consulting. Opportunities for Swiss Fintech In India — Executive Summary. 2021. URL: https://www.s-ge.com/en/publication/guide/20213-c5-india-fintech-fint1 (accessed on 15.01.2022);

[c] ESYA Centre. Digitalising Indian Retail capacity building for a global context. ESYA Centre. 2021. URL: https://www.esyacentre.org/documents/2021/2/12/digitalising-indian-retail-capacity-building-for-a-global-context (accessed on 15.01.2022);

[d] Nemoto N., Yoshino N. Fintech for Asian SMEs. URL: https://www.adb.org/sites/default/files/publication/502781/adbi-fintech-smes.pdf (accessed on 10.01.2022).

[e] RBSA Advisors. Fintech Industry in India Future of Financial Services. 2021. URL: https://rbsa.in/wp-content/uploads/reports/research-reports/RBSA-Advisors-Presents-FinTech-Industry-in-India-February2021.pdf (accessed on 10.02.2022).

products are more fairly priced and traded in the market. Also, the working capital requirement [16], which is the biggest obstacle to survival in the early stages of the business, can be unlocked with financial technology. SMEs can benefit from financial technology in a variety of ways, including safer and faster payments, improved customer experience, increased transparency, well-managed bookkeeping, and delivering a competitive advantage.

The Indian Fintech sectors

India's FinTech industry may be nascent, but it is expanding quickly especially to a substantial market because of the innovative startup ecosystem, and supportive government policies and regulations. The fintech sector in India has experienced rapid expansion in recent years as shown in (*Fig. 1*). Paytm, Pine Labs, PayU, and Faircent are some of the well-known names on the list of the many Fintech businesses that are increasingly based in India. SoftBank has been making active investments in numerous promising fintech businesses. As per Invest India,[5] the value of fintech transactions in India is expected to increase from US$ 66 billion in 2019 to US$ 138 billion in 2023 at a CAGR of 20%. $ 8.53 billion (in 278 deals) was invested in India's Fintech industry in FY 22, 323 banks participated in India's Unified Payments Interface (UPI) as of May 2022, and the system recorded 5.9 billion monthly transactions totaling more than $ 130 billion. Payments, Lending, Wealth Technology (WealthTech), Personal Finance Management, Insurance Technology (InsurTech), and Regulation Technology (RegTech) are sectors that make up the Indian Fintech business ecosystem. According to the Medici India Fintech report,[6] there are 2,174 active fintech start-ups in India, 405 of them are companies that offer digital payment services,

[5] BFSI — Fintech & Financial Services. URL: https://www.investindia.gov.in/sector/bfsi-fintech-financial-services (accessed on 17.01.2022).

[6] India FinTech Report 2020 by Medici. URL: https://www.fintechcouncil.in/pdf/India-Fintech-Report-2020-Executive-Summary.pdf (accessed on 15.08.2021).

Table 2

Different areas of financial technology

Areas	Fintech segment	Brief Description
Credit, Lending, and Deposits	Peer-to-Peer lending Marketplace for loans Crowdfunding Digital currencies	This subset of Fintech encompasses entire lending markets, including peer-to-peer lenders and marketplaces that connect borrowers with both private and institutional lenders. Platforms for crowdfunding and equity financing is covered as well
Payments	M-wallets Merchant payments International remittances Digital currencies	P2P (person-to-person), P2M (person-to-merchant), and G2P (government-to-person) transactions are examples of services that allow money to flow from one person to another. It also covers payment services provided using mobile or other technologies
Investment Management	Robo advisors, Smart contracts	This segment pertains to technology-assisted wealth advisory services
Personal Finance Management	Tax filing/processing, Credit scoring services Financial planning	With the help of technical tools and services, individual financial profiles can be actively managed
Market provision	Smart contracts, E-Aggregators, Cloud computing	It comprises services that facilitate the provision of information and services of the market in a more timely and cost-effective manner
InsurTech	Insurance aggregator	This covers small business insurance and Usage-based insurance

Source: Report of the Working Group on Digital Lending including Lending through Online Platforms and Mobile. URL: https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/DIGITALLENDINGF6A90CA76A9B 4B 3E 84AA0EBD 24B 307F1.PDF (accessed on 18.11.2021).

365 are digital lending businesses, 486 are involved in wealth management and personal finance, and 111 are involved in the insurtech sector.

Most people in India are cash driven. A step toward establishing a cashless society has been made with the help of Fintech innovations. The use of fintech has significantly changed how people manage their finances and conduct daily business. As per Mckinsey Digital Report 2019[7] digital payments market in India is predicted to more than triple from $ 3 trillion now to $ 10 trillion by 2026. Digital payments (non-cash) will account for roughly 65 percent of all payments by 2026 which means 2 out of 3 transactions will be through digital modes. There is a significant increase in UPI transactions from 2018 to 2020 (*Fig. 2*). Fintech services are also economical since they combined streamlined products with cutting-edge technology. Financial services that were previously

[7] Kaka N. Digital India: Technology to transform a connected nation. 2019. URL: https://www.mckinsey.com/~/media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/digital%20india%20technology%20to%20transform%20a%20connected%20nation/digital-india-technology-to-transform-a-connected-nation-full-report.pdf (accessed on 20.08.2021).

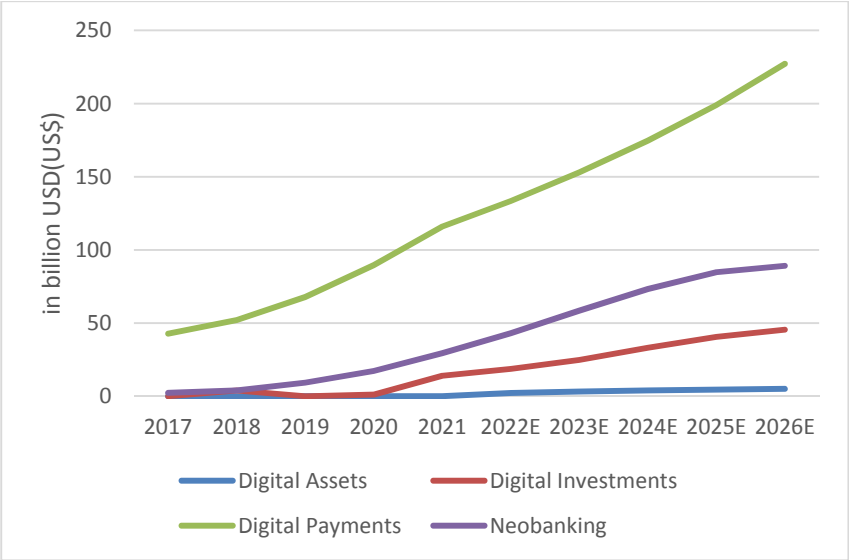

Fig. 1. **Increase in different Fintech sectors in India**

Source: Statista Research Department. URL: https://www.statista.com/topics/8077/digital-lending-industry-in-india/ (accessed on 17.01.2022).

provided by salespeople, desktop computers, and branches are now mobile because of these technologies and can move around freely on laptops and mobile phones. By learning about user habits, technologies like machine learning and predictive behaviour analytics enable users to make educated decisions about their savings and spending.

The digital payment spaces have witnessed a significant push due to mobile wallets, smart phones, near-field communications, and QR codes as described in *Table 3* where the volume of digital transactions has increased from 1695.2 to 43711.8 in a span of nine years (2012–2021). MSMEs, which are significant players in the global economy, have embraced mobile money. MSMEs are currently utilising mobile money for financial services like insurance, savings, and credit. They have begun receiving payment via mobile money (for their labour or for the sale of goods or services).

MSME strategies to adopt Fintech

Financial technology is required not only for the growth of micro, small and medium enterprises but also for the growth of the Indian economy. Also, high technological skills provide strategic advantages to businesses [17]. As per NSSO,[8] Indian medium and large enterprises are embracing financial technology in significant ways, even ahead of their Western counterparts, especially when it comes to mobile technology. Despite India's great performance in the adoption of mobile technology, today's small businesses in India are not realizing their full potential. MSME owners and managers may be apprehensive about innovations due to the financial costs involved in adopting innovative technologies [18] and/or because of the uncertainty revolving around new technologies [19].

The processes of financing activities in MSMEs are very different from those of large firms. Also, acceptance of any kind of technology for MSMEs is highly complicated in nature as not only firm-level variables but also owner-specific variables influence the level of acceptance. The financial behavior of the owner-manager is influenced by the entrepreneur dimension and entrepreneur cognition such as age, experience, education, and ownership structure. It has also been found that MSMEs are adopting fintech through mobile phones. Also, entrepreneurial experience and prior family business have a positive impact on entrepreneurial goals [20]. The more a person is inclined to adopt technology or gain technological knowledge, the more interested they will be in the adoption of Fintech Services.

[8] NSSO. Operational characteristics of unorganized manufacturing enterprises in India. 2007. URL: http://doc.inflibnet.ac.in/datarepository/index.php/catalog/79 (accessed on 01.02.2022).

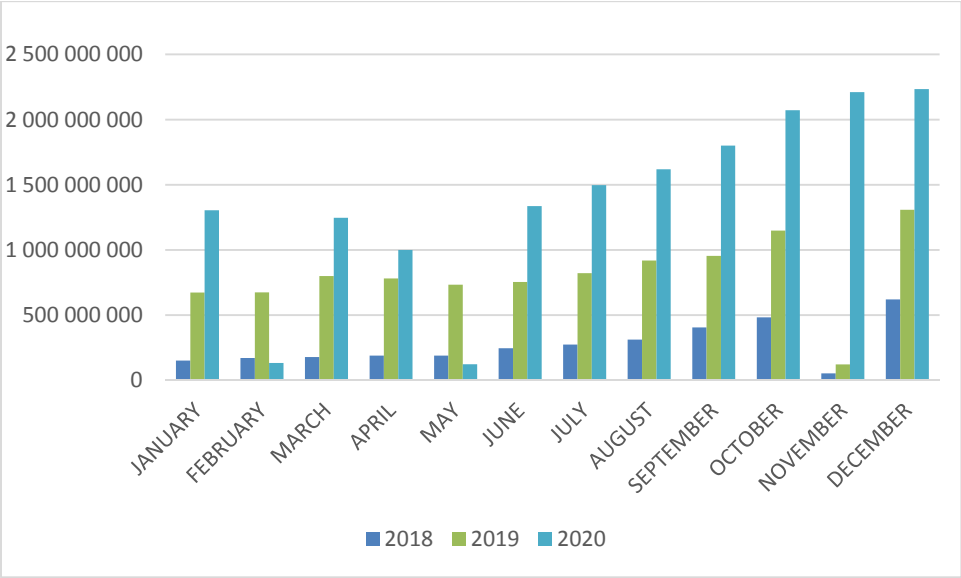

Fig. 2. **Volume of UPI Transactions in India**

Source: compiled by the authors. URL: https://www.npci.org.in/ (accessed on 17.10.2021).

Individuals' and organizations' adoption behavior towards technology acceptance is defined by a variety of models that have been studied in earlier research. The Technology Acceptance Model (TAM) is one of the most common models used by researchers in the study of individual and organizational technology adoption [21]. TAM proposed that perceived usefulness and perceived ease of use have a direct impact on behavioral intention to use the actual system [21, 22]. Various extensions to the TAM were also conducted, which included trust [23], satisfaction [24], government support [25], and brand [26]. In this study, various factors are considered that could impact the intention of MSMEs which has been derived from past literature (*Table 4*).

RESEARCH METHODOLOGY

Instrument development

The researchers employed a modified questionnaire for data collection. The measurement items used in the questionnaire were derived from previous studies carried out in developing countries.

The questionnaire consists of 25 questions, which are divided into three parts. The first part covers demographic and socioeconomic variables such as age, gender, education level, and experience in current business. The second part identifies questions related to the understanding of MSMEs related to financial technology. The third part is devoted to the questions related to the behavioural factors that could impact the attitude of respondents towards financial technology acceptance, using a five-point Likert scale ranging from 1 (Strongly Disagreed) to 5 (Strongly Agreed) for specific activities in business (*Table 5*).

Table 3

Volume of Total Digital Transactions

YEAR	VOLUME	VALUE
2012–2013	1695.2	710774.2
2013–2014	2451.2	784684.1
2014–2015	3517.9	822722.4
2015–2016	5947.1	920469
2016–2017	9780.8	1121649
2017–2018	14714.4	1370844
2018–2019	23260.2	1637134.25
2019–2020	34124	1620894.13
2020–2021	43711.8	1414851.73

Source: compiled by the authors. URL: https://www.npci.org.in/ (accessed on 17.10.2021).

Validity and reliability of the questionnaire

The validity of the questionnaire was determined by consulting subject experts and conducting a pilot study

Table 4

Summary of Prior Studies using TAM Model

Author	Variables Involved	Data Source	Implication
Y. Wang et al. [27]	Perceived Ease for Use, Perceived Trust, Perceived Usefulness, Perceived Privacy, User attitude, User acceptance	A paper-based questionnaire was used to poll 361 people	Voice recognition scored the highest in the PU scenario, according to the findings
D. Folkinshteyn and Lennon [28]	Perceived Ease for Use, Perceived Risk, Perceived Usefulness	Secondary data source	Bitcoin the money has several key favorable factors in PEU and PU for both developers and end-users, arising from its free open-source nature, putting the user in control, and greater transaction efficiency
R. Lindsay et al. [29]	Perceived ease of use, Perceived usefulness, Attitude, External variables as local supervision, the influence of peers Behavioural Intention and Actual Usage	43UK police force	The influence of local supervision, fit of technology, and influence of peer external variable is the most influential factors
G. Mortimer et al. [30]	Need for interaction, Social influence, Perceived risk, Perceived ease of use, Perceived usefulness	Intentions of consumers to adopt mobile banking	Apart from TAM model culture is the important factor for the adoption of m-banking
B. Marakarkandy et al. [31]	Perceived ease of use, Perceived usefulness, Attitude, subjective norm, image, banks initiative, internet banking self-efficacy, internet usage efficacy, trust, perceived risk, trialability, and government support	300 responses were collected	The study's findings corroborate the suggested model to a great extent, allowing researchers to better understand the impact of subjective norms, image, banks' initiatives, internet banking self-efficacy, internet usage efficacy, trust, perceived risk, and government backing on online banking adoption
J.L.M. Tam [32]	Perceived ease of use, Perceived usefulness, Attitude, Brand Familiarity	366 responses were collected in the Korean market	The findings revealed that buyers with varying levels of brand familiarity have certain similarities. Customers should be familiarised with a service while marketers capture opportunities to offer a favorable experience to gain future purchases
Z. Irani et al. [33]	Resources, Social Influence, Self-Efficiency, Utilitarian outcomes	358 responses were collected	Consumers' Behaviour Intention was highly influenced by utilitarian outcomes, self-efficacy, perceived resources, and social influence, according to the findings

Source: author compilation.

with 50 participants. The participants were asked to rate the questionnaire and express their thoughts on whether the questions were appropriate. Experts were also asked to provide additional information to make the questions more understandable. The experts were also asked if any more beneficial questions could be added, as well as whether any extraneous ones might be removed. The questionnaire has been modified to the best extent possible before conducting the survey. The questionnaire was also tested for reliability using Cronbach's alpha. The results of Cronbach's alpha indicate an instrument is reliable if alpha values are above 0.70. There are 25 items in the questionnaire to analyze the motives, preferences, and acceptance of financial technology. The alpha value of 21 items (excluding demographic questions) is.891, which indicates that the instrument is reliable.

Sampling and data collection

The snowball sampling approach, a non-random sample technique, has been used to acquire data. The original respondents introduced additional key informants who participated and were introduced to other respondents, leading to the usage of snowball sampling. A total of 150 questionnaires were shared with owners/managers of the firm operating in the Shahdara industrial area, situated in Delhi in North India. Shahdara industrial areas are covered under 24 approved industrial areas by the Labour commissioner of Delhi. The time period for the collection of responses was from December 2020 to February 2021. Out of the total questionnaires distributed, 117 responses were considered for the analysis, the response rate being 78%.

Data analysis

The data was recorded, coded, and analyzed using statistical software via SPSS (version 21). The data collected from the questionnaire is analyzed statistically with the help of frequency distribution, percentage analysis, mean scores, the Kruskal-Wallis H test, and the Mann-Whitney U test. The Kruskal-Wallis H and Mann-Whitney U tests were applied, and the assumptions made about the data were verified.

The Kruskal-Wallis H test is a rank-based non-parametric test that may be used to decide if there are statistically substantial variations among two or more groups of an independent variable on a continuous or ordinal dependent variable. It is viewed as a non-parametric substitute for the one-way ANOVA and an extension of the Mann-Whitney U test. The second assumption is that the independent variable must contain two or more categorical, independent groups. The third assumption is that data must be independent of observations. The fourth assumption is that distributions in every group should have the same distribution curve (which also means the same variability). After examining the data, this statistical test was used to generate reliable and legitimate results for analyzing the significant difference in the Fintech Service acceptance based on respondents' age, education, and experience.

The Mann-Whitney U test has similar assumptions to the Kruskal-Wallis H test except for the second assumption. For example, the Mann-Whitney U test is used when an independent variable contains only two categorical, independent groups [39]. Therefore, to analyze the significant difference in the Fintech Service acceptance based on respondents' gender, the Mann-Whitney U test is used.

RESULTS AND DISCUSSION

Analysis of knowledge of MSMEs towards Financial Technology

We obtained information by asking the respondents questions about their understanding of financial technology, what kind of technology behaviour they have for adopting any new technology, and the reasons for adopting Fintech services.

Table 6 reveals the behavior of the respondents while adopting any new technology in business. 37.6% of respondents consider themselves early adopters, which means that the MSME sector is making its way toward technology in their business. 45.3% of respondents are moderate adopters, who reflect the characteristics of the MSME sector and have previously adopted success stories. The remaining respondents are non-adopters who are not willing to adopt new technology in their business.

Table 7 discloses the understanding of financial technology among respondents. It reveals that the maximum respondent has a basic understanding of financial technology (40.2%). 35% of the respondents have a high awareness of financial technology services. Results show that only 12% of respondents have a low understanding, and 6.8% have very low knowledge of financial technology.

Table 5

Source of the questionnaire

CONSTRUCT	ITEM	SOURCE
Knowledge of Financial Technology	3	GPFI*
Perceived ease for Use	4	F.D. Davis [34]
Perceived Usefulness	3	
Trust	4	G. Kim et al. [35]
Satisfaction	3	Ngubelanga et al. [36]
Brand	2	Setiawan [37]
Government Support	2	L.-C. Hiew et al. [38]

Source: author compilation.

Note: GPFI. (2020). Promoting digital and innovative SME financing. World Bank Group. URL: https://www.gpfi.org/sites/gpfi/files/saudi_digitalSME.pdf (accessed on 01.07.2021).

Table 6

Behaviour for Adopting Technology

Types of Adopters	Number	%
Non- Adopter	20	17.1
Moderate Adopter	53	45.3
Early Adopter	44	37.6

Source: author compilation.

Table 8 discloses the key purpose for adopting Fintech services. 49% of respondents consider time savings as one of the important features for the adoption of Fintech services. 40% of respondents consider anywhere access an important reason for the adoption of Fintech services. IT security concerns could be the cause of this [40].

Analysis of MSMEs behaviour towards Financial Technology Acceptance

Statements were considered to measure (using a 5-point Likert scale) the impact of MSMEs preference towards Fintech Services. To record the MSME preference, logical statements are recorded and tabulated using percentage and mean rating evaluation. These statements were formed based on the Technology Acceptance Model [41, 42]. To better fit the present study perspective, some of the statements have been modified. The amplitude of consistency towards statements is denoted from 1 to 5 (five denotes strongly agreeing, while one strongly

Table 7

Understanding of Financial Technology among MSME Sector

Understanding of Financial Technology	Number	%
Very low	8	6.8
Low	14	12
Basic	47	40.2
High	41	35
Very high	7	6

Source: author compilation.

Table 8

Key Purpose for adopting Financial Technology

Motives for Adoption	Number	%
Anywhere access	40	34.2
Quick and easy implementation	21	17.9
Timesaving	49	41.9
Transparency in services	7	6
Total	117	100

Source: author compilation.

Table 9

Percentage of Respondents, Mean Score, Interpretation, and Recommendation

Construct	Items	Statement	1	2	3	4	5	Mean	Recommendations
Perceived Ease for use	PE 1	Using Fintech Services, I can meet my Business needs easily	0	0	5.1	82.1	12.8	4.08	Respondents agreed with the statement, implying that Fintech can bridge the credit gap that MSMEs currently face
	PE 2	It is easy to use Fintech Services	0	0	3.4	78.6	17.9	4.15	Respondents agreed with the statement, demonstrating the MSME sector's willingness to accept new technologies
	PE 3	Using Fintech Services improves the efficiency of Business, as accessing information about different platforms is faster	0	0	3.4	73.5	23.1	4.20	Respondent agreed with the statement which shows that Fintech providers are playing an efficient role in proving services
	PE 4	Fintech Services reduces the time of transaction	0	0	2.6	60.7	36.8	4.34	Respondent agreed with the statement which highlights one of the biggest advantages of Fintech i.e. It saves a lot of time
Perceived Usefulness	PU 1	Fintech Financial Products has Lower Transaction fees	.9	0	5.1	59.8	34.2	4.26	Respondent agreed with the statement which shows that Financial Product available digitally is causing less burden to MSMEs financially
	PU 2	Fintech Financial Products has a faster rate of Approval	0	0	5.1	57.5	37.6	4.32	Respondents agreed with the statement which highlights the efficiency of doing transactions digitally rather than in traditional mode
	PU 3	Fintech Financial Products has less Paperwork	0	0	3.4	69.2	27.4	4.24	Respondent agreed with the statement which highlights the ease of doing business with less paperwork
Trust	TR 1	Though I prefer Fintech services there is a minimum risk involved while making my queries and/or making banking transactions through Fintech Services Providers	3.4	.9	0	77.8	17.9	3.10	Respondents agreed with the statement which shows that MSMEs identify the risk related to digital transactions
	TR 2	I believe using Fintech Services my Business/ Personal information is safe	.9	0	17.1	48.7	33.3	4.14	Respondent agreed with the statement which shows that the MSME sector trust the Fintech sector for their business and personal information
	TR 3	I believe my money is safe in E-wallets/ Mobile apps	0	0	9.4	63.2	27.4	4.18	Respondent agreed with the statement which shows that users are trusting the Financial provider/ companies they are using
	TR 4	In general, I believe, I trust Fintech Services	0	0	8.5	59	32.5	4.24	Respondent agreed with the statement which can be interpreted as an acceptance of doing business Digitally

Table 9 (continued)

Construct	Items	Statement	1	2	3	4	5	Mean	Recommendations
Satisfaction	ST1	Fintech Services platforms provide fair/ reasonable services and products	0	0	6.8	70.9	22.2	4.15	Respondents agreed with the statement as many attractive financial products are offered on different platforms by Fintech Service providers
	ST2	I believe Fintech Services facilitate better decision making	.9	0	7.7	62.4	29.1	4.19	Respondents agreed with the statement as respondents can compare different products across different platforms and facilitate decision-making
	ST3	I get my refunds quickly while doing any transaction through Fintech Service Providers	0	0	4.5	60.7	35.0	4.31	Respondents agreed with the statement as the maximum time for any refund is within 48 hours
Brand	BR 1	I prefer to accept the services provided by familiar brands of Fintech Services platforms	0	0	6.0	54.7	39.3	4.33	Respondent agreed with the statement which shows that only established Financial service Provider products are accepted in the market. It also highlights one of the features of small businesses i.e., trust in previously used products by peers or used by them earlier
	BR 2	I do not use any new app for my banking transaction	.9	0	6.0	57.3	35.9	4.27	Respondent agreed with the statement which shows that customers do not rely on any new service provider. Brand Familiarity plays an important to respondents
Government Support	GS 1	I believe the government has introduced favorable legislation and regulations for Fintech Services in recent years	0	0	9.4	58.1	32.5	4.23	Respondent agreed with the statement which shows that respondents are aware of government initiatives and policies
	GS 2	I believe the government is active in setting new infrastructure such as the infrastructure telecom network, which has a positive role in promoting Fintech Services	0	0	11.1	53.8	35.0	4.24	Respondent agreed with the statement which shows that the Government is also inclined toward Financial Technology development

Source: author compilation.

disagrees). In addition, the following criteria are used for the analysis:

- A mean score of 1.00 to 1.80 indicates strong disagreement.
- A mean score of 1.80 to 2.60 indicates disagreement.
- The mean score between 2.60 and 3.40 means neutrality.
- The mean score between 3.40 and 4.20 means "agree".
- A mean score of 4.20 to 5.00 indicates that the authors strongly agree [43, 44].

Table 10

Demographic Profile of Respondents

Characteristics	Value	Frequency	Percentage (%)
Gender	Female	25	21.4
	Male	92	78.6
Age	20–30 Years	5	4.3
	31–40 Years	43	36.8
	41–50 Years	43	36.8
	51–60 Years	15	12.8
	61 or More	11	9.4
Education level	No Formal Education	14	12
	Senior secondary Graduate	43	36.8
	Vocational Diploma	16	13.6
	Postgraduate	41	35
	Ph.D.	3	2.6
Experience	Less than 3 years	8	6.8
	3–6 Years	13	11.1
	6–9 Years	34	29.1
	9–12 Years	34	29.1
	12 or More	28	23.9

Source: author compilation.

Analysing the impact of Fintech service acceptance based on different demographic variables

Acceptance of Fintech services (a dependent variable) is measured by using 20 statements in *Table 9*. Each statement is tested for a significant value of 0.05 and 0.10. Also, the Kruskal-Wallis H test was conducted to analyze the impact of age, education, experience, and gender on the respondents (independent variables). The demographic profile of respondents is discussed in *Table 10*. It has also been used to test the hypotheses formulated. As in the paper, we have questioned Likert statements that are ordinal in nature, so the most appropriate test when the dependent variable is rank-based, that is, ordinal in nature, is the Kruskal-Wallis H test. The significance value is either higher or lower than 0.05 and 0.10, which is used to accept or reject the hypothesis.

As shown in *Table 10*, the demographics of the respondents are comprised of gender, age, education, and experience in current business. Of the total respondents, 78.6% were men and 21.4% were women. The majority of the respondents were in the age groups of 31–40 years and 41–50 years (36.8% each). The majority of the respondents held education up to senior secondary (36.8%), 13.6% of the respondents held vocational diplomas, 35% were post-graduates, 12% of the respondents did not hold any formal education, and the remaining were Ph. Ds. After the computation of the 20 statements related to Fintech service acceptance, these statements were then combined, and a scale score was formed to accept or reject the null hypothesis. The results of the Kruskal-Wallis H test are given in *Table 11* and *Table 12*. The following hypotheses were formed to find out the significant differences in the acceptance of Fintech services.

Table 11

Kruskal-Wallis H Test

Items	Age		Education		Experience	
	Chi-Square	Sig.	Chi-Square	Sig.	Chi-Square	Sig.
PE 1	15.620	004	8.524	074	30.023	000
PE 2	19.208	001	10.393	034	22.523	000
PE 3	14.447	006	4.733	316	20.839	000
PE 4	16.599	002	12.154	016	18.083	001
PU 1	11.542	021	9.906	042	10.868	028
PU 2	8.505	075	8.436	077	9.539	049
PU 3	6.6166	187	10.596	031	9.866	.043
TR 1	10.212	037	3.188	527	8.815	066
TR 2	11.402	022	3.870	424	19.379	001
TR 3	8.615	071	9.687	046	11.866	018
TR 4	15.401	004	7.433	115	10.504	033
ST1	8.427	077	6.646	156	10.707	030
ST2	15.067	005	9.147	058	16.495	002
ST3	8.352	080	10.698	030	6.695	153
BR 1	9.837	043	10.290	036	16.631	002
BR 2	12.418	015	5.677	225	19.347	001
GS 1	14.788	005	3.641	457	9.209	056
GS 2	11.502	021	3.605	462	11.486	022

Source: author compilation.

Ha1: There is a significant difference in the acceptance of the Fintech Service based on respondents' age.

Ha2: There is a significant difference in the Fintech Service acceptance based on respondents' educational qualifications.

Ha3: There is a significant difference in the acceptance of the Fintech Service based on respondents' experience in the business.

Ha4: There is a significant difference in the acceptance of the Fintech Service based on respondents' gender.

Kruskal-Wallis H test and Mann-Witney U test have been used to find significant differences in the Fintech Service acceptance based on different demographic factors (*Table 13*) and (*Table 14*).

The significance value of either higher or lower than 0.05 and 0.10 is used either to accept or reject the alternate hypothesis. Based on Age, we reject the alternative hypothesis (Ha1) as the significance level (0.140) is more than 0.10, which means that there is no significant difference in the Fintech Service acceptance based on respondents' Age. Based on Educational qualification, we reject the alternate hypothesis (Ha2) as the significance level (.215) is more than 0.05 and 0.10 both, which means that there is no significant difference in the Fintech Service acceptance based on respondents' educational qualification. Based on Experience in Business, we accept the alternative hypothesis (Ha3) as the significance value (0.008) is less than 0.05, which means that there is a significant difference in the Fintech Service acceptance based on respondents' occupations. Based on Gender, we reject the alternative hypothesis (Ha4) as the significance level (0.340) is more than a10.05 and 0.10 both and Z

(0.955) is more than 1.96, which means that there is no significant difference in the Fintech Service acceptance based on respondents' gender.

FINDINGS

"Digitization has a strong impact on the financial services industry" [45]. After analyzing the data and putting the hypotheses to the test, the study's main conclusions are as follows: The majority of those classified as early adopters were actually young, between 31 and 40 years old, with a percentage of 19.65%. There was extensive acceptance of technology among the MSME sector as most respondents were considered moderate adopters, which is 52.13%. The results (*Table 6*), (*Table 7*) and (*Table 8*) show that MSMEs have knowledge about Fintech services. The MSME sector adopts financial technology for several reasons, but the most prominent reasons are saving time (41.9%), accessing the interface anywhere (34.2%), and because of quick and easy implementation (17.9%). The results are similar to a prior study, which explains that Fintech products were created from the bottom up with the consumer in mind, who were tech-savvy and wanted transactions to be as simple as possible [46]. Also, 40.2% of the MSMEs understand financial technology, and 35% have a high understanding of financial technology, which yields a great opportunity for Fintech developers and innovators.

Fintech has the ability to completely revolutionize the financial environment by offering a wide range of financial goods at low prices [46]. This can be seen from our study also, as 70.9% of respondents believe that Fintech platforms provide fair and reasonable services and products, 59.8% of respondents believe that Fintech services have lower transaction fees, and 73.5% of respondents agree that Fintech platforms provide efficiency in decision making as information about different products can be collected at a much faster rate. Fintech also makes it more likely for SMEs to borrow at reduced interest rates. which assists the MSME in meeting their business requirements [47, 48]. Fintech services are provided with an easy interface that can be used by using their mobile applications, as MSMEs are typically run by a few people wearing many hats [49] and they do not have much time to devote to one thing. Furthermore, these technologies enable

Table 12

Mann-Whitney U Test

Items	Gender	
	Z	Sig.
PE 1	.075	.940
PE 2	.770	.442
PE 3	.156	.876
PE 4	1.365	.172
PU 1	.474	.636
PU 2	1.324	.185
PU 3	1.260	.208
TR 1	1.769	.077
TR 2	.246	.805
TR 3	.644	.520
TR 4	.416	.678
ST1	.820	.412
ST2	.890	.374
ST3	1.475	.140
BR 1	.480	.632
BR 2	.764	.445
GS 1	.345	.730
GS 2	.074	.941

Source: author compilation.

borrowers to receive funds more rapidly by speeding up loan applications [7, 50] Among these advantages, there is a significant risk involved in fintech transactions, which is agreed upon by 77.8% of respondents. Thus, the result is similar to previous literature where consumer risk had the most negative effect on the Fintech continuation intention, while convenience had the strongest positive effect. As a result, the government must monitor and analyze the quick and transformative changes brought on by Fintech so that regulators and society can keep up with the underlying technological and entrepreneurial flux.[9] Brand familiarity and good experience also impact the behavioral intention of

[9] Reserve Bank of India. Annual Report 2020–2021. 2021. URL: https://rbi.org.in/Scripts/AnnualReportMainDisplay.aspx (accessed on 10.02.2022).

Table 13

Kruskal-Wallis H Test Statistic

Dependent variable: Fintech service acceptance	Independent variables		
	Age	Education	Experience
Chi-Square	6.926	5.791	13.777
Degree of Freedom	4	4	4
Significant Value	.140	.215	.008

Source: author compilation.

Table 14

Mann-Witney U test

Dependent variable: Fintech service acceptance	Independent variable
	Gender
Z	.955
Degree Of Freedom	1
Significant Value	.340

Source: author compilation.

consumers to adopt the product/service [51]. The results also show that brand familiarity also plays an important role for the respondents while adopting Fintech services. It can be concluded that with the help of the TAM Model, we can understand the behavior of MSMEs towards financial technology acceptance as perceived ease of use, perceived usefulness, trust, and government support impact the decisions of MSMEs as Fintech customers.

To find out how Fintech services are accepted among the MSME sector varies according to different demographic variables, the Kruskal-Wallis H test was performed, and we observe that MSME preferences with respect to Fintech services have significant differences on the basis of experience, but no significant differences are found on the basis of age, educational qualification, or gender, which is in contrast with the findings of the study by Demirguc-Kunt et al. (2018) [52], as the study observed differences in the acceptance of the usage of Fintech services-based on the gender of the owner/managers. The results of this research also have partial similarities with the previous studies which confirmed the significance of personal features of MSME owners and managers in their business decisions [53, 54]. There was no significant difference found in the acceptance of Fintech services based on the age of the owner/manager, which is the opposite of the previous studies, which say that motivations for using financial technology among the younger age group owners are greater as compared to older ones.

CONCLUSION AND IMPLICATION

Conclusion

The advent of the Fintech industry has made banking simple and straightforward[10] which has changed the ecosystem of the MSME sector. Overall, Fintech has brought some key changes in the MSME sector as well as the Indian banking ecosystem, such as improved opportunities for financial inclusion, motivation in entrepreneurship culture, credit assessment with the help of technology, improved customer experience in loan approval and disbursement, quick and easy funds transfer, etc. Thus, Fintech could be the solution for the MSME sector's different financing activities.

Practical and Managerial Implications

Our research has significant managerial and practical consequences. First, small businesses are looking for alternate financing solutions apart from traditional banks and financial institutions therefore, fintech companies should seize the opportunity by building trustworthy products/services. Fintech companies should consider brand building as a crucial point in their marketing campaigns. Second, small businesses are also showing interest in other digital services of fintech as digital investments, wealthtech, and insurtech hence, fintech companies should work on their robo-advisory and portfolio management tools and make them more user-friendly. Third, our findings complement the government's attempts to develop policies aimed at expanding Fintech services. For example, the Digital India Movement, Centralised KYC, the Stand-up India movement, and Payment Systems Vision 2019–2021. These policies have resulted in a significant improvement in digital transactions. The

[10] J. Skan, J. Dickerson, L. Gagliardi. Fintech and the evolving landscape: landing points for the industry. 2016. URL: https://www. Accenture. com/t20160427T053810__w__/us-en/_acnmedia/PDF-15/Accenture-Fintech-Evolving-Landscape.Pdf (accessed on 15.07.2021).

government can introduce some policies through which profile-based or personalized fintech services can be made available to the MSME sector. Fourth, awareness programs must be conducted by the government at regular intervals to increase the awareness of MSMEs. Lastly, there is a need for a strong financial transaction grievance redressal system that is governed by the government to encourage more small businesses to incorporate Fintech into their businesses.

LIMITATION OF THE STUDY AND SCOPE FOR FURTHER RESEARCH

Certain limitations applied to this research can be incorporated in future studies. The study used a sample of 117 respondents; therefore, the sample size should be expanded, or a new type and size of sample should be used to reinforce the results for a better representation of MSME sector preferences. Second, the study offers a broad perspective on financial technology and the preferences of small and medium-sized businesses. Further discussion of financial technology acceptability and its impact on MSME performance has been omitted, paving the path for future research. Thirdly, variables identified through the TAM model can be tested using more advanced statistical tools like regression analysis. Lastly, there are a lot more variables to be studied that impact the financial behaviour of the MSME sector, but this paper only discusses demographic variables, so other variables related to firm characteristics like the number of employees, export activity, and industry can also be incorporated.

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Methodological Aspects of Valuation of Credit Institutions under External Uncertainty

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ABSTRACT

The article is devoted to the research of the issues of commercial bank business valuation under the conditions of uncertainty. The study **aims** to develop a model for forecasting the value of total assets and loan portfolio of a commercial bank within the framework of value estimation under external uncertainty. The **relevance** of the paper is that in the context of the COVID-19 pandemic, military actions and sanctions pressure it is difficult to justify the market value of credit institutions due to the difficulties in implementing the methodology of assessment of banks whose business is associated with increased risks. The scientific **novelty** of the study lies in the development of a regression model that allows forecasting the value of total assets and the loan portfolio of a commercial bank as key value factors under external uncertainty. The authors used the following **methods** of scientific research: deduction, induction, correlation and regression analysis, and logical method. The key factors of business valuation of Russian banks are systematized. The authors propose to build a model within the framework of the income approach, based on the forecast of external cost factors: total assets and loan portfolio of the banking sector. A leading indicator that affects total assets and loan portfolio is justified. A model has been developed which makes it possible to forecast the total assets and loan portfolios of the banking sector and find the required value of the assets of the bank being evaluated through the market share. The model is tested on the example of the valuation of Sber. The authors **conclude** that the model developed by the authors makes it possible to build scenarios for future cash flows and quantify the valuation interval of a commercial bank. The prospect of further research is related to evaluating the influence of internal financial and non-financial factors in the context of the valuation management system. The article will be useful to practicing appraisers in business valuation and investors.

Keywords: valuation methods; external uncertainty; value factors; banking; forecasting model; banking sector assets

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INTRODUCTION

The situation of external uncertainty in an emerging economy has recently arisen more often. In the context of the COVID-19 pandemic and sanctions pressure, it is not easy to justify the market value of a commercial bank, as the appraiser has difficulty implementing the valuation methodology. They are caused by as follows:

1. High degree of information obsolescence. Events can move quickly, leading to significant volatility in many indicators.
2. Lack of reliable information and accurate forecasts for making informed decisions about the prospects for the business model of the property being evaluated.
3. Reflexive processes in the market that do not allow a sober assessment of the prospects of its individual segments.
4. The complexity of assessing business risks, taking into account the imposed sanctions, which obliges the appraiser to understand in detail their classification and the degree of impact on the business model.

"The high uncertainty of external factors in the recommendations of the expert council means a situation where, for objective reasons beyond the control of the appraiser, the value cannot be determined 'with a reasonable degree of certainty' (Article 393 of the Civil Code of the Russian Federation[1]). At the same time, the reasons are external in relation to the object of valuation and its market (political, military, macroeconomic, epidemiological/pandemic, etc.). The appraiser, within the framework of modern achievements in science and technology (methodology), and the rules of economic activity, cannot reliably take into account the nature and intensity of the influence of these causes on the cost of the valuation."[2]

Particularly relevant and debatable in the evaluation is the type of value being determined. Stock market indicators in extreme conditions and during panic moods are subject to high volatility and can reach extremely low values. For example, the MOEX index fell by 33% from February 22 to February 24, 2022, to the level of 2058 points (*Fig. 1*). As a result, trading on the stock exchange was stopped. Another example is the price of depository receipts for Sberbank shares on the London Stock Exchange, which fell to $ 0.05.[3]

At the same time, the applicability of exchange value (market value also belongs to this category) under external uncertainty is significantly limited. From the point of view of Art. 3 of the Federal Law "On Appraisal Activities",[4] the market value is understood as the most probable price at which the object of the valuation can be alienated on the open market in a competitive environment, when the parties to the transaction act reasonably, having all the necessary information, and the value of the transaction price is not affected by any or emergency circumstances.

Thus, the presence of extraordinary circumstances in certain territories at certain periods of time casts doubt on the very existence of market value. However, it is possible to determine other types of value outside the market that are not directly specified in the Federal Valuation Standard No. 2,[5] which requires a separate study.

The banking business is an important element of the market economy and plays a key role in capital redistribution, risk transformation, and economic growth. However, due to the specifics of the business

[1] Civil Code of the Russian Federation. Part 1. Dated 30.11.1994 51-FZ. Ed. as of 25.02.2022.

[2] Methodological explanations for determining the value under high uncertainty of external factors MP-1/22 dated 01.03.2022. URL: https://srosovet.ru/activities/Metod/MR 1–22/? (accessed on 21.03.2022).

[3] Information resource. URL: https://ru.tradingview.com/symbols/LSIN-SBER/ (accessed on 21.03.2022).

[4] Federal Law No. 135-FZ dated July 29, 1998 "On Valuation Activities in the Russian Federation" (as amended, entered into force on March 18, 2020).

[5] Order of the Ministry of Economic Development of Russia dated July 20, 2007 No. 255 "On Approval of the Federal Valuation Standard. Valuation Purpose and Cost Types (FSO No. 2)".

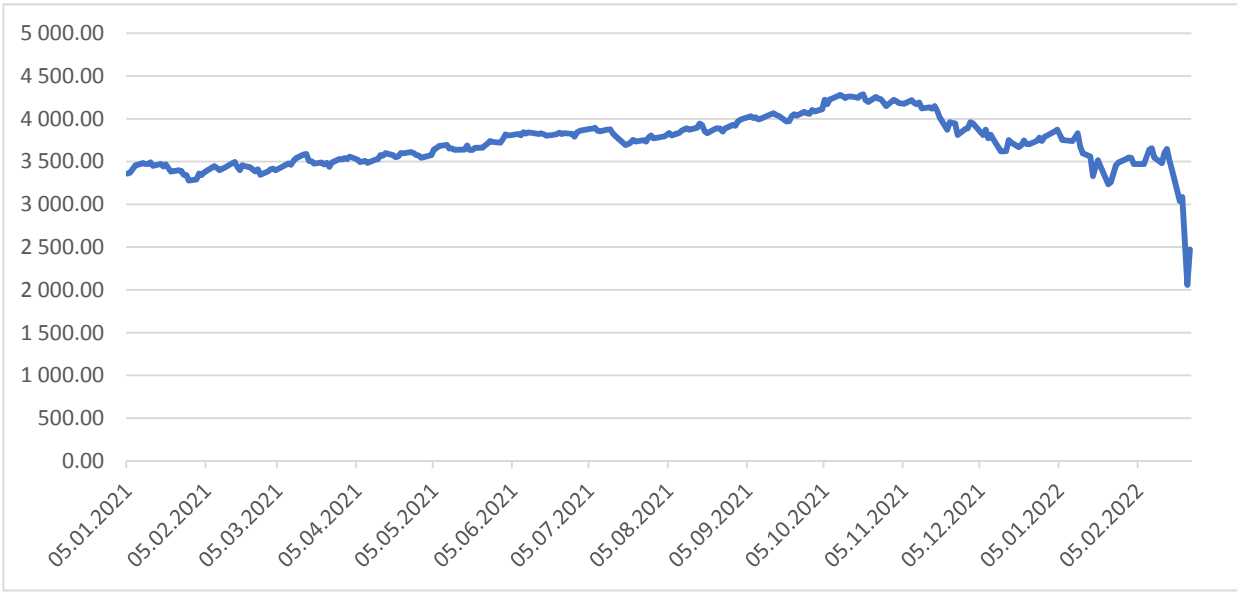

Fig. 1. **Dynamics of the Moscow Exchange Index (MOEX)**

Source: compiled by the authors according to cbonds.ru.

model, it is subject to significant risks, which, in conditions of high volatility, is reflected in financial results. Reflexive processes in the stock market directly affect their financial results. Thus, when evaluating this type of business, a detailed study and quantitative assessment of the main cost factors are required.

The **aim** of this study is to develop a model for forecasting the value of total assets and the loan portfolio of a commercial bank as part of a valuation under conditions of external uncertainty. To achieve this aim, the following tasks were set:

1. Determine the type of value and approach to valuation that is applicable in the face of external uncertainty.
2. To study and classify the external and internal factors of the value of a credit institution.
3. Identify leading indicators that will allow forecasting the total assets and loan portfolio of the banking sector.
4. Develop a forecasting model for the total assets and loan portfolio of the banking sector.
5. To test the developed model on the example of the valuation of PJSC "Sberbank".

METHODS

A. Damadaran [1], T. Copeland, T. Koller and others [2], J. Dermine [3], N. Antill [4], and Sh. Pratt [5] study the specifics of credit institutions and the applicability of the valuation methodology. Features of credit institutions as objects of assessment and their legal regulation are considered in the studies of V.M. Rutgaizer [6], A.E. Buditskii [7], I.V. Kosorukova, and M.A. Fedotova [8].

I.A. Nikonova and R.N. Shamgunov [9] consider approaches to developing a strategy for creating and increasing the market value of commercial banks and establishes the impact of investment projects and intangible assets on the value of a bank.

S. Yu. Bogatyrev and S.S. Dobrynin [10] develop the topic of assessing and managing the value of a bank under international economic sanctions using the residual income method according to the Edwards-Bell-Ohlson model. However, the successful application of the model requires up-to-date forecasts of the macroeconomic, financial, and banking sectors.

A.L. Rozhkovsky [11] substantiates the advantages of the commercial bank valuation model based on economic profit and gives

recommendations for adjusting profit and capital. The author systematizes financial and non-financial factors but does not pay due attention to external factors.

A. V. Tukhvatulina [12] considers the main factors that affect the competitiveness and cost of a commercial bank, without considering external factors.

Based on the sources on the research topic, it can be concluded that there is an insufficient study of the issues of the influence of external factors on the value of the bank, and the specifics of valuation under external uncertainty.

Among the features of credit institutions as objects of assessment, the following should be noted:

- complexity of a real assessment of the quality of assets and liabilities;
- high concentration of risks;
- availability of intangible assets;
- regulatory restrictions (requirements to comply with standards set by the regulator);
- the complexity of calculating **reinvestment** (a significant part of investments is made using borrowed funds, which makes it necessary to evaluate assets taking into account the amount of liabilities and vice versa);
- the main source of self-financing is profit, the role of depreciation is small;
- for credit and financial institutions, capital should be considered only in terms of **own funds**.

Among the approaches and methods of evaluation are cost, comparative and profitable methids. The applicability of these methods for estimating the value of a commercial bank under external uncertainty is discussed in *Table 1*.

The current version of the Federal Valuation Standards provides for four main types of value: market, investment, liquidation and cadastral.[6] As have been noted, the market value is not applicable by the appraiser under extraordinary circumstances and increased uncertainty. The liquidation value is a derivative of the market value, taking into account the factor of the forced sale of the asset. The investment value is more suitable for the purposes of valuation in emergency circumstances, as it is determined for a specific person for investment purposes and does not involve the alienation of the object on the open market. If there are no investment goals and the task is to assess the growth potential of the business value as part of the implementation of the business value management concept, then it is more logical to use this type of value as a fundamental one.

The fundamental value of a business is based on the present value of future earnings, "includes an assessment of the company's performance and development prospects, and is an aggregate indicator that can adequately reflect the company's potential ability to satisfy the interests of key stakeholders" [13].

Fundamental value is more suitable for management decisions within cost management, there is no obligation to conduct an assessment and there is no need to contact an independent appraiser. If an independent appraisal is required under the Valuation Law, it is recommended to use the investment value.

Taking into account the features of approaches and methods, the discounted cash flow method is most suitable for evaluating a commercial bank in order to determine the fundamental and investment value. The method is based on forecasting the bank's cash flows, risk assessment and subsequent discounting of the flows in order to determine the current value. It is also worth noting that this method is the only one acceptable for assessing growing banks or under conditions of uncertainty [7], as it allows assessing business prospects, taking into account sanctions restrictions and risks affecting the business model.

[6] Order of the Ministry of Economic Development of the Russian Federation of 20.07.2007 No. 255 "On Approval of the Federal Valuation Standard Purpose of Valuation and Types of Value (FVO No. 2)".

Table 1

Applicability of methods for estimating the value of a commercial bank in conditions of external uncertainty

Methods	Possibility of applying methods in bank valuation	Applicability under external uncertainty
1. Net assets method	Applicable for valuation of unprofitable banking business, does not take into account the profitability of the business	Applicable, allows you to estimate the cost of equity, taking into account the market value of assets and liabilities
2. Liquidation value method	Implemented to evaluate the bank in the liquidation of the banking business, does not take into account the profitability of the business	Applicable when it is impossible to fulfill one's obligations to counterparties
3. Deal method 4. Capital market method	Used when there is an active market and a sufficient number of comparables	Not applicable due to high volatility in the markets: in the event of a panic, the value of shares in open trading may decrease by up to 50%
5. Discounted cash flow method	Applicable for banks with unstable growth rate	Applicable for assessing business prospects under external uncertainty
6. Dividend discount method	Applicable for banks with unstable growth rates	Not applicable, as the payment of dividends during a crisis period can be significantly reduced or completely canceled
7. Direct capitalization method	Applicable for large, stable banks from the TOP 20 or for a credit institution with stable growth rates	Not applicable as there is no confidence in stable future growth rates
8. Gordon growth model	For the Gordon growth model, the condition of constant growth rate (g) is necessary, the discount rate (r) must be greater than g	Applicable to calculate the cost in the post-forecast period of time within the framework of the discounted cash flow method
9. EBO model (E.O. Edwards, P.W. Bell, J.A. Ohlson)	Applicable to the valuation of a bank with adjustments. The model combines income and cost approaches to valuation. The advantage of the method is the possibility of forecasting not an absolute indicator of profit, but a relative indicator of the profitability of the company's advanced capital. Disadvantage — discrepancies in the valuation of the bank's net assets	Partially applicable, as up-to-date forecasts of macroeconomic indicators of the banking sector are needed

Source: developed by the authors.

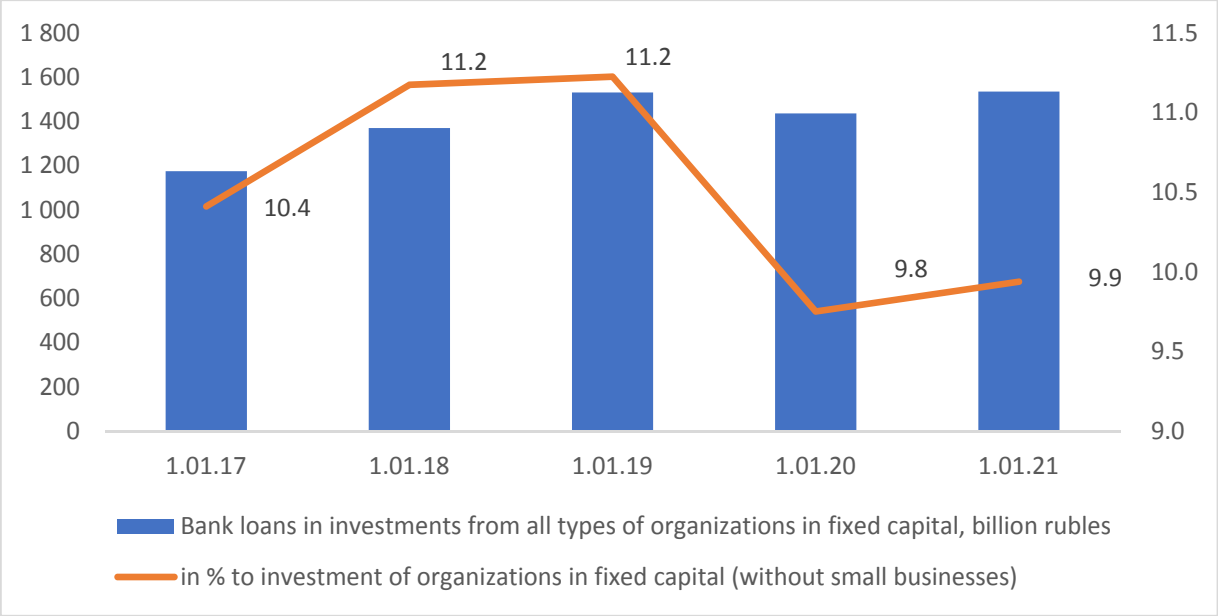

Fig. 2. **Bank loans in investments of organizations of all forms of ownership in fixed assets (excluding SMEs), billion rubles**

Source:compiled by the author according to the Central Bank*.

* Statistical indicators of the banking sector No. 233. March 2022. URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fcbr.ru%2FCollection%2FCollection%2FFile%2F39835%2Fobs_233.xlsx&wdOrigin=BROWSELINK (accessed on 21.03.2022).

In a study by Ken-Yien Leong [14], devoted to the valuation of bank shares in developed countries, it is noted that the best result in valuation is given by a comparative approach (capital market method, P/E multiplier). However, the capital market method is not applicable in an environment of high stock price volatility. The excellent predictive power of the discounted cash flow method (FCFE) was also noted).

In order to justify the business prospects of a commercial bank, it is necessary to identify financial and non-financial factors that have a significant impact on cash flows. This is especially true of external factors, since they are the most difficult to forecast for the formation of forecasts of future activity.

Correlation-regression analysis tools are used to assess and model the influence of external factors, which makes it possible to statistically substantiate this influence.

RESULTS AND DISCUSSION

The country's financial sector retained the significant potential for further growth in the medium term, as the level of financial intermediation remains relatively low. Many companies continue to invest primarily through retained earnings rather than bank lending (*Fig. 2*).

Banks dominate the financial system, while non-bank financial institutions remain underdeveloped but are gradually gaining importance. It is also worth noting that the country's banking sector is significantly consolidated, with 9 banks accounting for 75.37% of total assets (*Table 2*).

The lack of institutional investors is holding back the development of private sector investment and equity markets. According to the Central Bank of the Russian Federation, in 2020 the market share of banks in terms of assets amounted to 82%, the rest was almost equally distributed between insurance, pension funds, mutual funds, and individual investments through brokerage companies.[7]

Russian banks have been hit by the 2020 pandemic, but not as badly as in many other

[7] Industry report Financial services Russia 1 quarter 2022, Economist Intelligence Unit. URL: https://www.emis.com/ (accessed on 24.03.2022).

Table 2

Total assets and shares of credit institutions

No.	Bank	Type of business model	Volume of assets as of 01.02.2022, thousand rubles	Share of total banking sector assets, %
1	Sber	Universal	38,368,756,022	31.48
2	VTB	Universal	19,500,995,348	16.00
3	Gazprombank	Universal	8,705,774,216	7.14
4	National Clearing Center	Non-bank credit institution	6,354,963,312	5.21
5	Alfa Bank	Universal	6,003,928,854	4.93
6	Russian Agricultural Bank	Industrial	4,099,242,428	3.36
7	Credit Bank of Moscow	Universal	3,604,988,677	2.96
8	Bank Otkritie	Universal	3,293,166,258	2.70
9	Sovcombank	Universal	1,936,403,488	1.59

Source: calculated by the authors according to kuap.ru*.

* Information resource of banking analytics. URL: https://kuap.ru/banks/ranks/ (accessed on 23.03.2022).

countries. According to the IMF, industry profits fell by 5.8% to 1.6 trillion rubles ($ 21.7 billion). Net interest income increased by 8.4% to 3.2 trillion rubles, while non-interest income increased by 11.2% to 2.9 trillion rubles. Operating expenses grew moderately, by 4.4%, to 2.4 trillion rubles. The main reason for the decrease in profits was provisioned for possible losses on loans, which increased by 39.7% to 1.8 trillion rubles.[8]

The aggravation of the geopolitical situation and the imposition of US and European sanctions threaten the planned positive growth rates. According to Frank's media[9] estimates, the country's GDP in 2022 may fall to 10%, unemployment to rise to 12%, and the banking sector will need additional capitalization by 5–6 trillion rubles. According to the Central Bank's,[10] consistent forecast, GDP will fall to 8%, inflation may accelerate to 20%. Discrepancies in expert forecasts are common, especially when the uncertainty is very high.

The deterioration of macroeconomic indicators against the background of the aggravation of the geopolitical situation will lead to a significant decline in the banking industry. However, in order to understand the order of numbers based on the results of the correction, it is necessary to classify external and internal factors that affect cash flows and, thus, form the fundamental value of a commercial bank.

[8] Industry report Financial services Russia 1 quarter 2022, Economist Intelligence Unit. URL: https://www.emis.com/ (accessed on 24.03.2022).

[9] Announcement. URL: https://www.kommersant.ru/doc/5240055 (accessed on 24.03.2022).

[10] Central Bank of the Russian Federation. URL: https://cbr.ru/statistics/ddkp/mo_br/ (accessed on 24.03.2022).

Table 3

Fundamental value factors of a commercial bank

External	Internal	
	Financial	**Non-financial**
Regulatory requirements for minimum capital adequacy, liquidity ratios, etc.	Total assets (including loan portfolio)	Client capital [20]
Level of competition	Effective interest rates on interest bearing assets and liabilities	Human Capital [20]
Changing customer preferences	Operating expenses	Intellectual property
Pandemic restrictions	Cost of risk by loan products / lending segments	Management concepts
Sanction restrictions	Write-off rates for the loan portfolio by loan products / lending segments	Level of digital maturity (information systems)
Key rate	Integral risk level	Systemic significance
MOSPRIME 3M, 6M	Loan portfolio quality	Corporate culture
GDP growth rate	Business model type	Management processes
Ruble inflation, wage growth index		Network Relations
Rate of exchange		Financial connections
Yield of bonds of Russian issuers		
US Treasury yield		
US dollar inflation		
The volume of total assets, loans and deposits in the banking sector		

Source: developed by the authors.

The study of O. N. Salmanova [15] explores the relationship of multipliers (P/E, P/BV) with the fundamental indicators of commercial banks (the growth rate of profit and risk in the form of a coefficient). However, this is not enough to understand the growth drivers. In separate works, cost factors of intracorporate management are considered — remuneration of the board of directors[11] [16], brand [17], diversification

[11] In this case, the share price is used as a regressor. It is important to note that the share price is not the market value, but the basis for determining the market capitalization of the company.

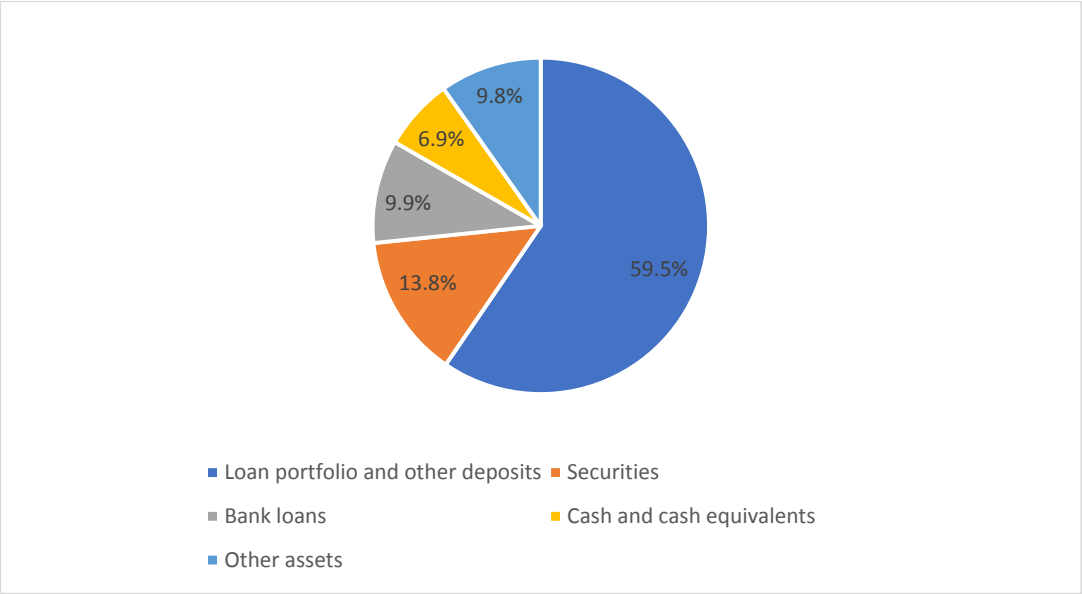

Fig. 3. **Structure of assets of credit institutions grouped by areas of investment, % (as of February 1, 2022)**

Source: calculated by the authors according to the Central Bank*.

* Statistical indicators of the banking sector No. 233. March 2022. URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fcbr.ru%2FCollection%2FCollection%2FFile%2F39835%2Fobs_233.xlsx&wdOrigin=BROWSELINK (accessed on 21.03.2022).

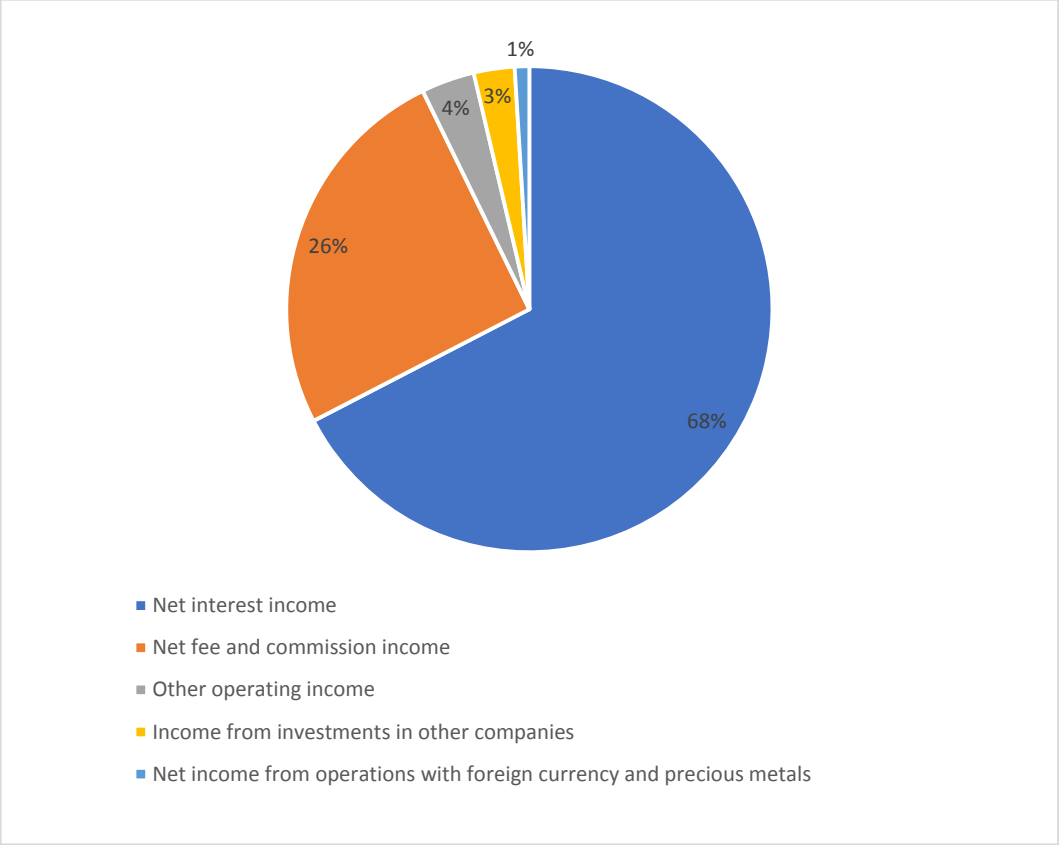

Fig. 4. **Income structure of operating credit institutions (% of total income for 2021)**

Source: calculated by the authors according to the Central Bank.

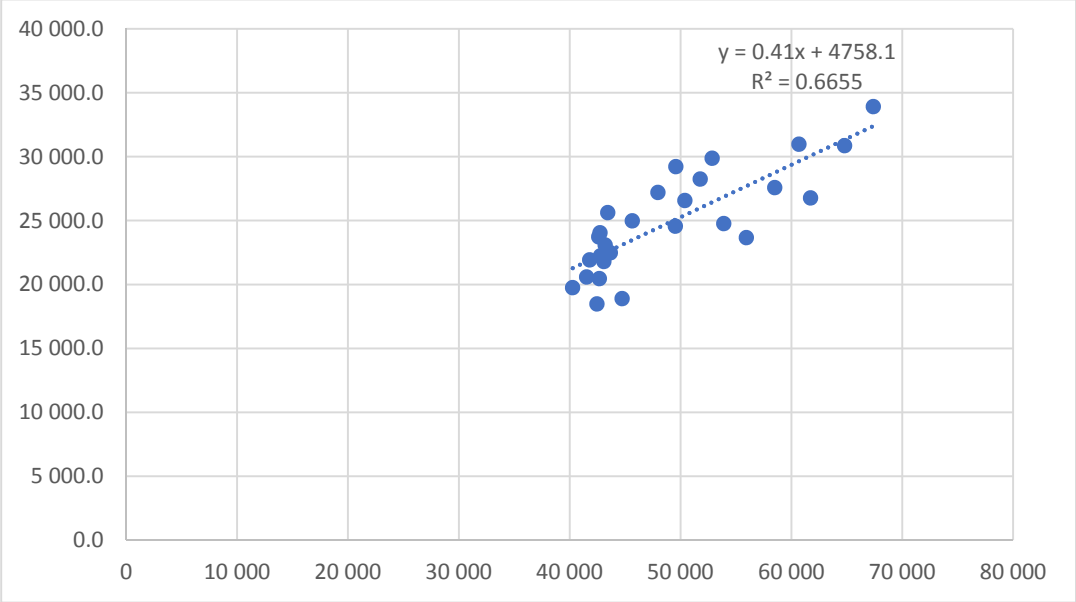

Fig. 5. **Graph of the dependence of the loan portfolio (billion rubles, abscissa axis) and GDP, (billion rubles, ordinate axis)**

Source: calculated by the authors.

of the loan portfolio [18], and quality of the loan portfolio [19].

All key factors of the bank's value can be classified as follows (*Table 3*).

The main source of income for a commercial bank is interest income from performing assets, which are represented by a loan portfolio (69.4%), debt investment securities available-for-sale and held-to-maturity (13.8%), and other assets, if they generate interest income (*Fig. 3*). Another source is non-interest income, which is represented by commissions, transactions with securities, foreign exchange, and precious metals.

Accordingly, the structure of income of credit institutions is dominated by interest income at 68% (share of net interest income in 2021), fee and commission income received from credit and other services is 26%, and other income accounts for only 7% (other operating income, investment income to other companies, net income from operations with foreign currency and precious metals) (*Fig. 4*).

Thus, the operating cash flow (income and expenses) of the bank depends on the *balance sheet.*

In this regard, in order to calculate the free cash flow of a bank, it is first necessary to predict its balance sheet.

In assets, balance sheet items are divided into two categories: items that are forecast as **a percentage of total assets,** и статьи, *and items that are* ***forecast based on other indicators.***

First, items that are not based on total assets are calculated:

a) cash and cash equivalents (projected as a share of customers' current accounts):

cash and cash equivalents = current accounts of the bank's customers × share of cash and cash equivalents in current accounts of customers;

b) required reserves in the Central Bank — are forecasted as a share of total liabilities, except for funds of the Central Bank, subordinated loans, and other liabilities. Typically, this proportion is projected to be constant at the historical level:

required reserves in the Central Bank =
= [total liabilities — (funds of the Central Bank +
+ subordinated loan + other liabilities)] ×
× share of required reserves in the corresponding liabilities;

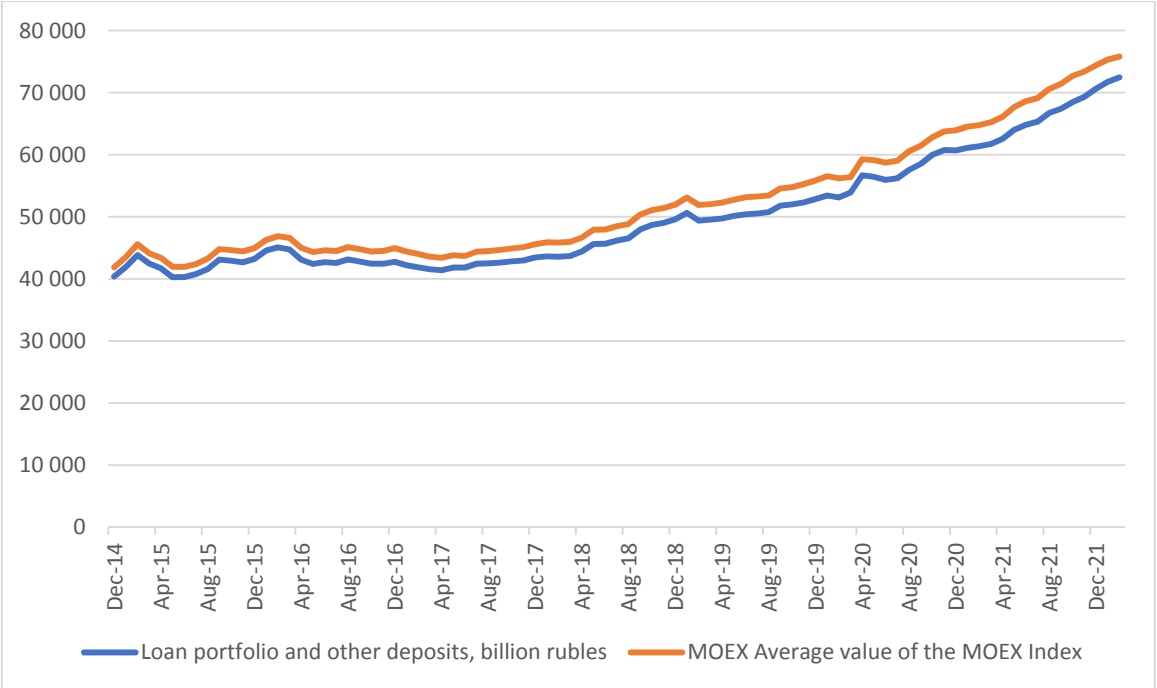

Fig. 6. **Dynamics of the loan portfolio of the banking sector (billion rubles) and the average value of the Moscow Exchange Index (basis points) for the comparable period**

Source: calculated by the authors.

c) loan portfolio:

loan portfolio = loan portfolio before impairment – allowance for loan impairment.

The value of the loan portfolio before impairment allowance can be predicted as a share of the volume of loans in the banking sector (market share), then the formula will look as follows:

loan portfolio before allowance for impairment of the loan portfolio = volume of the loan market × market share of the bank.

Corresponding shares are calculated separately for loans to legal entities and individuals or for smaller lending segments if management reporting and the bank's budget/strategy require such a breakdown. As a rule, the bank's market share is predicted based on its strategy or taken equal to the budget value / historical share.

In the absence of a loan market forecast, the loan portfolio before provisions is determined taking into account the growth rate of nominal GDP. Functionally, the volumes of the loan portfolio of the banking sector and GDP moderately correlate with each other, which is confirmed by the multiple correlation coefficient of 66% (*Fig. 5*). However, GDP is a consequence of investment activity and the result of active participation in this process of the banking sector.

The loan portfolio of the banking sector depends on the level of investment activity and the state of the economy as a whole. With a significant slowdown in economic growth and a decrease in investment activity, the assets of the banking sector are subject to correction.

Technically, it is difficult to use the expected GDP growth rates for the purposes of forecasting the loan portfolio, since, under external uncertainty, forecasts are often late and differ significantly from each other.

As indicators that may indicate a decrease in investment activity and problems in the economy, it is possible to use the Moscow

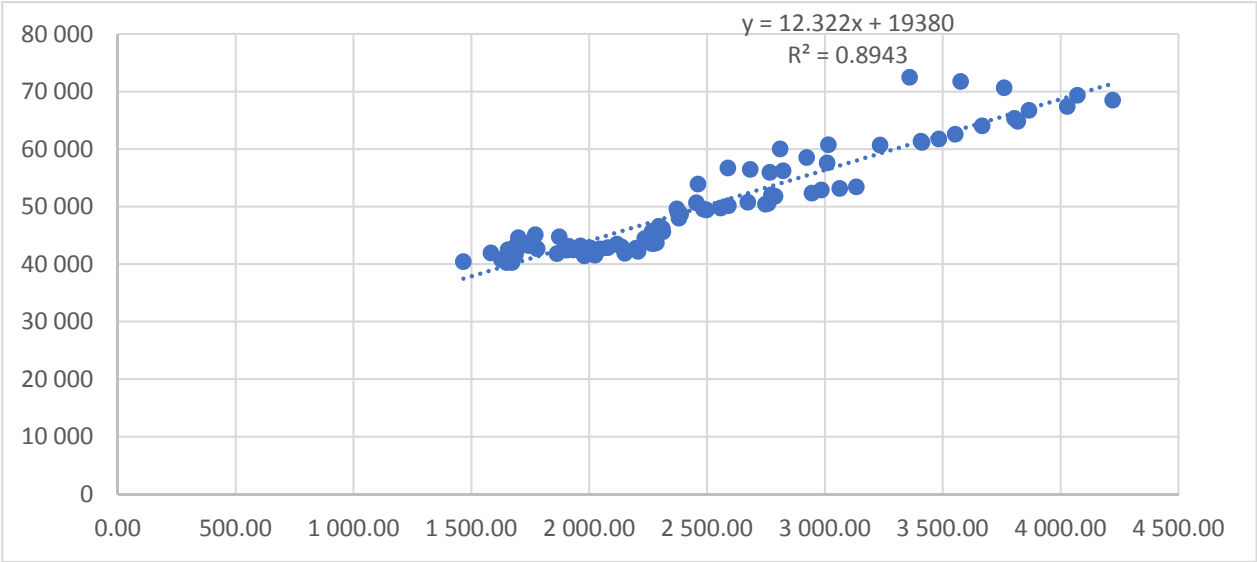

Fig. 7. **Relationship between the loan portfolio of the banking sector (ordinate axis) and the Moscow Exchange Index (abscissa axis)**

Source: calculated by the authors.

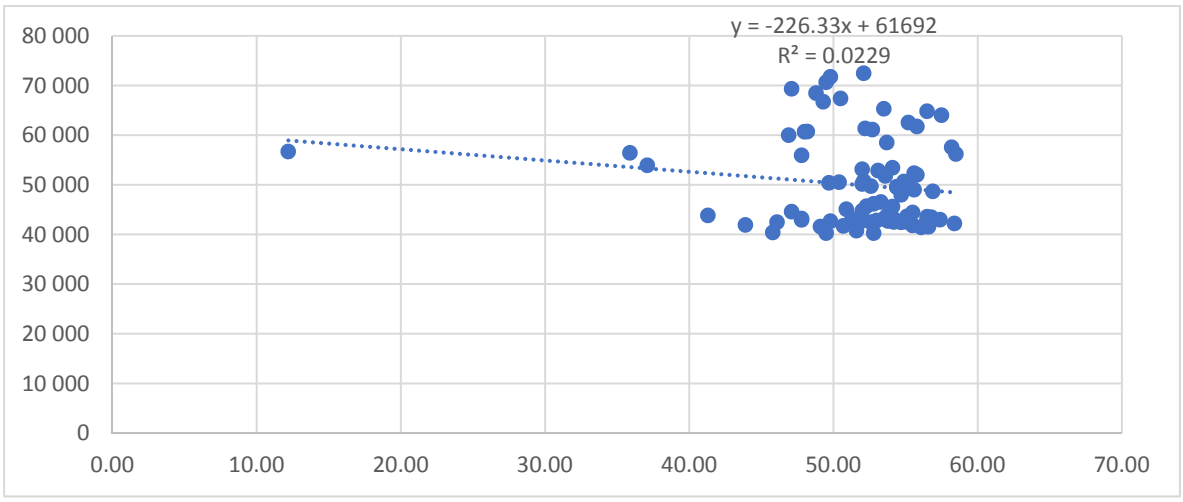

Fig. 8. **Relationship between the loan portfolio of the banking sector (ordinate axis) and the PMI index (abscissa axis)**

Source: calculated by the authors.

Exchange index and PMI[12] in the services sector. PMI is formed based on the results of a survey of purchasing managers and reflects the idea of the further movement of key macroeconomic indicators. The index can take a value from 0 to 100. Values above 50 mean an increase in business activity compared to the previous month, and less means a recession.

The relationship between total assets and the bank loan portfolio with the Moscow Exchange index is logical since the loan portfolios and shares of the largest banks are also concentrated in the largest public companies that are part of the index.

To confirm the hypothesis about the relationship between the indicators, we collected

[12] Announcement. Purchasing Managers Index. URL: https://quote.rbc.ru/news/training/5b155fc59a79473b856de349 (accessed on 21.03.2022).

Table 4

Conclusion of the results of the regression analysis of the influence of the Moscow Exchange Index on the loan portfolio of the banking sector

Indicator	Coefficients	Standard error	t-statistics	P-value
Y-intersection	19380.18	1183.209042	16.37933446	5.00333E-28
*X*1 (MOEX Index)	12.32195	0.459510104	26.81540982	3.05513E-43
Regression statistics				
Multiple *R*	0.945668			
R-square	0.894287			
Normalized *R*-square	0.893044			
Standard error	2939.064			
Observations	87			

Source: calculated by the authors.

data on the loan portfolio of the banking sector,[13] monthly averages of the Moscow Exchange index[14] and PMI in the service sector for the period from 2014. *Fig. 6* shows the dynamics of the Moscow Exchange index and the volume of the loan portfolio of the country's banking sector.

The coefficient of determination between the Moscow Exchange Index and the volume of the loan portfolio is 89%, which indicates a close relationship between these indicators (*Fig. 7*).

The loan portfolio has no connection with the PMI indicator (determination coefficient 2.29%) (*Fig. 8*).

To describe the statistical significance of the Moscow Exchange Index, we will use the "Data Analysis" — "Regression" toolkit in the MS Office package (*Table 4*).

Schematically, the banking sector loan portfolio forecasting model can be represented as formula (1):

$$Y = 19380.18 + 12.32195 \times X, \quad (1)$$

where Y — the projected value of the banking sector's loan portfolio, billion rubles; X — the average value of the Moscow Exchange Index for the period, basis points.

The reliability of the model is confirmed by the high *R*-squared value (determination coefficient) — 0.89. The *P*-value of the factor is not higher than 0.15, the *t*-statistic is higher than 2.

Similarly, the total assets of the banking sector are significantly interconnected with the Moscow Exchange Index (*Fig. 9*).

To describe the statistical significance of the Moscow Exchange Index with total assets, we will use the "Data Analysis" — "Regression" toolkit in the MS Office package (*Table 5*).

Schematically, the forecasting model for the total assets of the banking sector can be represented as formula (2):

$$Y = 36128.15657 + 19.85289058 \times X, \quad (2)$$

where Y — the forecast value of the total assets of the banking sector, billion rubles; X — the

[13] Overview of the banking sector of the Russian Federation. Statistical indicators. Central Bank of the Russian Federation. 2022. No. 233. URL: https://cbr.ru/statistics/bank_sector/review/ (accessed on 21.03.2022).

[14] Information and analytical system Cbonds. URL: www.cbonds.ru (accessed on 21.03.2022).

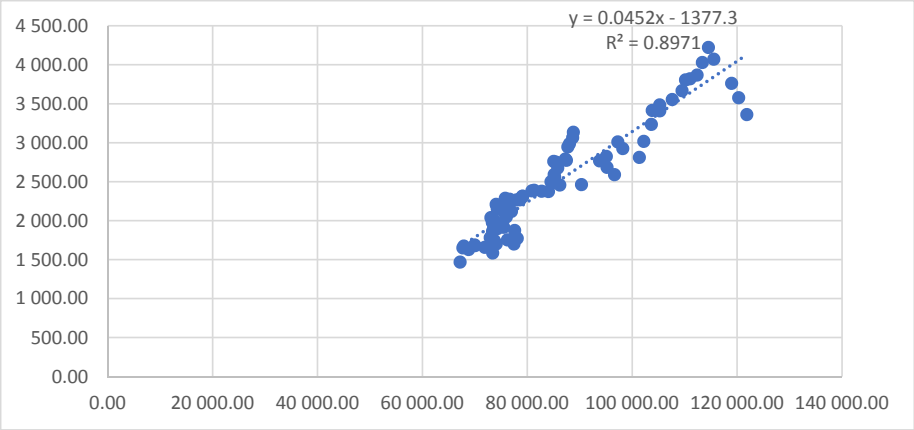

Fig. 9. **Relationship between the total assets of the banking sector (ordinate axis) and the Moscow Exchange Index (abscissa axis)**

Source: calculated by the authors.

Table 5

Conclusion of the results of the regression analysis of the influence of the Moscow Exchange Index on the total assets of the banking sector

Indicator	Coefficients	Standard error	t-statistics	P-value
Y-intersection	36128.15657	1877.614077	19.24152413	1.01142E-32
*X*1 (MOEX Index)	19.85289058	0.72918868	27.22599944	9.59202E-44
Regression statistics				
Multiple *R*	0.947167459			
R-square	0.897126195			
Normalized *R*-square	0.895915915			
Standard error	4663.950346			
Observations	87			

Source: calculated by the authors.

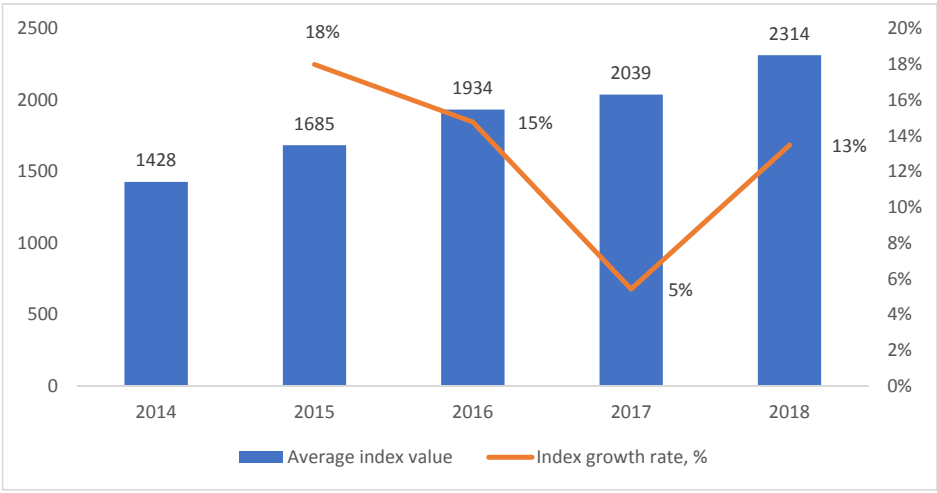

Fig. 10. **Ретроспективные средние значения индекса Московской биржи / Retrospective average values of the Moscow Exchange Index**

Source: calculated by the authors.

Table 6

Forecast values of total assets and loan portfolio of the banking sector

Forecast of banking sector assets	2022	2023	2024	2025	2026
Model prediction					
Total assets of the banking sector, billion rubles	64,478	69,580	74,524	76,608	82,068
Banking sector loans, billion rubles	36,976	40,143	43,211	44,505	47,893
Probable scenario for the value of the MOEX Index	1428	1685	1934	2039	2314
Forecast by share of expected GDP					
Total assets of the banking sector, billion rubles	83,040	83,853	84,622	85,214	86,113
Banking sector loans, billion rubles	51,944	52,710	53,669	54,679	56,083
GDP, growth rate forecast, according to the Central Bank, %	–8.00	1.00	1.50	1.00	1.00
GDP forecast in absolute terms, billion rubles	98,012	98,992	100,477	101,482	102,497
Share of total assets of the banking sector in GDP,%	84.72	84.71	84.22	83.97	84.01
Share of banking sector loans in GDP, %	53.00	53.25	53.41	53.88	54.72

Source: calculated by the authors.

average value of the Moscow Exchange Index for the period, basis points.

Based on the results of the regression analysis, two models were obtained that make it possible to build an operational forecast of the total assets of the banking sector and lending volumes in the country based on the average value of the Moscow Exchange Index for the analyzed period.

The forecast is probabilistic in nature and many other factors are not taken into account. In a situation where the exchange has been closed for a long time, even such a leading indicator will not work at one point in time. However, when trading resumes, the level of asset prices and the prospects for further action will be determined.

In the situation of suspension of trading, as a basic assumption, the authors hypothesized

Table 7

Valuation of Sber using the DCF method (scenario based on the developed model)

Indicator	Calculation algorithm and data source	Forecast of indicators by years					
		2021 (fact)	2022	2023	2024	2025	2026
Balance figures							
Total assets of the banking sector, billion rubles	Model prediction		64,478	69,580	74,524	76,608	82,068
Banking sector loans, billion rubles	Model prediction		36,976	40,143	43,211	44,505	47,893
Share of PJSC Sberbank in total assets of the banking sector,%	Mean value since 2014	36	35	36	36	35	36
Share of PJSC Sberbank in credit assets, %	Mean value since 2014	40	43	43	43	43	42
Gross Loans, million rubles	Forecast of banking sector loans * share in loan assets	28,517,500	16,037,439	17,273,843	18,427,492	18,922,852	20,168,165
Share of loan portfolio provisions, % of loans, as of the date	Mean value since 2014	4.99	6.20	6.40	6.46	6.41	6.32
Allowance for possible losses on loans, million rubles	Gross Loans * Share of loan portfolio provisions, % of loans	–1,422,000	–994,478	–1,105,106	–1,190,634	–1,212,038	–1,275,611
Net loans, million rubles	Gross Loans – Allowance for Possible Loan Losses	27,095,500	15,042,960	16,168,737	17,236,858	17,710,814	18,892,553
Total assets, million rubles	**Total assets of the country's banking sector, million rubles × Share of Sberbank in total assets, %**	**41,165,500**	**22,808,259**	**24,749,694**	**26,552,687**	**27,105,825**	**29,223,952**
Deposits, million rubles	Bank loan portfolio / L/D ratio	28,312,400	15,730,499	17,319,773	18,538,616	19,060,438	20,349,706
LDR (Loans to Deposits Ratio, ratio of loans and deposits), %	Mean value since 2014	101	102	100	99	99	99
Total liabilities, million rubles	**Deposits + additional liabilities**	**35,521,000**	**18,867,608**	**20,979,459**	**22,960,046**	**23,714,830**	**25,972,430**
Equity capital, million rubles	**Fixed capital + retained earnings**	**5,645,000**	**3,940,651**	**3,770,236**	**3,592,640**	**3,390,994**	**3,251,521**
Liabilities and equity, million rubles	**Total Liabilities + Equity**	**41,166,000**	**22,808,259**	**24,749,694**	**26,552,686**	**27,105,824**	**29,223,951**
Performance results							
Net margin, (net interest income / loan assets), million rubles	Mean value since 2014	6.32%	6.36%	6.47%	6.66%	6.58%	6.49%
Net interest income, million rubles	Interest income margin, % × Average value of the loan portfolio for the two previous periods		1,417,498	1,078,281	1,189,455	1,229,499	1,269,290
Allowance for possible losses on loans, % loans for the period, million rubles	Allowance for possible losses on loans from P&L statement / Mean value of gross loans	125,271	397,250	319,085	214,929	218,316	226,897
Net interest income after the accrual of provisions, million rubles		1,676,729	1,020,249	759,196	974,526	1,011,183	1,042,393
Non-interest income, million rubles	Commissions and other income (% of the average loan portfolio in the retrospective period)	725,310	609,629	630,145	644,444	625,269	651,271
Revenue, million rubles		**2,527,310**	**2,027,127**	**1,708,426**	**1,833,899**	**1,854,768**	**1,920,561**
Non-interest expenses, million rubles	Retrospective average of the ratio of non-interest expenses to revenue before provisions for possible losses × Net interest income t + 1 + non-interest income t + 1		914,275	770,534	827,125	836,537	866,211
Write-off of assets, million rubles	% mean value in hindsight		–10,863	–8,457	–8,183	–7,597	–8,863
EBT (earnings before taxes), million rubles			**1,101,990**	**929,435**	**998,591**	**1,010,634**	**1,045,487**
Accrued tax, million rubles		288,590	230,831	194,687	209,173	211,695	218,996
Net income, million rubles		**1,089,141**	**871,158**	**734,748**	**789,419**	**798,939**	**826,491**
Calculation of cash flow equity							
Depreciation, million rubles	Fixed assets t – 1 × Depreciation rate	–	107,808	113,333	126,363	138,631	148,393
Capital expenditures, million rubles	% of revenue	–	–16, 693	–139,646	–146,660	–146,436	–152,742

Table 7 (continued)

Indicator	Calculation algorithm and data source	Forecast of indicators by years					
		2021 (fact)	2022	2023	2024	2025	2026
Sources (+), million rubles	[Total liabilities t] – [Total liabilities *t* – 1]	–	–1,130,164	2,111,851	1,980,587	754,784	2,257,600
Use (–), million rubles	[Net Loans t] – [Net Loans] *t* – 1	–	–12,052,540	1,125,777	1,068,120	473,957	1,181,739
Cash Flow Equity, million rubles		–	–3,259,351	1,694,510	1,681,589	1,071,961	1,898,003
Discount rate (*r*), %	W. Sharpe model [21]: *CAPM* (*r*) = *Rf* + β × *MRP* + *SCRP*	22.46					
Market return (*Rm*), %	Median annual return of the MOEX Index since 2013	15.87					
Risk-free rate of return (*Rf*), %	Median value of the MOSPRIME 3M rate since 2013[1]	8.31					
Market premium (*MRP*), %	(*Rm* – *Rf*)	7.56					
Systematic risk (β), fractions of a unit	$\beta = \frac{Cov(r_i, r_m)}{Var(r_m)}$ where *Cov*(r_i, *rm*) – the covariance of the return of the i-th asset ri (Sberbank shares since 2010) and the average market return rm (MOEX Index since 2010) *Var*(*rm*) – variation of the average market return rm	1.21					
Premium for the risk of external sanctions restrictions, %	We propose to apply a risk premium in the range of 0 to 5%, since no peace agreements have been reached and the risks of restrictions on the financial sector are high	5					
Discount factor	1 / (1 + *r*) ^ *n*		0.80	0.65	0.52	0.42	0.34
Current value of cash flow equity, million rubles	549939		–2661589	1129962	915692	476671	689202
Terminal value calculation (Gordon Growth Model)							
Terminal value (TV), million rubles	[EBT × (1 + g)] / K	3936627					
Capitalization rate (K), %	*r* – *g*	21.46					
Long-term income growth rate (g), %	Forecast of the Central Bank of the Russian Federation[2]	1					
Current value of the terminal value, million rubles	TC × discount factor of the last forecast period	1429467					
Calculation of the cost of equity							
Cost of equity, million rubles	Present value of cash flow equity + current value of terminal value	1979405					
Number of outstanding ordinary shares, million psc		21.5					
Fundamental value of 1 share, rub.		**92**					
Current price of 1 share on the market, rub. (as of 24.02.2022)		**130**					

Source: calculated by the authors.

[1] Information and analytical system Cbonds. URL: www.cbonds.ru (accessed on 21.03.2022).

[2] Central Bank of the Russian Federation. URL: https://cbr.ru/statistics/ddkp/mo_br/ (accessed on 20.03.2022).

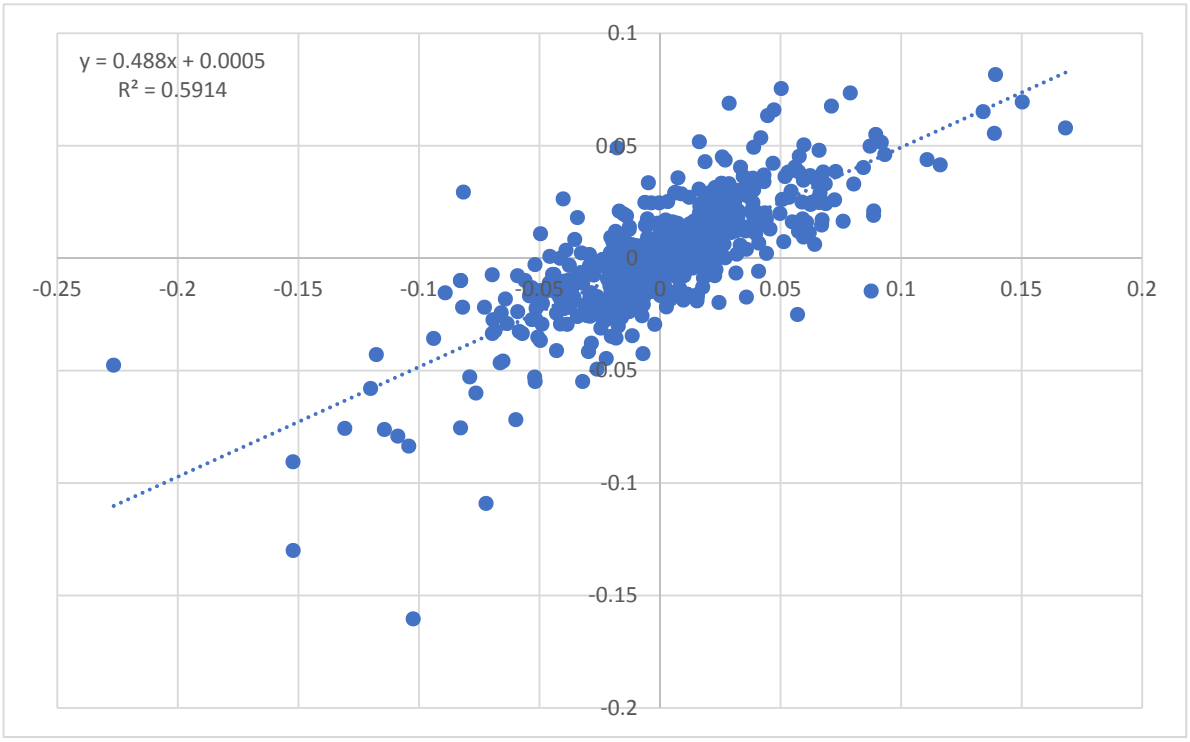

Fig. 11. **Scatter chart of the profitability of shares of Sberbank and the MOEX index (data from 2010 to 2020)**

Source: calculated by the authors.

that the Moscow Exchange Index could fall to the level of the 2014 crisis. Then the country faced sanctions for the first time. In 2014, the Moscow Exchange Index fell to 1428 points (*Fig. 10*). A slow recovery followed, with an average growth rate of 13% over six years.

If we project the current situation and the values of the index, then the forecast values of the total assets of the banking sector and the loan portfolio are expected to be as follows (*Table 6*).

Accordingly, if the Moscow Exchange Index for March falls to 1428, then the loan portfolio is expected to correct by 49%. Out of 72,460 billion rubles (February 2022) to 36,976 billion rubles with a confidence interval of +/– 5,761 billion rubles.

Under external uncertainty, the developed models give a more pessimistic forecast compared to the standard approach (shares of projected GDP), which will allow us to evaluate the total assets and loan portfolio of the banking sector and find the required value of the bank's assets are estimated through the bank's market share.

Let us test the developed model on the example of the assessment of Sberbank. The results of the calculation of the discounted cash flow (DCF) model are presented in *Table 7*.

The following assumptions were used in the calculations:

6) maintaining the position of the bank in the market of the banking system at a level not lower than the average values since 2014;

7) when calculating interest income, the average interest margin since 2014 was used, since the external assessment does not provide enough data to correctly justify interest rates for all segments of the portfolio;

8) the possible growth of problem debt in the portfolio is not taken into account, based on the fact that multiple increases in overdue debt can be avoided due to timely restructuring (according to the experience of the crisis years of 2014 and 2020);

9) cash flow equity;

10) the terminal value is calculated according to the Gordon growth model.

The measure of systematic risk (beta coefficient) was calculated based on the

statistics of the Sberbank share price and the Moscow Exchange Index since 2010 (*Fig. 11*).

Based on the results of calculating the value of Sberbank and the scenario of the developed model (*Table 6*), we can conclude that the fundamental value of Sberbank is 1,979,405 million rubles (92 rubles per share as of March 23, 2020, in the absence of trading, which does not allow tracking the current dynamics of the Moscow Exchange Index). In accordance with the scenario of expected GDP growth rates (agreed on the forecast of the Central Bank of the Russian Federation, the cost calculation is not given in the article), the fundamental value of Sberbank is 2,808,765 million rubles (131 rubles per share).

Practical approbation of the model for forecasting the total assets and loan portfolio of the banking sector based on the indicator — the Moscow Exchange Index allows us to conclude that this approach is suitable. However, in the conditions of the suspension of trading on the stock exchange, the model may give an error in forecasts, since it is based on the assumption about the dynamics of the index in past crisis periods. After the resumption of trading, the value of the stock index will be determined, which will make it possible to refine the forecast, adjust scenarios, and cost intervals and make the right investment decision. However, it is important to consider that the stock market will be regulated after the opening of trading and technically may even show growth in the short term. In this regard, it is important to use the average values of the index.

CONCLUSIONS

The valuation methodology is sufficiently developed and has a universal character. However, not all methods are applicable for evaluating credit institutions under external uncertainty, when there are difficulties in making forecasts. A significant problem for forecasting is external industry factors that affect the value of the bank.

The proposed method for forecasting the total assets of the banking sector and the loan portfolio will quickly justify a motivated judgment about the value range of the bank being evaluated. Models can reduce the labor costs of an external appraiser or investor when developing a financial model and generating scenarios when implementing the discounted cash flow method under external uncertainty.

The number of external factors is much larger and it is not always possible to assess their impact by linear regression. Customer behavior, new sanctions, and regulatory restrictions cannot be predicted. The modern Russian economy has never experienced such a shock before. Under such conditions, only a scenario approach will allow one to form a confidence interval and assess the margin of safety of the business model of a credit institution.

Separate attention deserves internal financial and non-financial factors, the impact of which must be studied separately since the considered approach to valuation does not allow building a system for managing the value of a commercial bank. These aspects will be considered in future studies.

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The Study of Spatial Heterogeneity and Interregional Relations in the Processes of Attracting Banking Capital to the Russian Economy

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ABSTRACT

Increased spatial heterogeneity in recent years in the processes of attracting banking capital to the Russian economy negatively affects the pace of socio-economic development of regions. The purpose of the research is to assess the dynamics of changes in spatial heterogeneity in the processes of attracting banking capital in the Russian economy and to model the system of interregional relationships in these processes. Scientific novelty of research is the development of a methodological approach involving the systematic use of methods such as: spatial autocorrelation analysis according to the methodology of P. Moran and L. Anselin, regression analysis using panel data, testing cause-and-effect relationships using the Granger method, formation of a matrix of functional dependencies between regional systems. The developed methodological approach allowed to confirm the trend of increasing spatial heterogeneity in the processes of attraction of banking capital in the Russian economy, to identify regional centers with a high level of concentration and formation a matrix of interregional relationships. It is shown that almost all Russian banking capital is now concentrated in Moscow, St. Petersburg and the Kostroma region. The inflow of bank capital into the economy of these regions leads to its outflow from regions with inverse relationships (negative index of spatial autocorrelation). The results of the research can be used by the executive authorities of the federal and regional levels to find mechanisms to attract banking capital in the economy of regions. One such mechanism could be a reduction in the key rate of the Bank of Russia and State support for regional banks that use low interest rates for lending to households and enterprises in the real sector of the economy.

Keywords: banking capital; panel regression analysis; spatial autocorrelation analysis; Granger test; modeling of interregional relationships; regional systems

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INTRODUCTION

The banking sector plays a key role in the development of economies of various levels of regional systems. It provides the real sector with financial resources for the implementation of investment projects aimed at the modernization and technological upgrading of production processes, the introduction of techno-technological, organizational and social innovation to diversify production and increase the competitiveness of products. In addition, banks and credit institutions perform another important function — provide settlement and cash services for enterprises, ensure the security of their financial resources. On the key role of the banking sector in providing credit resources to enterprises of the real sector of economy wrote S. Yu. Glazev [1], A. G. Aganbegyan [2], O. V. Motovilov [3], M. Yu. Alieva [4], V. I. Vagizova [5] and other researchers.

The banking sector forms the financial basis for the development of territorial systems at various levels, attracting investment in infrastructure projects, implemented strategic projects and socio-economic development programmes, investment in debt securities (state institutions, regions of the Russian Federation, municipalities), crediting their internal state debt. The capital attracted by banks contributes to the improvement of the budgetary security of the territories, and therefore — the solution of the acute socio-economic problems of their development.

R. W. Goldsmith [6], M. Pagano [7], P. J. Montiel [8], P. O. Demetriades and K. H. Hussein [9], S. Daly et al. [10], G. Uddin et al. [11] noted significant impact of investments and loans attracted by banks on the economic growth of territorial systems in own work.

Consider that banking sector at the center of the Territory's financial system, E. N. Ryabinina and A. F. Savderova gave the banking sector "a key role in ensuring the balanced development of the economy in the implementation of the strategy of socio-economic development" [12]. The authors wrote that "sustainable socio-economic development of regions is impossible without an adequate amount of financial resources and it is credit organizations that accumulate and mobilize money capital, turning them into a major source of funds for the economic entities". Y. V. Zhariy and Y. V. Krasnianska noted the "important role of banks in the implementation of strategies of socio-economic development of territorial systems, in particular their credit resources" [13].

However, the vast majority of researchers, while emphasizing the importance of banks in the socio-economic development of territorial systems, noted that "existing problems and limitations (lack of a strong resource base of Russian banks, high competition from international financial organizations, the problem of capitalization of the banking sector) are prevent the attraction of bank investments in the Russian economy at present" [14]. In particular, E. M. Magomadov argued that "underdeveloped banking network in the regions continues to prevent the expansion of investment activities. Successful financing of measures to promote the investment image of regions and create the necessary institutional and organizational conditions for large-scale investment is impossible without sustainable and competitive regional banks" [15].

According to V. V. Sofronova, "restructuring of the banking system of the regions, accompanied by a reduction in the number of credit organizations, a decrease in the capacity of the banking system of the regions, leads to the fact that banks do not provide enough of the region's economy with credit resources" [16], "resources of regional banks and their foreign affiliates are not enough not only for the development of regional economies, but also to maintain the established demand of organizations for short-term credit resources, the existing institutional structure of the banking sector

does not create financial stability and stability of the region's economy" [16].

S.D. Ageeva and A.V. Mishura noted in their research that "the displacement of regional banks by the federal makes it difficult to survival of the regional banking sector, which is the driver of regional development" [17]. O.L. Bezgacheva wrote that "Russian banking sector is unevenly developed, and the weaker the banking sector in the region, the weaker its economy" [18].

Spatial disparities in the development of the banking system were noted by V. V. Maslennikov and S. V. Maslennikov. They argued that "disparity in the territorial development of the banking sector reduces the opportunities of small banks, as well as competition in this sector" [19]. "Development of regional banking systems can ensure sustainable economic growth", noted by D.N. Chugurov and T.V. Schastnaya [20].

We see today that spatial heterogeneity (diversity) in the processes of attracting bank capital to the Russian economy, associated with the significant concentration of banks and other credit institutions in the central regions and their gradual liquidation in the other regions, reduces the availability of bank credit for the real, productive sector of the economy, households located in remote territorial systems from the center. As a result of the reduction of the network of regional banks in these regions, there are tendencies of decline in the volume of attracted bank investments in debt securities of regions of the Russian Federation, the volume of loans allocated to them, and this has a negative impact on the budget availability of remote from center of regions. In the context of the need to actively attract investment in the economy, the research of the heterogeneity of placement and use of bank capital, as well as its solution, become the most topical.

Based on the importance and relevance of this problem, the main purpose of the paper was to research the spatial heterogeneity of the attraction of bank capital in the Russian economy and modelling interregional relationships in the processes of its relocation. To achieve it, given the following tasks:

- theoretical analysis of methodical approaches to research of heterogeneity of processes of attraction of bank capital to the economy;
- formation of a systematic methodical approach to research of spatial heterogeneity of processes of attraction of bank capital in the Russian economy and modeling of interregional relationships in these processes;
- study of spatial features of formation and use of bank capital by institutional sectors and assessment of influence of factors on these processes by regression modelling;
- spatial autocorrelation analysis by the method of P. Moran and L. Anselin to establish regional centers of active attraction of bank capital, spatial clusters with a high level of its concentration, their influence zones and interregional relationships in these processes;
- study of cause-and-effect relationships between regions in the processes of attracting bank capital to the economy using the Granger test and their confirmation by means of regression modelling.

The solution of these tasks allowed to confirm the trend of increasing spatial heterogeneity in the processes of attracting bank capital into the Russian economy, to identify regional centers with a high level of concentration and form a matrix of interregional relationships. This matrix will allow in the future to form forecast scenarios of attraction of bank capital in the economy of regions and to determine the mechanisms of smoothing spatial heterogeneity.

THEORETICAL AND METHODOLOGICAL ISSUES OF RESEARCH

In the scientific literature there are several approaches to assessing the attraction of banking capital in the economy. A theoretical review of the papers showed that in order to research the spatial heterogeneity of the

attraction of banking capital in the region's economy usually use methods of regression analysis: geographically weighted regression, method of least squares on spatial data, spatial regression modeling using panel data; spatial autocorrelation methods, simulation modeling, etc. The most common method for the research of processes of attraction of bank capital to the economy of regions is regression analysis of data. It was used in the works by E. Demid [21], A.R. Nizamani et al. [22], Z. Kovtun [23]. Based on method of least squares and method of moments (generalized method of moments, GMM) was used in the works of Bashir U. et al. [24], H-u. Rahman et al. [25].

In research by S.D. Ageeva and A.V. Mishura, a two-step method of least squares was used to estimate the regional distribution of banking institutions for 2000–2013, while GDP and GRP per capita, population of the region, economic structure of the region, political weight of the region, linguistic and cultural characteristics, quality of higher education in the region, climate and geography were considered as factors [17]. This method allows to estimate the relationship between variables, but the significant disadvantage of regression data analysis is impossibility to determine the spatial features of the studied indicator.

Rajan and Zingales' approach was used by O.G. Vasilyeva, and J.A. Kovshun As a dependent variable, researchers applied the index of production for manufacturing industries, and as explanatory variables — the level of development of the financial sector of the region and the industry's dependence on external financing [26]. This approach is based on regression analysis of data and is comparable to the least squares method.

J.K. Ashton's research uses analysis of variance (ANOVA) and panel regression analysis to assess differences in interest rates on attracting banking services to regions [27]. The main limitation of this method is impossibilitydetermine the spatial features of the studied indicator.

K.K. Valiullin and S.L. Merzlyakova considered the features and trends of the spatial development of the banking sector in the Russian Federation [28]. To estimate the heterogeneous structure of the banking sector, the authors used the Herfindahl-Hirschmann index (HHI), and to assess the spatial aspects — the method of analysis. The Herfindahl-Hirschman index allows to determine the degree of concentration of the studied indicator, the main limitation of this method is the impossibility to determine interterritorial interactions between regions [28].

The nature and scale of regional financial disparities in Turkey was assessed by A.O. Birkan and S.K. Akdogu [29] using spatial econometrics techniques, namely: calculation of local Moran indices and geographically weighted regression. The use of these tools allowed them to identify "hot and cold points" attracting of bank loans in the regions in Turkey. Limitation of this methodical approach is heterogeneity of the obtained results depending on the type of used matrices of spatial weights.

In the research by M. Yu. Malkina [30] that using of the Herfindahl-Hirschman index, the index of interregional concentration of assets and liabilities of bank profit, and the coefficient of variation and the Gini coefficient was used to calculate the uneven provision of credit institutions to the population of the regions. This approach allows to calculate the concentration of bank assets and interregional uniformity of provision of regions with banking services, but does not allow to estimate spatial interactions between regions in the processes of attracting bank capital.

A promising method for assessing the spatial heterogeneity of attracting bank capital into the region's economy is agent-based modelling. The models formed by this method allow high accuracy imitate behavior of different agents (banks) in a certain territory, for example at the level of the region or the country as a whole. In particular, this

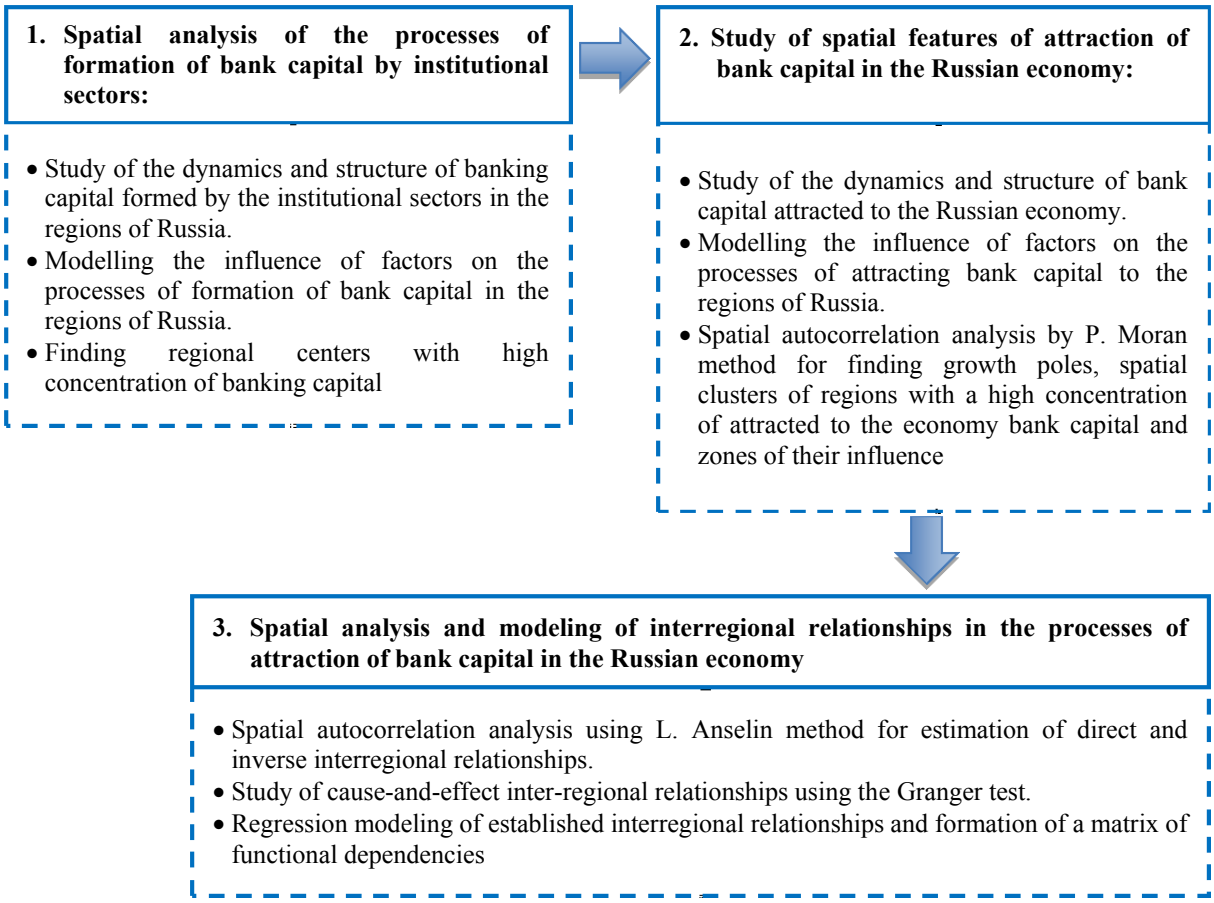

Fig. 1. **Algorithm of spatial heterogeneity research in the processes of attracting banking capital in the Russian economy**

Source: compiled by the authors.

approach was used to model European [31] and Russian banking systems [32].

Thus, the methods currently used do not allow assessment of interregional relationships, spatial features of attraction of bank capital, as well as cause-and-effect interregional relationships in the processes of attracting bank capital to the Russian economy. A systematic methodical approach based on methods of panel data regression analysis, spatial modeling and determining causation, with the aim of complex research of spatial heterogeneity of attraction of bank capital to the economy of regions of the Russian Federation. The need to take into account the spatial specificity of the formation and use of bank capital by the institutional sectors at the regional level, research and modeling of interregional relationships in the processes of its involvement in the Russian economy for the further development of mechanisms to reduce spatial heterogeneity have led to the need to develop a new methodological approach. The algorithm of this methodical approach is presented on *Fig. 1*.

At the initial stage of the research, using statistical methods, the dynamics and structure of the formation of institutional sectors of bank capital in the regions of Russia are evaluated. At the same time, it is supposed to research the dynamics of such sources of formation of bank capital as: placed deposits and attracted funds of legal entities, deposits of individuals, funds of commercial organizations, budgetary institutions, State and other extra-budgetary funds on settlement accounts, as well as credits and

other funds received from credit organizations. In the research of the processes of formation of banking capital of the regions of Russia, it is expected to take into account the resources coming into the banking sector in both domestic and foreign currency.

For more correct display of spatial aspects of formation in regions of banking capital, it is proposed to systematize data both on regional banks and on branches of credit institutions registered in other territorial systems. Since in the vast majority of regions are no regional banks and the banking sector is represented only by branches of other credit institutions, this approach will allow more accurately estimate dynamics of bank capital formation of these regions.

To assess the impact of factors that attract resources from institutional sectors (financial and non-financial corporations, households and government), is expected to hold a regression modeling in the banking sector of the economy using panel data on 85 subjects of the Russian Federation for the period from 2006 to 2020. The modeling will test the influence of such factors as the volume of the gross regional product of regions of the Russian Federation, the average per capita income of the population, the balanced financial result of enterprises, the size of the interest rate of the Bank of Russia. Regression modeling will allow to establish key factors of formation of bank capital in regions.

To assess the spatial features of the formation of bank capital it is planned to use graphical and statistical methods of analysis to allocate three groups of regions:

• with a high level of resources attracted by the institutional sectors to the banking sector of the economy (beyond the limits, calculated of the formula (1);

• with the volume of attracted resources in the banking sector above the Russian average;

• with low level of resources involved.

$$X_{max} = \bar{X} + \sqrt{\frac{\Sigma\left(X_i - \bar{X}_i\right)}{n}}, \qquad (1)$$

where X_{max} — an indicator of the high volume of resources attracted to the banking sector, calculated for 85 subjects of the Russian Federation, mln rub.;

$\bar{X}$ — average Russian resources attracted to the banking sector, mln rub.;

X_i — average Russian resources attracted to the banking sector, mln rub.;

n — number of regions.

This analysis will identify regions that attract significant resources from institutional sectors to the banking sector of the economy and confirm the presence of spatial heterogeneity in the processes of banking capital formation at the regional level.

At the next stage of the research, it is supposed to assess the spatial features of the use of the banking capital formed in the regions, its attraction to the Russian economy. Based on the set task, at this stage, it is important to study the dynamics of the structure of the region's attracted to the economy of bank capital — both in institutional sectors and in areas of its use (lending to financial and non-financial organizations, individuals, investments in shares, discounted bills, debt securities — obligations of the Russian Federation and corporate debt securities). This analysis will establish the regional specificity of the use of bank capital. At this stage, regression modelling using panel data will identify factors that have a significant impact on the amount of bank capital attracted to the region's economy, and the built model can be further used to develop mechanisms to increase the financial resources of regions for progressive socio-economic development.

To research the spatial heterogeneity of the processes of attraction of bank capital formed in the regions to the Russian economy at this stage, spatial autocorrelation analysis using the Patrick Moran method with standardized and traditional matrices of spatial weights (inverse distances) on related boundaries, linear distances and roads is assumed. More detailed methodological bases of this

analysis are revealed in our earlier works [33]. Calculation of global and local indexes of spatial autocorrelation on several matrices of spatial weights will allow more correct and reasonable study of spatial heterogeneity of processes of attraction of bank capital into the Russian economy, on diagram dispersion of autocorrelation indices to identify regions that are centers of attraction of bank capital (growth poles), spatial clusters of regions similar in volume of attracted capital, as well as zones of their strong and weak influence, which are necessary for further analysis of interregional relationships in the processes of attracting bank capital to the economy.

For their study in the third stage, it is assumed to carry out spatial autocorrelation analysis using the method of Luc Anselin using the above-mentioned matrices of spatial weights. Selection in its matrix of local indexes of spatial autocorrelation values above the average values calculated for positive and negative indexes, will identify potential interregional relationships in the processes of attracting bank capital to the Russian economy. At the same time, positive local autocorrelation indices of Anselin will establish direct interregional relationships (both regions actively attract bank capital), and negative indices — inverse, opposite interregional relationships (one region actively attracted bank capital, while the second — almost none).

To confirm the established interregional relationships in the processes of attracting bank capital to the economy at this stage it is expected to test them with the help of the Granger test on casuality. This test will determine cause-effect relationships in the processes of attracting bank capital to the economy in interconnected regions, establish the directions of these relationships (regions influencing the processes of attracting bank capital).

Regression modeling of cause-effect relationships established by Granger will confirm their validity and form a matrix of functional dependencies between regions in the processes of attracting banking capital to the economy. This approach to the modelling of interregional relationships was discussed in more detail in our work [34]. Its use in this study is necessary to confirm the processes of increasing heterogeneity of banking capital attracted to the Russian economy, active development of interregional relationships in the zones of its concentration.

Presented in this article a methodical approach, involving the systematic use of statistical methods of analysis, regression modeling, spatial autocorrelation analysis and testing cause-relationships, allows complex and reasonably to study the spatial heterogeneity of the processes of attracting bank capital in the Russian economy, to identify factors contributing to its concentration and use in certain regions, establish and confirm emerging interregional relationships in the processes of attracting bank capital to the economy.

RESULTS OF THE RESEARCH

A study of the dynamics of resources attracted by financial and non-financial corporations, households and the public administration sector to the Russian banking sector of the economy showed that the sector has built up significant financial potential over the past 14 years (68 526.4 bln rub. as of 2020). Between 2006 and 2020, the volume of resources attracted by the institutional sectors increased 5.1 times. At the same time, a significant part of these resources (42%) were deposits of individuals (households). The share of attracted resources in the structure of the banking capital formed in the regions has hardly changed. Significant changes in the structure of banking capital formed in the regions occurred in the sector of non-financial corporations: the share of borrowed funds in bank deposits rose (from 16.4 to 31.7%) and the share of deposited funds in current accounts of credit institutions decreased (from 25.1 to 14.4%). In the structure of bank capital

Table 1

Transformation of spatial features of the formation of banking capital in Russia

2006			2020		
Region	**The volume of resources attracted to the banking sector, mln rub.**	**The level of concentration of Russian banking capital in the region, %**	**Region**	**The volume of resources attracted to the banking sector, mln rub.**	**The level of concentration of Russian banking capital in the region, %**
Moscow	9 379 900	70.1	Moscow	50 613 971	73.9
St. Petersburg	676 362	5.1	St. Petersburg	13 566 704	19.8
Tyumen region	361 062	2.7	Kostroma region	985 225	1.4
Republic of Tatarstan	236 579	1.8	Republic of Tatarstan	680 517	1.0
Sverdlovsk region	206 876	1.5	Sverdlovsk region	511 258	0.7
Moscow region	204 533	1.5	Tyumen region	344 679	0.5
Samara region	166 916	1.2	Amur region	268 272	0.4
Krasnodar region	119 757	0.9	Republic of Crimea	178 004	0.3
Republic of Bashkortostan	102 892	0.8	Samara region	158 013	0.2
Nizhny Novgorod region	98 570	0.7	Krasnodar region	155 545	0.2
Novosibirsk region	97 966	0.7	Chelyabinsk region	119 777	0.2
Chelyabinsk region	97 640	0.7	Primorsky Krai	114 914	0.2

Source: compiled by the authors. URL: http://www.cbr.ru/archive/region/info/ek/credit-orgs/ (accessed on 13.12.2021).

of the regions of Russia, the share of borrowed loans of Russian and foreign financial corporations significantly decreased (from 16.2 to 11.9%). This indicates a gradual recovery of financial sustainability of the banking sector in the regions after the 2009 crisis. Then in the structure of its capital the share of credit resources was 21%. During this period the spatial features of formation of bank capital also changed significantly (*Table 1*).

If the resources attracted by the institutional sectors to the Russian banking

Table 2

The results of regression modeling of the influence of the interest rate of the Bank of Russia on the volume of attracted resources in the banking sector of regions (with fixed effects)

Variables	Coefficient	Standard error	t-stat	p-value
const	7.16	0.75	9.49	1.22E-20***
IR	1.18	0.34	3.46	0.00056***
The results of regression statistics				
LSDV R-squared	0.53		P-value (F)	5.1E-136***
LSDV F (82, 1147)	15.68			
Criterion Schwartz	6056.6		Criterion Acaike	5632.1
Parameter rho	0.87		Criterion Hennan-Quinn	5791.8
Breusch-Pagan test statistic:			LM = 2087,3	0.0000***
Wald test to heteroscedasticity (null hypothesis — observations have a common error variance):			Chi- square (82) = 56 844.9	0.0000***
Wooldridge test for estimating autocorrelation:			Test statistic: F (1, 82) = 490.9	3.99E-36***
Null hypothesis — normal distribution:			Chi — square (2) = 112.5	3.79E-25***

Source: compiled by the authors.

Note: *** — the value level of the coefficient: if the coefficient is significant at a significance level of 1%, it corresponds to "***", if at a significance level of 5%, it "**", and if only at a significance level of 10%, it "*".

sector were concentrated in several regions in 2006: in Moscow (70.1%) and St Petersburg (5.1%), Republic of Tatarstan (1.8%), Tyumen region (2.7%), Sverdlovsk region (1.5%), Moscow region (1.5%), Samara region (1.2%), while by 2020 its heterogeneity (diversity) increased significantly. Almost all Russian banking capital is now concentrated in Moscow (73.9%) and St Petersburg (19.8%). Panel regression analysis showed that the main factor that influenced the formation of banking capital in the regions is the interest rate of the Bank of Russia (*Table 2*). Its increase of 1%, according to the built model, contributes to an additional inflow of resources to the banking sector of the regions at 1.18% of the current level.

Additional inflow of funds to the banking sector of the economy with an increase in the interest rate is due to the deposits of financial and non-financial corporations, government sector and households, investments in government and corporate debt securities attracted by these sectors.

The capital formed by the banking sector is actively attracted to the Russian economy. From 2006 to 2020, the volume of lending to non-financial organizations increased by 3.9 times (to 33.8 trn rub.), to financial organizations — by 6.7 times (to 8.9 trn rub.), to individuals — by 8.4 times (to 17.7 trn rub.). The volume of investments in shares rose by 3.1 times (up to 2 trn rub.), in debt securities — obligations of the Russian Federation — by

Table 3

Results of regression modeling the influence of the interest rate of the Bank of Russia on the volume of bank capital attracted to the regional economy (with fixed effects)

Variables	Coefficient	Standard error	t-stat	p-value
const	16.06	0.89	18.14	7.36E-65***
IR	–2.28	0.36	–6.26	5.38E-10***
The results of regression statistics				
LSDV R-squared	0.66		P-value (F)	5.6E-211***
LSDV F (82, 1147)	26.71			
Criterion Schwartz	5072.3		Criterion Acaike	4647.8
Parameter rho	0.87		Criterion Hennan-Quinn	4807.5
Breusch-Pagan test statistic:			LM = 3388.6	0.0000***
Wald test to heteroscedasticity (null hypothesis — observations have a common error variance):			Chi- square (82) = 109949	0.0000***
Wooldridge test for estimating autocorrelation:			Test statistic: F (1, 82) = 230.6	2.05E-25***
Null hypothesis — normal distribution:			Chi — square (2) = 1094.7	1.9E-238***

Source: compiled by the authors.

3.5 times (up to 3.4 trn rub.), in corporate debt securities — by 7.4 times (up to 8 trn rub.).

At the same time, analysis of the dynamics of the structure of bank investments allowed to establish a number of negative trends:

• significant decline in resources for the non-financial corporations' sector, which includes both the real and the productive sectors of the economy (the share of bank investments in the sector decreased from 71.2 to 59.3%);

• reduction of the share of attracting bank capital in the public sector (from 6.4 to 4.7%);

• significant increase in the share of credit allocated to households in the composition of bank capital (from 13.7% to 23.9%), which confirms the current trend of increasing debt load of households;

• growth of lending by the banking sector of other financial institutions actively engaged in speculative operations with foreign currency, shares and debt securities of foreign issuers, high-risk derivative financial instruments. Their share in the structure of bank capital attracted to the economy increased from 8.7 to 12.1%.

Regression modelling using the panel data for the research period from 2006 to 2020, the results of which are presented in *Table 3*, showed that to actively attract bank capital to the economy of the regions it is necessary to reduce the interest rate of the Bank of Russia:

$$V = e^{16.06} * IR^{-2.28}, \quad (2)$$

where V — volume of bank capital attracted to the economy of regions, mln rub.; IR — interest rate of the Bank of Russia, %.

The reduction of the interest rate of the Bank of Russia by 1% will contribute to

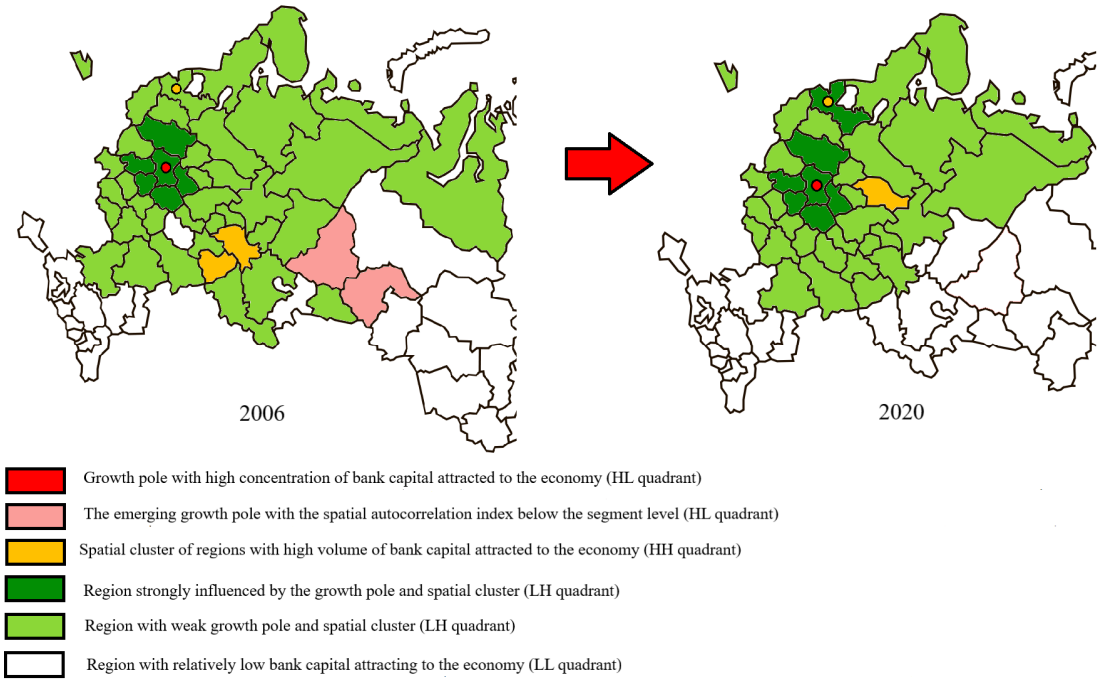

Fig. 2. **Transformation of P. Moran's scatter diagram in terms of the volume of bank capital attracted to the regional economy for the period 2006–2020**

Source: compiled by the authors.

the growth of bank capital attracted to the region's economy by an average of 2.3%. Constructed non-linear regression models for each region separately identified the areas in which this factor has a greater influence. These regions include: Stavropol region, in which a 1% reduction in the interest rate of the Bank of Russia will contribute to the growth of bank capital attracted to the economy by 5.8%, Nizhny Novgorod region (4.2%), Novgorod region (4.2%), Novosibirsk region (4%), Republic of Kabardino-Balkaria (3.9%), Republic of Mordovia (3.3%), Krasnodar region (3.1%), Rostov region (2.9%), Kirov region (2.7%), Chelyabinsk region (2.7%). The constructed models showed that the current policy of the Bank of Russia, aimed at maintaining a high interest rate, contributes to a stronger outflow of bank capital far from the central part of the regions.

The elasticity coefficient of the effect of the interest rate of the Bank of Russia on the volume of attracted bank capital in the central regions is significantly lower than the average of 2.3%. For example, in the Tula region it is only 1.9%, Smolensk region — 1.8%, Vladimir region — 1.7%, Ivanovo region — 1.6%, Ryazan region — 1.6%, Kursk region — 1.6%, Tambov region –1.4%, Orlov region — 1.3%, Belgorod region — 1.2%, Lipetsk region — 1.6%.

The worsening geopolitical situation in Russia and the severe sanctions imposed, especially on the financial sector, have already led to a significant increase in the interest rate of the Bank of Russia (to 20%). This has attracted significant financial resources from households, financial and non-financial corporations to the banking sector in the form of securities investments and deposits, which our early studies have shown [34], will be used by credit institutions exclusively for speculative purposes. The increase in the interest rate will contribute to an even deeper spatial centralization of the attracted bank capital in the Russian economy and its outflow from the Stavropol region, Nizhny Novgorod region, Novosibirsk region, Rostov region, Kirov region, Chelyabinsk regions, Republic of Kabardino-Balkaria, Republic of Mordovia and Krasnodar region.

Table 4

Results of a spatial autocorrelation analysis of the volumes of attracted bank capital to the economy of Russian regions in 2020

Indicators	Road distance matrix (normalized)	Road distance Matrix	Linear distance matrix (normalized)	Linear distance matrix
Moran global index	–0.025	–0.030	–0.021	–0.025
sd(Ii)	0.0001	0.0001	0.0001	0.0001
E(Ii)	–0.000003	–0.000004	–0.000003	–0.000004
Z-score	–269.10	–290.33	–261.04	–283.97
p-value	0.000	0.000	0.000	0.000
Direct interregional links		Backward interregional backward links		
Moscow	St. Petersburg	Moscow	Moscow, Vladimir, Kaluga, Tula, Ryazan, Tver, Yaroslavl regions	
	Kostroma region	St. Petersburg	Leningrad region	

Source: compiled by the authors.

The research of the dynamics of lending and investment activity of the banking sector in the regions allowed to establish a trend of increasing spatial heterogeneity (diversity) not only in the processes of formation of institutional sectors of bank capital, but also in the processes of its attraction to the Russian economy (*Fig. 2*). The diagram of spatial autocorrelation by P. Moran clearly shows the high concentration of bank capital attracted to the economy in Moscow. The region was an obvious growth pole throughout the period under review, with its well-established zone of strong influence on surrounding regions. However, in addition to it, in 2006 two other growth poles were allocated — Sverdlovsk and Tyumen regions, which attract significant banking capital to the economy.

These regions were classified by us as potential emerging growth poles, as they did not have a zone of strong influence on the surrounding regions as Moscow, their local spatial autocorrelation indexes were significantly below average. By 2020, due to the elimination of a significant number of regional banks and the high concentration of bank capital in the central regions, these regions have ceased to be growth poles. The volume of attracted bank capital also decreased significantly in the economy of the Samara region and the Republic of Tatarstan, to the regions, which in 2006 were the so-called spatial clusters (similar territories in terms of the amount of attracted bank capital). During the period under review, the concentration of bank capital attracted to the economy in the central part of Russia, in particular in St. Petersburg and the Kostroma region, increased significantly. The influence of growth poles and formed spatial clusters on the surrounding regions, in particular Moscow —on the Moscow, Tver, Kaluga, Tula,

Table 5

Results of modeling of interregional relationships in the processes of attracting banking capital to the economy

Region	St. Petersburg (SP)	Leningrad region (Len)	Vladimir region (Vlad)	Kaluga region (Kalug)	Moscow (M)	Moscow region (Mos)	Tver region (Tv)	Tula region (Tul)	Ryazan region (Ryaz)
Kirov region (Kir)							Kir = 25 696.5 + 0.97 * Tv	Kir = 25 241 + 0.62 * Tul	Kir = 11 913.2 + 1.13 * Ryaz
Nizhny Novgorod region (NN)			NN = –8121.4 + 7.39*Vlad	NN = 5.8 * Kalug			NN = 60 242.4 + 6.73 * Tv		NN = 7.3 * Ryaz
Penza region (Penz)	Penz = 0.004 * SP		Penz = 3327.6 + 0.62* Vlad		Penz = 0.0005 * M	Penz = 0.07 * Mos			
Republic of Mari El (RME)							RME = 578.5 + 0.59 * Tv		RME = –7101.8 + 0.67 * Ryaz
Republic of Mordovia (RM)							RM = 10 589.4 + 0.93 * Tv		
Republic of Tatarstan (RT)				RT = 13.42 * Kalug			RT = 14.83 * Tv	RT = 546 044.8 + 3.23 * Tul	RT = 474 908.1 + 5.92 * Ryaz
Samara region (Sam)							Sam = 228 955.8 + 10.89 * Tv		Sam = 14.04 * Ryaz
Saratov region (Sar)		Sar = 49 357 + 1.75 * Len					Sar = 49 118.1 + 1.17 * Tv		
Ulyanovsk region (Ul)	Ul = 0.004 * SP								
Chuvash Republic (Chu)	Chu = 0.006 * SP				Chu = 0.0007 * M			Chu = 7967.5 + 0.62 * Tul	
Arkhangelsk region (Arkh)	Arkh = 0.004 * SP		Arkh = 2103.4 + 0.65 * Vlad	Arkh = 0.57 * Kalug		Arkh = 0.07 * Mos	Arkh = –877.3 + 0.87 * Tv	Arkh = 4181.84 + 0.45 * Tul	Arkh = 0.73 * Ryaz
Vologda region (Volog)	Volog = 0.02 * SP	Volog = 45 545 + 2.08 * Len			Volog = 0.002 * M		Volog = 2.28 * Tv		Volog = 25902.5 + 1.62 * Ryaz

Table 5 (continued)

Region	St. Petersburg (SP)	Leningrad region (Len)	Vladimir region (Vlad)	Kaluga region (Kalug)	Moscow (M)	Moscow region (Mos)	Tver region (Tv)	Tula region (Tul)	Ryazan region (Ryaz)
Novgorod region (Novg)			Novg = –119.6 + 0.48 * Vlad						
/ Pskov region (Psk)							Psk = 262 + 0.48 * Tv		
Republic of Karelia (Kar)	Kar = 0.003 * SP				Kar = 0.0004 * M	Kar = 0.06 * Mos	Kar = –379.2 + 0.61 * Tv	Kar = 829.2 + 0.36 * Tul	
Republic of Komi (Komi)					Komi = 0.000 * M	Komi = 7800.8 + 0.09 * Mos	Komi = 4549.1 + 0.93 * Tv	Komi = 7601.5 + 0.53 * Tul	Komi = –4318.7 + 0.98 * Ryaz
Belgorod region (Bel)									
Bryansk region (Bryan)		Брян = 0.97 * Len							
Vladimir region (Vlad)	Vlad = 0.006 * SP				Vlad = 0.0007 * M	Vlad = 0.12 * Mos		Vlad = 6227.9 + 0.63 * Tul	Vlad = –7745.1 + 1.16 * Ryaz
Voronezh region (Voron)							Voron = 6.18 * Tv	Voron = –24 248 + 4.31 * Tul	Voron = –105 110.3 + 7.56* Ryaz
Ivanovo region (Iv)					Iv = 0.0005 * M	Iv = 10 240.3 + 0.05 * Mos	Iv = 5110.7 + 0.61* Tv		
Kaluga region (Kalug)	Kalug = 0.009 * SP								
Kostroma region (Kostr)			Kostr = 641 380.6–7.92 * Vlad					Kostr = 593 141.9–5.04 * Tul	
Kursk region (Kursk)	Kursk = 0.007 * SP				Kursk = 0.0008 * M		Kursk = 14 822.5 + 0.91 * Tv		
Lipetsk region (Lip)	Lip = 0.007 * SP				Lip = 0.0009 * M		Lip = 15 319.9 + 1.06 * Tv		

Table 5 (continued)

Region	St. Petersburg (SP)	Leningrad region (Len)	Vladimir region (Vlad)	Kaluga region (Kalug)	Moscow (M)	Moscow region (Mos)	Tver region (Tv)	Tula region (Tul)	Ryazan region (Ryaz)
Moscow region (Mosc)			Mosc = −32 532.2 + 8.67 * Vlad	Mosc = 6.45 * Kalug			Mosc = 26 397.1 + 8.55 * Tv		Mosc = −72 053.5 + 9.39 * Ryaz
Orel region (Orel)	Orel = 0.002 * SP		Orel = 552.7 + 0.33 * Vlad						
Ryazan region (Ryaz)	Ryaz = 0.007 * SP		Ryaz = 9049.4 + 0.79 * Vlad		Ryaz = 0.0007 * M	Ryaz = 16 829.8 + 008 * Mos	Ryaz = 8981.9 + 0.96 * Tv		
Smolensk region (Smol)	Smol = 0.005 * SP								
Tambov region (Tamb)					Tamb = 0.0003 * M		Tamb = 2500.9 + 0.43 * Tv		
Tver region (Tver)	Tver = 0.005 * SP			Tver = 0.68 * Kalug	Tver = 0.0006 * M	Tver = 0.09 * Mos			
Tula region (Tula)	Tula = 0.008* SP				Tula = 0.0009 * M	Tula = 0.15 * Mos			
Yaroslavl region (Yaros)			Yaros = −13 192.9 + 2.43 * Vlad	Yaros = 1.73 * Kalug			Yaros = 2.31 * Tv	Yaros = 9519.8 + 1.39 * Tul	Yaros = 2.16 * Ryaz
Volgograd region (Volg)	Volg = 0.009 * SP				Volg = 0.001 * M	Volg = 16 163.3 + 0.16 * Mos	Volg = 1.89 * Tv		

Source: compiled by the authors.

Vladimir, Ryazan regions and St. Petersburg — on the Leningrad region has increased.

As can be seen in *Fig. 2*, the influence of the centers of attraction of bank capital narrowed and concentrated in the central part of Russia.

Spatial autocorrelation analysis by the methods of P. Moran and L. Anselin using different matrices of spatial weights not only confirmed the heterogeneity of the processes of attracting bank capital to the Russian economy (global Moran indices has negative values), but also direct and inverse interregional relationships in these processes (*Table 4*). Positive indexes of spatial autocorrelation in the Anselin matrix were established between Moscow and St. Petersburg, Kostroma region, which indicates the similarity of these regions in the processes of attracting bank capital, the potential direct relationships between the regions.

Bank capital growth in one region can contribute to growth in an interconnected region. Negative indexes of spatial autocorrelation (inverse relationships) established between Moscow and Moscow region, Vladimir, Kaluga, Tula, Ryazan, Tver, Yaroslavl regions, between St. Petersburg and Leningrad region, confirm the identified growth poles and spatial clusters as shown in the Moran dispersion diagram (*Fig.2*). These regions are characterized by opposite trends in the processes of attracting bank capital to the economy: inflow of attracted to the economy of bank capital in Moscow, according to the results of spatial autocorrelation analysis, leads to its outflow from the surrounding regions.

For a more detailed study of interregional relationships, the Granger test on causality in the processes of attracting bank capital to the Russian economy was conducted. This test allowed to establish cause-and-effect relationships between regions in these processes, to determine the spatial directions of data relationships. Regression models of influence of some regions on others in the processes of attraction of bank capital in the economy were built on the basis of the relationships established by the Granger test. Part of the regression models, formed by regions related to growth poles, spatial clusters and zones of their influence, are represented in *Table 5*.

For example, according to the modelling results, it was found that the growth of bank capital attracted to the economy in Moscow by 1 bln rub. contributes to its growth in the Penza region by 0.5 mln rub., Vologda region — by 2 mln rub., Vladimir region — by 0.7 mln rub., Ivanovo region — by 0.5 mln rub., Kursk region — by 0.8 mln rub., Lipetsk region — by 0.9 mln rub., Ryazan region — by 0.7 mln rub., Tambov region — by 0.3 mln rub., Tver region — by 0.6 mln rub., Tula region — by 0.9 mln rub., and Volgograd region — by 10 mln rub.

Inverse relationships were established between the Kostroma, Vladimir and Tula regions. Inflow of attracted to the economy of banking resources in the Vladimir region for 1 mln rub. contributes to the outflow of these resources from the Kostroma region for 7.9 mln rub., and additional inflow of bank capital in the Tula region in the amount of 1 mln rub. causes its outflow from the Kostroma region by 5 mln rub.

In the course of the research, models of relationships for other regions were built, but because the spatial autocorrelation analysis did not identify these regions as poles of growth, spatial clusters or zones of their influence, these inter-regional relationships were found to be insignificant.

Thus, the developed methodical approach allowed to establish a tendency of strengthening of spatial heterogeneity of processes of attraction of bank capital into economy, to identify and model interregional relationships. The formed models showed the urgent need to reduce the interest rate of the Bank of Russia to attract more active bank capital in the Russian economy, especially now, in the context of the deteriorating

geopolitical situation and severe financial sanctions. The reduction of this rate will make bank loans more accessible to non-financial corporations, households and the public administration sector in remote regions, will contribute to the development of the system of regional banks serving the interests of the population and enterprises of the real sector of economy. Regional banks that actively attract investment in the economy, support economic and social infrastructure projects and provide credit to households and non-financial corporations at reduced interest rates, targeted public support should also be provided.

CONCLUSION

Theoretical analysis of works devoted to the study of spatial aspects of formation and attraction of bank capital in the economy showed that spatial heterogeneity of these processes negatively affects the socio-economic development of territorial systems. Review of research in this field substantiated the need for systematic use of methods of statistical, regression and spatially autocorrelation analysis for assessment of dynamics of spatial heterogeneity of processes of attraction of bank capital in economy and modeling of interregional relationships in these processes. The methodical approach presented in the article allowed to establish the features of formation and use of banking capital of regions by institutional sectors, to identify the different impact of the interest rate of the Bank of Russia on these processes. The novelty of the developed approach was the systematic use of methods of regression analysis and spatial autocorrelation by the method of P. Moran and L. Anselin to identify regional centers of attraction of banking resources, spatial clusters of similar regions by the volume of bank capital attracted to the economy and their influence zones. This approach allowed to establish an increase in the concentration of banking capital attracted to the economy in the central part of Russia (Moscow, St. Petersburg and the Kostroma region) and formed inverse relationships with regions, forming a zone of strong influence of growth poles and spatial clusters (with the Moscow, Tver, Kaluga, Tula, Vladimir, Ryazan and Leningrad regions). The research showed that regions having an inverse relationship (negative index of spatial autocorrelation) are characterized by opposite tendencies in the processes of attracting bank capital to the economy: inflow of bank capital attracted to the economy in Moscow and St. Petersburg leads to its outflow from these regions.

Testing with the help of Granger established in the course of spatial autocorrelation analysis of direct and inverse relationships between the growth poles, spatial clusters and regions, forming their zone of influence, allowed more in-depth investigation of cause-and-effect relationships between regions in the processes of attracting bank capital to the Russian economy, and regression analysis — form a matrix of functional interregional relationships in these processes.

The developed methodical approach helped to substantiate the hypothesis on the strengthening of spatial heterogeneity in the processes of attracting bank capital to the Russian economy, to establish and model interregional relationships, which can then be used to construct forecasts and search for mechanisms to smooth this heterogeneity for more efficient spatial distribution of banking capital.

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Formation of the Pre-Pensioner Segment in the Labor Market: Financial and Management Aspects

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ABSTRACT

The article considers the results of the implementation of the pension reform in Russia in 2018, reflected in changes in labor market indicators according to Rosstat. **The purpose** of the study is to develop a scientific understanding of the processes of formation of the pre-pensioner segment of the Russian labor market under the influence of its external and internal factors. The authors use **methods** of statistical, correlation, and regression analyses, the calculation of the average for a certain integral of functions, as well as the method of linear modeling of multiple regression. The study assesses the scientific elaboration of the research topic abroad and in Russia. The issues of financial literacy of the population are analyzed. The financing of the training of pre-retirees in the professional competencies that are currently in demand on the labor market and support for unemployed pre-retirees who are registered with the employment center are considered. The selection of relevant demographic data and a sample labor force survey by age group has been carried out. The total number of pre-pensioners in 2018–2020 has been calculated and their structure according to the status of labor activity in the Russian labor market has been identified. The general dynamic, structural, and gender characteristics of the economic activity of pre-pensioners in the labor market are analyzed. The demand for pre-retirees by type of economic activity in 2019 is assessed. The authors **conclude** that there is a tendency to reduce the share of the pre-pensioner segment in the labor market after reaching the project retirement age threshold from 10.88% to 9.76%. The employment rate in this group of the population will be 66%. The study has established that the demand for pre-pensioners by type of economic activity in the labor market is 1.13 times higher for women than for men. A methodical approach has been developed to analyze the results of assessing the demand for state support measures by pre-pensioners. The article analyzes the influence of financial and social measures of state support for pre-pensioners on increasing their labor activity and competitiveness in the labor market. The results of the study can be used by the authorities to substantiate the assessment of the effectiveness of financing the measures they take to provide social and economic support to pre-retirees.

Keywords: pre-pensioner; working capacity; employment; financial literacy; employer; employment; labor market; subsidies from the budget; financing of state support measures

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INTRODUCTION

The emergence of such a new segment as pre-pensioners on the Russian labor market represents a fait accompli of employers in the struggle to increase their incomes, and of the state — to accelerate GDP growth by raising the retirement age [1, 2].

From the ongoing reformatting of the labor market through the transformation of labor resources, all its subjects expect the resolution of the contradiction of the capitalist mode of production by expanding the scale of exploitation of hired labor by increasing the number of employees. In the meantime, the maneuvers on the scale of employment retain the possibility of only a short delay in the onset of the next crisis in GDP growth rates [3, p. 187]. In connection with the ongoing transformation, the problem of scientific explanation of the directions and strength of the trends in the formation of the pre-pensioner segment in the labor market, filling its content and assessing the impact of such factors on all this has arisen, such as employment, ability to work, economic activity, unemployment, measures of social and financial support, financial literacy, pension expectations of the population.

The relevance of the study on the topic is determined by the demand by the Russian Government for the results of explaining the trends and patterns of formation of the pre-pensioner segment in the labor market, in obtaining a scientific assessment of the demand for socio-economic support measures for the pre-pensioners, as well as receiving recommendations and proposals for improving the mechanism for their provision.

The object of the study is the process of formation of the segment of pre-pensioners, and the subject field is the factors of influence on the process of formation of the labor market.

The purpose of the study is to develop a scientific understanding of the processes of formation of the segment of pre-pensioners of the Russian labor market under the influence of its external and internal factors.

The objectives of the study are to analyze the trends and content of the formation of the pre-pensioner segment in the labor market and assess the demand for state support measures by them in order to maintain working capacity and increase competitiveness in the labor market. An assessment of the scientific elaboration of the issues raised in the article by researchers abroad and in Russia is given. The methods of statistical, correlation-regression analysis, calculation of the average over a certain integral of functions, as well as the method of linear modeling of multiple regression of demand for measures of state support for pre-pensioners in the Russian labor market are used.

SCIENTIFIC ELABORATION OF THE RESEARCH TOPIC

Scientific solutions on the topic abroad are based on studies of practices to prevent workers from leaving the labor market and increase the level of activity among workers aged 50 to 65 years in OECD countries with more than forty years of experience in such activities [4–8]. For this purpose, various liberally oriented models of flexible retirement age or gradual retirement are used. The study by A. Soest, A. Kapteyn, and J. Zissimopoulos [9] is devoted to assessing the degree of their acceptability [9].

The US pension sector is maximally liberalized [10, 11]. At the same time, the report by A. Gurría (2018) notes that, despite the weakness of the employment protection system in the labor market and the absence of mandatory retirement age in the United States, the employment rate of the population aged 55–64 years is 3 p.p. higher than in other OECD countries.[1]

The impact of changing the statutory retirement age on the labor supply of older people in OECD countries was studied by K. Geppert et al.

[1] OECD (2018), Working Better with Age and Fighting Unequal Ageing in the United States, forthcoming, OECD Publishing, Paris. URL: https://www.oecd.org/social/working-better-with-age-and-fighting-unequal-ageing-in-us-davos-2018.htm (accessed on 10.04.2022)

(2019).[2] M. Nikolova and C. Graham (2014) focus on the study of the optimal relationship between retirement age and the financial burden of public pension systems [12].

The scientific report by H. Dubois, G. Runceanu, and R. Anderson (2016) on extending working life through flexible pension schemes focuses on the issue of employment motivation in the pre-retirement age, both at the national and EU sectoral levels of EU Member States, mainly by reducing the working day by up to 80%.[3]

The results of an Aegon Longevity Center and Transamerica Center (2015) survey of 16,000 respondents on their readiness to retire and an analysis of the implementation of flexible pension measures in 15 countries in Europe, America, Asia and Australia show that the most common system in which an employee of pre-retirement age a special contract with more flexible terms of employment is offered. On average, 26% of pre-retirees over 55 years old prefer to retire before the age of 65, 55% are inclined towards a flexible system of work up to the official pension, and 27% of employers provide them with the opportunity to work part-time.[4]

Fifty percent of pre-retirees believe that their employer does not provide enough information and support to prepare for retirement. Nevertheless, pre-pensioners note a significant activity of social responsibility of 14–24% of employers in providing the following types of support:

(1) opportunities to move from full-time to part-time employment;

(2) work more suitable for older workers;

3) flexible pension schemes with work beyond the normal retirement age;

4) medical assistance in retirement;

5) financial advice;

6) retraining or advanced training.[5]

Studies of the economic activity of pensioners in the Russian labor market revived ten years ago, and those of pre-pensioners five years ago [13, 14]. In 2020, the HSE Labor Market Research Laboratory analyzed the regional features of employment and unemployment of the population of pre-retirement age in Russia. As a result, it was found that employed workers of pre-retirement age have, on average, higher levels of education than the general population of pre-retirement age; the range of places of employment for workers of pre-retirement age is limited; the unemployment rate for workers of pre-retirement age is at a low level.[6] At the same time, 23.6% of Russian employers are not satisfied with the professional skills of pre-pensioners.[7]

The federal budget for the period from 2020 to 2022 provides for annual subsidization of the regions in the amount of 3.4 billion rubles[8] to train pre-pensioners in the professional competencies that are currently in demand in the labor market. Calculations show that subsidies from the budget for the education of one pre-pensioner during this period will grow

[2] Labour supply of older people in advanced economies: the impact of changes to statutory retirement ages. Working Paper English 11 Jun 2019 Christian Geppert, Yvan Guillemette, Hermes Morgavi, David Turner Pages: 43 in URL: OECD Economics Department Working Papers (accessed on 10.04.2022).

[3] Eurofound (2016), Extending working lives through flexible retirement schemes: Partial retirement, Publications Office of the European Union, Luxembourg. 88 p. URL: Extending working lives through flexible retirement schemes: Partial (europa.eu) (accessed on 10.04.2022).

[4] OECD (2018), Working Better with Age and Fighting Unequal Ageing in the United States, forthcoming, OECD Publishing, Paris. URL: https://www.oecd.org/social/working-better-with-age-and-fighting-unequal-ageing-in-us-davos-2018.htm (accessed on 10.04.2022).

[5] The New Flexible Retirement. Aegon Center for Longevity and Retirement (2015). URL: The New Flexible Retirement | Aegon (accessed on 10.04.2022).

[6] Smirnykh L.I., Emelina N., Travkin P.V., Leonova L.A., Roshchin S. Yu., Solntsev S.A. Workers of pre-retirement age in the labor market in the Russian Federation: information bulletin. Roshchin S. Yu., Solntsev S.A., ed. National Research University Higher School of Economics. M.: Higher School of Economics; 2020. P. 8. URL: https://lirt.hse.ru/data/2020/07/22/1596769602/Pre_pensioner_e_book.pdf (accessed on 10.04.2022).

[7] Ibid. P. 30.

[8] Kostenko Ya., Sidorenko E. You will learn before retirement: how to distribute subsidies for the education of citizens 50+. News. November 11, 2019. URL: https://iz.ru/941234/iaroslava-kostenko-elena-sidorenko/pered-pensiei-nauchishsia-kak-raspredeliat-subsidii-na-uchebu-grazhdan-50 (accessed on 07.04.2022).

from 444 to 478 rubles per year. In general, the allocated subsidies are focused on the annual education of only 75 thousand pre-pensioners out of the available 7 million people. Also, at the expense of budget financing, city, and regional job fairs are held, focused on the employment of pensioners.

To support unemployed pre-pensioners registered with the employment center, 16.4 billion rubles are planned in the budget of the Pension Fund of the Russian Federation for the period from 2020 to 2022 with an annual increase in volumes of 26.8%, 34.1%, and 39.1%, respectively.[9]

At the same time, it should be noted that the level of financial literacy of the population in general and, in particular, people of pre-retirement age is quite low [15, 16]. The behavior of pre-pensioners is characterized to a large extent by carelessness regarding the concern for ensuring the stability of the source, and sufficient retirement income through their actions in solving current social and labor problems [17]. Regarding independent investment in their future pension, 72% of the population have formed negative expectations due to the measures of the authorities to "restrict the use of pension savings", 64% are afraid to invest due to "corruption in the financial sector and authorities", and 52% have concerns for the safety of investments due to the "lack of clear control over the activities of the PFR" [17]. Also, the low level of financial literacy refers to knowledge of the basics of pension legislation. Both understandable explanations for the pre-pensioners of the point-based system in the Russian pension system and detailed information about the non-state pension system and its possibilities are needed [16].

To change this situation, according to D. S. Tulenty, A. S. Ermolaeva, P. G. Raba, it is necessary to change the principles of implementation of pension relations, which will provide pre-pensioners with the opportunity to choose strategies for financial behavior. In this case, the future material well-being of pre-pensioners will largely depend on their own decisions. Increasing the financial literacy of the elderly is a necessary condition for making an effective individual decision on how to form a pension. At the same time, activities to ensure financial literacy should be aimed at the principles and tools for the formation of future pensions [18].

Among the problems of the formation of the pre-pensioner segment in the Russian labor market are increased risks of age discrimination by employers, pay, job status, precarization of employment [19–23]. The impact of gender differences on employment in the segment of pre-retirees was identified by M. Agranovich [24]. Nevertheless, A. Lukyanova and R. Kapeliushnikov give an optimistic forecast for the formation of the pre-pensioner segment in the Russian labor market [25].

A generalization of the scientific elaboration of the research topic shows that even the similarities in the behavior of pre-pensioners in the labor markets of different countries differ in the essence of the institutionalization of their mechanisms: in the countries of Europe, America, Asia, and Australia, liberal models of behavior regulation prevail, and in Russia — the paternalistic model. For this reason, the use of their results as arguments for our study is hardly acceptable, with the exception of instrumental components.

ANALYSIS OF TRENDS AND SEGMENT FORMATION CONTENT

In the study, we proceed from the fact that the labor resources represent "a part of the population with physical development, mental abilities and knowledge that are necessary for work" in the sectors of the economy.[10]

[9] The budget included 4.4 billion rubles for early pensions for unemployed pre-pensioners. IAFI Banks today, 2019. URL: https://bankstoday.net/last-news/v-byudzhet-zalozhili-4–4-milliarda-rublej-na-dosrochnye-pensii-bezrabotnym-predpensioneram (accessed on 08.04.2022).

[10] Zlatin P.A. et al. Management of labor resources. Textbook for students of higher educational institutions in economic and managerial specialties. Zlatin P.A., Krekova M.M., ed. by

Таблица 1 / Table 1

Dynamics and structure of economic activity of pre-pensioners

Indicator	Years			Rate of change in 2020 to 2018, %
	2018	2019	2020	
Population of pre-retirement age, thousand people	9796.91	9522.98	9267.78	94.60
Total number of employees, thousand people	72 354	71 933	70461	97.38
Employment of pre-pensioners, thousand people	8271	8049.8	7665.9	92.68
Share of pre-pensioners in the total population, %	6.67	6.49	6.33	–
Share of pre-pensioners in the employed population, %	11.43	11.19	10.88	–
Employment rate of pre-pensioners, %	84.42	84.53	82.72	–
Unemployment rate of pre-pensioners, %	3.77	3.49	4.18	–
Level of economic activity of pre-pensioners, %	88.19	88.02	86.9	–

Source: compiled by the authors according to Rosstat. Results of the sample labor force survey. Relevant years. Moscow: Rosstat; 2018–2020, Tables 1.9; 2.1a; 4.3; 21. URL: https://rosstat.gov.ru/compendium/document/13265 (дата обращения: 10.08.2021) / (accessed on 10.08.2021).

The working-age population is of paramount importance in the labor resources. It includes persons "mainly of working age, capable of participating in the labor process by their psychophysiological data".[11] Threshold values of the working age are established by the legislative bodies of the central government.

The working-age population itself has different attitudes towards participation in socially useful activities in exchange for personal income. The population participating in the creation of such an income is classified as economically active (labor force),[12] and not participating — as economically inactive. An important behavioral characteristic of the economically active population from the point of view of the issues under study is that not the entire labor force is realized in the labor market, but only in terms of the working capacity of the worker.

An innovation of the pension reform in 2018 was the increase in the age threshold of the working-age population to 60 years for women, to 65 years for men, and the allocation

Federal Agency for Education, Moscow State. industrial un-t. M.: MGIU publishing house; 2010. P. 4. URL: https://search.rsl.ru/ru/record/01004920396 (accessed on 10.04.2022).

[11] Ibid. P. 5.

[12] Classification of statistical data on the composition of the labor force, economic activity, and status in employment. Methodological provisions on statistics. Moscow: Rosstat; 2006. URL: https://www.gks.ru/bgd/free/b99_10/isswww.exe/stg/d000/i000080r.htm (accessed on 10.04.2022).

of a special age category of the working-age population with the status of "pre-pensioners" in the final five-year plan. In general, the reform in the distribution of public goods has changed not only the timing of access for a significant part of the working-age population to receiving such personal income to the means of subsistence as an old-age pension but also the structure of the labor market. The reform affected the interests of the economically active part of the population to a greater extent, which changed the nature of its economic behavior, mainly in older age groups [2, 26].

Next, we will analyze the trends in the processes of the behavior of the population of pre-retirement age in the labor market. Rosstat data show that, despite a pronounced downward trend in the population of pre-retirement age from 2018 to 2020 by 5.4 p.p. (100–94.6%), their share in the total population was quite stable: 6.33–6.67% (*Table 1*).

At the same time, calculations according to Rosstat data, based on the average of a certain integral of regression functions in the interval of 50–55/51.5–56.5 years for women and 55–60/56.5–61.5 years for men, according to the employed population in the pre-retirement age, show that the number of this category of the economically active population, as the retirement age gradually increased, decreased at an average rate of 3.73% per year. As a result, over two years of reforms, their number decreased to 92.68%. With this outcome, the share of pre-retirees in the employed population for the period from 2018 to 2020 consistently decreased from 11.43 to 10.88% (*Table 1*). There is a pronounced trend toward a decrease in the pre-pensioner segment in the labor market with each subsequent stage of raising the retirement age to the indicator of the upper limit of the working capacity of the population.

According to our calculations, upon reaching the project milestone of the transformation of the labor resources of Russia in connection with the completion of the formation of the segment of pre-pensioners in the labor market, its total share in the total number of economically active population will decrease from the current 10.88% to 9.76% (4.28% for women aged 55–59 and 5.48% in men aged 60–64). Since the share of men pre-pensioners will remain at the same level, the identified decrease will occur due to a reduction by more than a third of women pre-pensioners: from 6.12 to 4.28%. Thus, there are significant differences in the strategies for continuing the labor activity of men and women of pre-retirement age in the labor market: women prefer the status of "outside the labor force" to the status of "labor force".[13] At the same time, for women of pre-retirement age, even in the labor force, the average working time of participation in the "production process of economic entities" is 1.074–1.093 times less than for men, which confirms the conclusion that women are less interested in employment.

At the same time, the employment rate of pre-pensioners in 2018–2020 was 82.82–84.53% (*Table 1*), which is very close to the level of employment of population groups aged 30–49 (83.8–89.3%).[14] Consequently, in the transition period, there is a high demand for pre-pensioners in the labor market. However, as the retirement age reform targets are reached, the employment rate of pre-pensioners may drop to 77% for men and 55% for women, and the overall employment rate in this population group will be 66%.

Table 2 gives an idea of the greatest demand for pre-pensioners by type of economic activity in 2019.

According to *Table 2* data, despite the fact that in 2019 the share of male pre-retirees in the employed population was 5.32%, and women 5.87%, the demand for the former in the above types of activities was 1.8–2.7 times

[13] On the approval of the Official Statistical Methodology for the formation of a system of indicators of labor activity, employment, and labor underutilization, recommended by the 19th International Conference of Labor Statisticians. Order of Rosstat dated December 31, 2015. No. 680. Moscow: Rosstat; 2015. 32 p. URL: https://rosstat.gov.ru/storage/mediabank/met-680.pdf (accessed on 10.08.2021).

[14] Labor force, employment, and unemployment in Russia. Moscow: Rosstat; 2020. 147 p. URL: https://rosstat.gov.ru/storage/mediabank/2EfrJGVJ/Rab_sila_2020.pdf (accessed on 10.08.2021).

Table 2

Demand for pre-pensioners by type of economic activity in 2019, %

Type of economic activity	Men	Women
Agriculture, forestry, hunting, fishing, and fish farming	13.8	14.0
Electricity, gas, and steam; air conditioning	13.2	15.7
Water supply; wastewater disposal, waste management, and remediation activities	15.0	15.8
Manufacturing	10.5	13.4
Transport and storage	11.7	13.8
Real estate	14.2	14.8
Education	14.2	13.6
Healthcare and social services	14.0	14.5
Construction	9.6	12.8
Culture, sports, leisure, and entertainment	9.6	13.5
Other	11.7	14.4

Source: compiled by the authors according to Rosstat. Labor Force, Employment and Unemployment in Russia. Moscow: Rosstat; 2020. 147 p. URL: https://rosstat.gov.ru/storage/mediabank/2EfrJGVJ/Rab_sila_2020.pdf (accessed on 10.08.2021).

higher than the average, ranging from 9.6 to 14.2%, and the latter — 1.6–2.4 times higher than the average, ranging from 12.8 to 15.8%. At the same time, the average level of demand for women in these types of activities in the labor market is 1.13 times higher than for men.

In general, for most types of economic activity in the labor market, there is a high demand for representatives of the pre-pensioner segment by employers. However, the labor mobility of pre-pensioners in the Russian labor market is half the average for all age groups.

The employment of pre-pensioners largely depends on the development of their professional capacity for work, determined in modern conditions by the level of education. According to the HSE research team (2020), the maximum employment rate of "the population of pre-retirement age is observed among holders of higher education (89.8%), and the minimum level is among those who do not have a basic general education (33.7%)".[15] In total, the presence of secondary and higher education among pre-retirees significantly expands the "range of job availability", since this is more mental work, for which they have enough individual performance, unlike those who do not have such education.

Analysis of the trends in the formation of the segment of pre-pensioners in the labor market cannot be complete without assessing the contribution of unemployed pre-pensioners to it [15, 24]. It should be noted that the unemployment rate in the segment of pre-pensioners is almost the same as in the group of the population aged 30–49 years (3.4–4.4%),[16] and varies depending on the general situation in the labor market in the range of 3.49–4.18% (*Table 1*). Thus, the unemployment of pre-pensioners can be regulated by ordinary methods.

[15] Smirnykh L.I., Emelina N., Travkin P.V., Leonova L.A., Roshchin S. Yu., Solntsev S.A. Workers of pre-retirement age in the labor market in the Russian Federation: Information bulletin. Roshchin S. Yu., Solntsev S.A., red. National Research University Higher School of Economics. M.: Higher School of Economics; 2020. P. 16. URL: https://lirt.hse.ru/data/2020/07/22/1596769602/Pre_pensioner_e_book.pdf (accessed on 10.04.2022).

[16] Labor force, employment, and unemployment in Russia. Moscow: Rosstat; 2020. C. 115. URL: https://rosstat.gov.ru/storage/mediabank/2EfrJGVJ/Rab_sila_2020.pdf (accessed on 10.08.2021).

According to a survey in 2020 by the recruiting company HeadHunter, it was revealed that 65% of non-working pre-pensioners are looking for a job, and among those who continue to work, 34%[17] are looking for a job. For 35% of pre-pensioners, the search for a job lasts from a month to six months, and for another 31% — more than six months. For 87% of pre-pensioners, job searches are complicated. In 51% of cases, the difficulties are caused by low wages and the lack of work in professional fields, in 31% of cases the difficulty is due to the lack of work in compliance with the Labor Code, and in 26% — due to the remoteness of the place of work from home.[18]

The main reason employers refused employment to pre-pensioners was their age and health problems (32%), and in 36% of cases, the refusal was without explanation. At the same time, 62% of pre-pensioners themselves believe that their age at employment is a significant disadvantage, and in 38% of cases this disadvantage was a poor command of modern technologies. On the contrary, 67% of pre-pensioners consider "a more responsible approach to work" as their advantages, 60% — professional knowledge and experience, 52% — an interest in long-term employment, 45% — an understanding of work and the ability to achieve results, 36% — willingness to be a mentor.[19]

A 2020 survey of employers by the recruiting company HeadHunter revealed that the real reason for the refusal of 57% of pre-pensioner in employment is not the age, but "the discrepancy between the employer's salary offers and the pre-pensioners' expectations.[20]

In general, the segment of pre-pensioners in the labor market in 2018–2020 demonstrates almost the same level of participation in the labor force (86.90–88.19% — *Table 1*) as the population groups aged 35–49 years (91.5–93.0%).[21]

Due to the objective decrease in the population of pre-retirement age, the costs of the authorities in base prices for indirect and direct measures to support the active participation of pre-retirees in the labor market will decrease.

The results of the analysis of the processes of the behavior of the population in the segment of pre-pensioner of the labor market can serve as a basis for explaining their trends and patterns, as well as justification by the authorities for assessing the effectiveness of their measures for the socio-economic support of pre-pensioners and entrepreneurs to enhance participation in the "production process of economic units", corresponding their real reactions.

ASSESSMENT OF THE DEMAND FOR STATE SUPPORT MEASURES BY PRE-PENSIONERS

The general expectations of the population from the state measures in the pension sector can be judged by the VCIOM data through the attitude of part of the population to the pension reform. 90% of respondents believe that the state should act as the main source of financing pensions, invest resources in the pension provision of citizens in the present and future [17, 27].

The authors propose to determine the real demand for measures of state support for the activity of their participation in the labor market by pre-pensioners based on the hypothesis that their specific attitude to support measures is expressed by personal assessments of expectations associated with ideas about their own attitude to the conditions in which they have to act (live) with the measures provided by the state in the areas grouped in *Table 3*.

[17] Work and age: Stereotypes and reality. Website: HeadHunter. July 31, 2020. URL: https://hh.ru/article/27243 (accessed on 10.04.2022).

[18] Ibid.

[19] Ibid.

[20] Ibid.

[21] Results of a sample labor force survey. Relevant years. Moscow: Rosstat; 2018–2020, Tab. 1.9. URL: https://rosstat.gov.ru/compendium/document/13265 (accessed on 10.08.2021).

Table 3

Types of guarantees and benefits provided to citizens of pre-retirement age

Scope of support	Types of guarantees and benefits
Labor relations	Provision of increased unemployment benefits
	Early retirement
	Ban on dismissal due to age
	Providing opportunities for advanced training and retraining with the payment of a scholarship equal to the minimum wage under the programs of employment centers
	Provision of paid two days off for annual medical examination
Property relations	Retention of the right to receive a funded pension from the age of 55/60 years
	Granting the right to a mandatory share in the inheritance to citizens of pre-retirement (former retirement) age
	Preservation of the right of disabled women who have reached the age of 55 and men who have reached the age of 60 to receive alimony
	Exemption from property tax
	Reduction of the tax base (deduction) for land tax
Healthcare	Increase in financing by the Compulsory Social Insurance Fund of payments to enterprises for vouchers for sanatorium and resort treatment of pre-pensioners by 30%
	Provision of medications for free
	Preferential manufacture of dentures
Services	Reduced transport fares
	Discount on overhaul
	Discount on utility bills

Source: compiled by the authors.

The contents of *Table 3* show that support measures for pre-pensioners are aimed at four areas of their life: labor relations, property relations, healthcare and services. In total, the authors studied the need for sixteen support measures in the covered areas of life.

Based on the adopted methodology for assessing the demand for state measures to support citizens who are in pre-retirement age, the authors conducted a pilot survey of working pre-pernsioners. The survey was conducted in order to use its results to create a methodology for developing a model for assessing the demand for measures to support pre-pensioners.

The survey involved citizens of pre-retirement age from eight subjects of the Russian Federation: five subjects of the Central Federal District, one subject of the Southern Federal District and two subjects of the North Caucasus Federal District. The survey involved 24 women (64.9%) and 13 men (35.1%).

The methodological approach to analyzing the results of assessing the demand for state support measures by prepensioners is as follows.

The authors propose to identify quantitative assessments of the demand for certain types of state support measures by pre-pensioners in each of the four areas of their life using the scale of the bipolar semantic differential of verb antonyms according to the degree of demand for each of the proposed measures: "unnecessary-necessary" in seven degrees: "not at all necessary" — 0.00; "not necessarily" —

Table 4

Distribution of personal assessments of the demand for support measures in the field of employment by pre-pensioners, units

Weighted average of verbal assessments of the level of demand for support measures	Types of guarantees and benefits				
	Increased unemployment benefits	Early retirement	Ban on dismissal due to age	Providing opportunities for advanced training and retraining with the payment of a scholarship equal to the minimum wage under the programs of employment centers	Provision of paid two days off for annual medical examination
Total	0.61172	0.71683	0.85511	0.59589	0.734

Source: compiled by the authors.

Table 5

Distribution of personal assessments of the demand for support measures in the field of property relations by pre-pensioners, units

Weighted average of verbal assessments of the level of demand for support measures	Types of guarantees and benefits				
	Retention of the right to receive a funded pension from the age of 55/60 years	Granting the right to a mandatory share in the inheritance to citizens of pre-retirement (former retirement) age	Preservation of the right of disabled women who have reached the age of 55 and men who have reached the age of 60 to receive alimony	Exemption from property tax	Reduction of the tax base (deduction) for land tax
Total	0.72739	0.60678	0.54028	0.89933	0.77278

Source: compiled by the authors.

0.17; "rather not necessary" — 0.34; "it is difficult to say whether it is necessary or not" — 0.50; "rather necessary" — 0.67; "necessary" — 0.83; "extremely necessary" — 1.00..

The results of the survey were analyzed using the methodological approach described below. When processing the results of the survey, the following was established.

In the sphere of labor activity, which is directly related to the economic activity of the population in the labor market, the distribution of weighted average personal assessments of the demand for support from state bodies by pre-pensioners by five types of measures was studied and presented in *Table 4*.

Table 4 shows that in the labor market, such a measure of state support as "a ban on dismissal due to age" is most in demand by pre-pensioners (0.85511 units). The received assessment at the verbal level means that this measure is "necessary". The least demanded measure was "providing opportunities for advanced training and retraining with the payment of scholarships equal to the minimum wage under the programs of employment centers" (0.59589 units). On the verbal scale,

Table 6

Distribution of personal assessments of the demand for state support measures provided in the healthcare sector for pre-pensioners, units

Weighted average of verbal assessments of the level of demand for support measures	Types of guarantees and benefits		
	Increase in financing by the Compulsory Social Insurance Fund of payments to enterprises for vouchers for sanatorium and resort treatment of pre-pensioners by 30%	Provision of medications for free	Preferential manufacture of dentures
Total	0.7335	0.84867	0.76039

Source: compiled by the authors.

this measure is located between the estimates "it is difficult to say whether it is necessary or not" and "rather necessary". Its low demand is explained by the fact that from 24 to 32% of pre-pensioners have a higher education, and 51% have a secondary vocational education [18, p. 36]. The range of variation between these measures is 43.5%, which is equal to two-and-a-half intervals of the applied semantic differential. The demand for the remaining three support measures varies from 0.61172 to 0.734 units. This means that their demand for supporting the economic activity of pre-pensioners in the labor market is not so decisive, since according to the semantic differential they are closest to the "rather necessary" assessment.

The generalized demand for support measures according to the weighted average is 0.70271 units. On this basis, we can conclude that, in general, the measures proposed by the authorities to support pre-retirees in the field of labor activity are assessed by them as "rather necessary".

In the field of property relations, the distribution of personal assessments of the demand for five types of state support measures by pre-pensioners is presented in *Table 5*.

According to the data in *Table 5*, the greatest demand for pre-pensioners, according to the weighted average assessment, is observed in relation to the measure "exemption from property tax" (0.89933 units). The assessment received at the verbal level of the respondents means that this measure is "necessary". The least demand by pre-pensioners is observed in relation to the "preservation of the right of disabled women who have reached the age of 55, and men who have reached the age of 60, to receive alimony" (0.54028 units). On the verbal scale, this measure is close to the assessment "it is difficult to say whether it is necessary or not". The range of variation between these measures is 66.45%, which is almost equal to four intervals of the applied semantic differential.

The demand for the remaining three measures of state support in the field of property relations by pre-pensioners varies from 0.60678 to 0.77278 units. This means that on the semantic differential, the remaining three measures are located closest to the "rather necessary" assessment (0.67 units).

The generalized demand for support measures according to the weighted average is 0.709312 units. Consequently, in general, the measures proposed by the authorities to support pre-pensioners in the field of property relations are assessed by them as "rather necessary" (0.67 units).

In the field of healthcare, which directly ensures the safety of the working capacity of pre-retirees in the labor market, the distribution of their personal assessments of the demand for support measures provided by state bodies was studied according to three types of measures (*Table 6)*.

According to *Table 6* the weighted average assessment of the measure "provision of medications for free" is most in demand by

Table 7

Distribution of personal assessments of demand by pre-pensioners for support measures provided by state bodies in the service sector, units

Weighted average of verbal assessments of the level of demand for support measures	Types of guarantees and benefits		
	Reduced transport fares	Discount on overhaul	Discount on utility bills
Total:	0.89406	0.91039	0.92161

Source: compiled by the authors.

pre-pensioners (0.84867 units). According to the semantic differential, it is commensurate with the level of demand for the "necessary" (0.83 units). The remaining two support measures "increase in financing by the Compulsory Social Insurance Fund of payments to enterprises for vouchers for sanatorium and resort treatment of pre-pensioners by 30%" (0.7335 units) and "preferential manufacture of dentures" (0.76039 units) also gravitate to demand at the "necessary" level.

The generalized need for support measures according to the weighted average assessment in the healthcare sector is 0.780853 units. Consequently, in general, the measures proposed by the authorities to support their performance in the labor market are assessed by pre-pensioners as "necessary" (0.83 units) according to the semantic differential.

In the service sector, the distribution of personal assessments of the needs of pre-pensioners for state support was studied according to three types of indicators (*Table 7*).

Table 7 shows that the measure "discount on utility bills" (0.92161 units) is the most demanded by pre-pensioners according to the weighted average assessment. Its value is located in the center of the semantic differential of the interval between the demand levels "necessary" (0.83 units) and "extremely necessary" (1.0 units). At the same time, the levels of demand by pre-pensioners for the measures "reduced transport fares" (0.89406 units) and "discount on overhaul" (0.91039 units) are only 3.08 and 1.2% less than the maximum in the service sector.

The generalized demand for support measures according to the weighted average assessment in the service sector is 0.908687 units. Thus, the measures of support offered by the authorities in the service sector are assessed by pre-retirees at the level located in the center of the semantic differential in the interval between the levels of demand "necessary" (0.83) and "extremely necessary" (1.0 units).

In general, an analysis of the results of assessing the demand for support measures by residents of Russian regions of pre-retirement age showed that they expect measures from the authorities most of all in the service sector (0.908687 units — the assessment is between the "necessary" and "extremely necessary"). The measures of this support group increase the competitiveness of the labor force of pre-pensioners in the labor market. Thus, the "discount on overhaul" and "discount on utility bills" form preferential conditions for the reproduction of the working capacity of pre-pensioners in the labor market, driven by age-related health problems. The "reduced transport fares" measure increases competitiveness in terms of reducing the cost of bringing pre-pensioners their workforce to the labor market.

To a lesser extent, pre-pensioners demand state support measures for the safety of their ability to work in the labor market at the expense of the healthcare sector (0.780853 — according to the semantic differential, it is closer to the "necessary" assessment). However, with regard to the "provision of medications for free", pre-pensioners confidently assess this measure as "necessary" (0.84867).

Table 8

Linear model of multivariate regression on variables of pre-retirement demand for support measures proposed by the authorities

Independent variables	Model coefficients, a_n	Standard error	*t*-statistic	*P*-value
Y – intersection, equal to a_0	0.375564	0.071	5.319	0.000
*X*1 – provision of increased unemployment benefits	–0.00749	0.032	–0.231	0.820
*X*2 – early retirement	–0.0019	0.046	–0.041	0.968
*X*3 – ban on dismissal due to age	0.029236	0.039	0.749	0.462
*X*4 – providing opportunities for advanced training and retraining with the payment of a scholarship equal to the minimum wage under the programs of employment centers	–0.03366	0.045	–0.748	0.463
*X*5 – provision of paid two days off for annual medical examination	–0.00054	0.054	–0.010	0.992
*X*6 – retention of the right to receive a funded pension from the age of 55/60 years	–0.02378	0.041	–0.582	0.567
*X*7 – granting the right to a mandatory share in the inheritance to citizens of pre-retirement (former retirement) age	0.154255	0.050	3.102	0.005
*X*8 – preservation of the right of disabled women who have reached the age of 55 and men who have reached the age of 60 to receive alimony	–0.06945	0.046	–1.496	0.150
*X*9 – exemption from property tax	0.055786	0.101	0.550	0.588
*X*10 – reduction of the tax base (deduction) for land tax	–0.02895	0.039	–0.740	0.468
*X*11 – increase in financing by the Compulsory Social Insurance Fund of payments to enterprises for vouchers for sanatorium and resort treatment of pre-pensioners by 30%	0.044609	0.047	0.947	0.355
*X*12 – provision of medications for free	–0.18835	0.093	–2.027	0.056
*X*13 – preferential manufacture of dentures	0.072122	0.043	1.685	0.107
*X*14 – reduced transport fares	0.17467	0.087	2.001	0.058
*X*15 – discount on overhaul	0.441169	0.123	3.584	0.002

Source: compiled by the authors.

The sphere of property relations has little to do with the behavior of pre-pensioners in the labor market. Despite the general demand by pre-pensioners in 0.709312 units of the semantic differential corresponding to the level "rather necessary", such a support measure as "exemption from property tax" (0.89933) is characterized by them as "necessary". The least demanded by pre-retirees of property relations is a measure of support in relation to the remote period from their pre-retirement period — "preservation of the right of disabled women who have reached the age of 55 and men who have reached the age of 60 to receive alimony" (0.54028 — "it is difficult to say whether it is necessary or not"). At the same time, the measure "exemption from property tax" (0.89933 units) is most in demand by pre-pensioners. Its level according to the semantic differential exceeds the assessment "necessary" (0.83 units).

The total demand by pre-pensioners for state support measures in the field of labor relations is at the level of 0.70271 units of semantic differential, which corresponds to the assessment "rather necessary" (0.67 units). At the same time, a significant decrease in the overall level of demand by pre-pensioners for measures of state support in the field of labor relations is affected by such a measure as "providing opportunities for advanced training and retraining with the payment of a scholarship equal to the minimum wage under the programs of employment centers" (0.59589). According to the semantic differential, this measure is located between the estimates "it is difficult to say whether it is necessary or not" (0.50) and "rather necessary" (0.67).

Thus, an analysis of the results of assessing the demand for pre-pensioners in eight regions of Russia on state support measures showed that theoretically, the level of demand for measures by pre-pensioners is explained by their influence on the development and preservation of working capacity, increasing competitiveness in the labor market by creating favorable conditions for reproducing the working capacity of pre-pensioners and delivering their workforce to the labor market, and relevance in a time of their provision.

It is possible to form a holistic view of the interrelations and influence on each other of disparate types of demand for measures of state support for pre-pensioners in various aspects of maintaining and reproducing their working capacity, as well as increasing their competitiveness in the labor market using a general linear multivariate regression model:

$$Y = a_0 + a_1X_1 + \ldots + a_nX_n, \quad (1)$$

where a_n — coefficients at variables X_n, n varies from 0 to i-th value.

To select the most appropriate dependent variable, which fully reflects the mutual influence and relationships between the various types of state support measures proposed by the authorities, a correlation analysis of the matrix of the initial 16 variables was performed. As a result of this analysis, it was found that the sum of the squared deviations for the $X16$ variable "discount on utility bills" is the maximum: 1.565. This circumstance served as the basis for choosing it as an independent variable with the designation Y.

The remaining types of measures of state support for pre-pensioners $X1$ — $X15$ are taken by us as independent variables. With respect to Y, a linear model of multivariate regression $X1$ — $X15$ was constructed. The found regression coefficients of independent variables and a number of statistical estimates for the resulting model are given in *Table 8*.

The analysis of the quality of the obtained model according to statistical estimates showed that the coefficient of multiple correlation tightness R = 0.9547557 between Y and independent factor signs of the demand for state support measures by pre-pensioners $X1$—$X15$ turned out to be the maximum of all other options we tested.

The closeness of the reduced R value to one indicates a high statistical significance of the constructed multiple regression model. The revealed fact gives good reason to be confident

in the adequacy and reliability of the model explanation of the relationship between the demand for measures to support pre-pensioners of the dependent variable "discount on utility bills" *Y* and the factor (independent) of the characteristic X1—X15 (*Table 8*).

Let us characterize the revealed connections. Firstly, the model shows that if for all the studied support measures, types of guarantees and benefits offered by the authorities, the demand for "extremely necessary" among pre-pensioners is 1.0 units, then the dependent demand for "discount on utility bills" will be equal to 0.99328 units, i.e. will be demanded as a "extremely necessary" measure. Thus, whatever equal value is set for each independent variable, the *Y* value will also be equal to that value. Consequently, the demand for "discount on utility bills" by pre-pensioners can rightfully be considered a key parameter of demand for all other measures of state support.

Secondly, the value of the *Y*-intersection indicator, equal to 0.375564 units of demand, which is a sign of incomplete coverage of the variables of the model of the phenomenon under study, indicates that 37.55% of the demand for pre-pensioners is reflected in measures not yet included by government authorities in support measures. In an ideal model, the *Y*-intersection should be equal to zero, which is possible only as an exceptional case.

Thirdly, changes in the demand for pre-pensioners only for six support measures (*X*7, *X*8, *X*12 — *X*15) noticeably (0.07–0.441 units) affect the change in *Y* — the demand for "discount on utility bills" by pre-pensioners. Consequently, the demand for other support measures (*X*1 — *X*6, *X*9 — *X*11) should be equal to any of the arbitrary *Y* values in the range from 0.0 to 1.0 units with a small deviation of 0.001–0.0446 units.

Fourthly, of the support measures *X*7, *X*8, *X*12 — *X*15 the strengthening effect on *Y* of 0,0721–0,4411 units is only in measures *X*7, *X*13 — *X*15. On the contrary, they weaken the demand for pre-pensioners on Y by –0,0694 ÷ –0,1883 units in measures *X*8 and *X*12, and vice versa, an increase in the demand of pre-pensioners on "discount on utility bills" will weaken their demand in measures *X*8 and *X*12.

In addition, it should be noted that all *t*-statistics for support measures *X*7, *X*8, *X*12 — *X*15 have such values that confirm their sufficient reliability from 90 to 98%.

In general, the developed model for assessing the demand for state support measures by pre-pensioners revealed good adequacy in highlighting the real strength and direction of the relationships of various types of demand, showed sufficient reliability in explaining the relationships between the types of demand for pre-pensioners in state support measures by regression coefficients with a dependent variable.

During the analysis of the model, it was proved that the key parameter for assessing the demand for measures to support pre-pensioners is such a measure as "discount on utility bills". Demand for it serves as a benchmark for establishing acceptable demand criteria for all other support measures, based on the lower "necessary" (0.83 units) and upper "extremely necessary" (1.00 units) thresholds and are determined by the calculation method based on the indicators of the model. To check the sensitivity of the model of this sample, it is enough.

CONCLUSIONS

The study of the formation of the pre-pensioner segment in the labor market allows us to draw the following conclusions.

In most countries of Europe, America, Asia, and Australia, liberal models of regulating the behavior of pre-pensioners in the labor market prevail, while in Russia, the paternalistic model prevails. The mechanical transfer of methods for regulating the behavior of pre-pensioners from one model to another is often inadequate.

The low level of financial literacy of people approaching retirement age is the cause of careless behavior in regard to ensuring sufficient retirement income. Improving the financial literacy of pre-pensioners, aimed at the principles and tools for forming a future pension,

is a necessary condition for making an effective individual decision on the method of forming a pension.

The formation of the pre-pensioner segment in the labor market has a pronounced tendency to decrease with each subsequent stage of raising the retirement age to the upper limit of the working capacity of the population.

The sixteen measures of state support for pre-pensioners are aimed at four areas of their life: labor relations, property relations, healthcare, and services. The implementation of these measures is carried out at the expense of state funding.

In the field of labor relations, pre-pensioners employed in the labor market most demand the measure of state support for the "ban on dismissal due to age". In the sphere of property relations, the measure for "exemption from property tax" is more in demand by pre-pensioners. In the field of healthcare, the most demanded measure by pre-pensioners is the state support measure for the "provision of medications for free", and in the service sector — "discount on utility bills".

The research results can serve as a basis for explaining their trends and patterns, as well as for substantiating the assessment by the authorities of the effectiveness of financing the measures they take to provide social and economic support to pre-pensioners.

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L. A. Zhigun — general supervision of the article, problem statement, development of the conceptual framework of the article, section "Assessment of the demand for state support measures by pre-pensioners".
E. V. Kamneva — sections "Scientific elaboration of the research topic" and "Analysis of trends and content of the formation of the segment".
M. V. Polevaya — abstract, introduction, conclusions.
S. Zappala — analysis of foreign sources.

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Analysis of Household Income Dynamics in the Russia Based on the RLMS Database

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ABSTRACT

The **goal** of the study is to estimate the parameters of the stochastic wage process using data from the Russian Longitudinal Monitoring Survey of Higher School of Economics (RLMS-HSE). The main **method** of analysis is econometric estimation, which includes two steps. In the first step, the authors estimated a Mincer-type regression. In the second step, they estimated the parameters of the stochastic wage process using the generalized method of moments. As a **result**, the autoregression coefficient turned out to be lower, and the variance of shocks was higher than in similar foreign studies. The results of the research allow to **conclude** that labor incomes in Russia are less stable over time and are marked by great uncertainty. The practical value of the work lies in the possibility of using the obtained estimates when calibrating general equilibrium models with heterogeneous agents, which is demonstrated in the framework of estimation of macroeconomic effects from hypothetical tax maneuvers based on the canonical model with heterogeneous agents.

Keywords: wages; labor income; labor income profile; RLMS; generalized method of moments; general equilibrium model; heterogeneous agents

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INTRODUCTION

Household income dynamics play an important role in decisions about consumption and savings, human capital accumulation. In the economic literature, household income trajectories are described as stochastic processes in which the key indicators are variance of shocks and autocorrelation. The first indicator characterises how big unexpected changes in income can be experienced by the household, the second indicator — how long income will be able to adjust to previous levels. With the risk of declining incomes in the future, the most important characteristic of consumer behavior is the precautionary motive in which households save for the rainy day. Of course, the precautionary motive is different for households with different levels of assets (which includes the entire history of income shocks), leading to a heterogeneous propensity to consume for households with different levels of accumulated wealth. This fact has stimulated the active development of dynamic stochastic models of general equilibrium with heterogeneous economic agents for the analysis of monetary and fiscal policy in business cycle analysis as opposed to traditional models with representative agents (see, for example, [1, 2]). General equilibrium models with heterogeneous agents, the key source of heterogeneity in which idiosyncratic uninsurable risk in income, were also built to analyse many other issues, namely social insurance [3], impact of economic policies on inequality and entrepreneurial sector [4, 5].

Despite the fact that income modelling is used in many areas of economic research, as far as we know, there are no such estimates on Russian data. In the [6] income decomposition was made only on permanent and uncorrelated transitive component, but the presence of autocorrelation was not considered. This work aims to fill this gap and give a wide range of estimates based on RMLS microdata.[1]

The results can be of practical value for calibrating general equilibrium models for the Russian economy with heterogeneous economic agents. The last section of the article describes the calibration and results of the general equilibrium model with heterogeneous agents under alternative tax policies: increase in VAT, increase in VAT with reduction of insurance premiums, increase in VAT with reduction of income tax.

The article is structured as follows. The second section provides an overview of the literature, the third section describes the data used, the fourth section presents the results of an empirical analysis. The last section presents a canonical general equilibrium model with heterogeneous agents as an example of the practical application of the estimates from the previous sections to calibrate models of a given class, on the basis of which the effects of hypothetical tax manoeuvres are Estimated.

REVIEW OF THE LITERATURE

The rejection of the assumption of full insurance, highlighted the idiosyncratic shocks that determine the economic choice. The assumption of incomplete markets where individuals are at risk of unemployment or changes in labor productivity allows the precautionary motive to be taken into account in general equilibrium models with heterogeneous agents [7–9]. The precautionary motive encourages agents to accumulate savings in the event of an unexpected loss of work or loss of productivity.

In models with heterogeneous agents, idiosyncratic risks of labor incomes follow the Markov chain of the first order. Taking this into account, the problem of a household with exogenous work in a heterogeneous agent economy can be formulated as follows:

$$V(\epsilon,a)=\max_{c,a'}\left[u(c)+\beta E\left\{V(\epsilon',a')|\epsilon\right\}\right]$$

[1] Russian monitoring of the economic situation and health of the population of HSE Research Institute (RLMS HSE), conducted by the National Research University "Higher School of Economics" and LLC "Demoscope" with the participation Centre for Population of the University of North Carolina in Chapel Hill and the Institute of Sociology of the Federal Research and Sociology Center of the RAS. URL: https://rlms-hse.cpc.unc.edu and http://www.hse.ru/rlms (accessed on 11.11.2021).

$$\text{s.t. } a' = (1+r)a + w_\epsilon - c$$

$$a' \geq a_{\min}$$

$$\pi(\epsilon' | \epsilon) = \text{Prob}\{\epsilon_{t+1} = \epsilon' | \epsilon_t = \epsilon\},$$

where $V(\epsilon, a)$ — value function; $u(c)$ — utility of the agent dependent on consumption c; β — discount factor; ϵ — state variable for stochastic agent's income; a — asset stock of the agent, not lower than a_{min}; r — interest rates in the economy; w_ϵ — agent's labor income ϵ; $\pi(\epsilon' | \epsilon)$ — transition matrix showing the probability of transition from state ϵ to new state ϵ'.

The standard approach for calibrating data matrix $\pi(\epsilon' | \epsilon)$ used in heterogeneous agent models includes two steps: estimation of the continuous Markov process for the stochastic component of earnings and discretization of this process. The most commonly used discretization algorithms are presented in the works [10–12]. The labor income process is represented as fluctuations around the deterministic function of the observed variables, using the stochastic process of the residuals of the standard Mincer regression. Thus, the logarithm of income is generally described by the formula:

$$\ln W_{i,t} = \underset{\text{characterization}}{g(t, X_{i,t} \ldots)} + \underset{\text{heterogeneous profile}}{[\alpha_i + \beta_i t]} + \underset{\text{stochastic component}}{[\int_{i,t} + \nu_{i,t}]}$$

$$\epsilon_{i,t} = \rho \epsilon_{i,t-1} + \eta_{i,t}, \quad (1)$$

where $\ln W_{i,t}$ — logarithm of the agent's labor; $g(\cdot)$ — function of deterministic variables (time period, demographic variables, etc.). Input parameters for discretization of a random process are estimates of autoregression coefficient ρ and variance σ_η^2.

Parameter estimates are obtained by minimizing the distance between elements of the empirical autocovariance matrix of the regression residuals and their theoretical counterparts, derived from the specification (1).

Single opinion on specification in the literature did not work out. In an earlier work [13] based on the Panel Study of Income Dynamics (PSID) the following specification was estimated:

$$y_{i,t} = \alpha_i + \epsilon_{i,t},$$

$$\epsilon_{i,t} \sim ARMA(p, q),$$

where $y_{i,t}$ — stochastic component of labor income.

The time series for both income and wages were stationary only in the first differences, indicating a random walk. The variance of individual effects α_i was insignificant. In addition, T. MaCurdy proposed a statistical test that pointed to a process without individual effects. The final specification did not include individual effects, and the shock $\epsilon_{i,t}$ описывался процессом ARMA (1, 2). was described by the ARMA process (1, 2). The autocorrelation estimates for income and wages were 0.974 and 0.975 respectively, which is quite close to one. In the future, the idea that the stochastic component of earnings is better described by the process of random walk was also supported by the conclusions of [14–16].

However, these findings are contested in the work [17], in which the author's two approaches to modeling the process of labor incomes are compared. The first is the restricted income profile (RIP). This approach assumes that individuals are exposed to strong and highly persistent income shocks. In doing so, they meet similar income profiles throughout their lives. The second is the heterogeneous income profile (HIP). This approach implies that individuals are exposed to less persistent income shocks and face individual income profiles throughout their lives. The theoretical motivation of the second approach is the notion of human capital, which implies differences in income levels among people with different abilities.

In this work, the logarithm of labor income described by the restricted income profile was specified by the following specification:

$$y_{i,j,t} = \alpha_i + \beta_i j + \epsilon_{i,j,t} + \mu_t \nu_{i,j,t},$$

$$\epsilon_{i,j,t} = \rho\epsilon_{i,j-1,t-1} + \phi_t\eta_{i,j,t},\ \epsilon_{i,0,t} = 0,$$

where j — potential experience of an individual (age minus duration of education); β_i — slope coefficient with variance σ_β^2; and random heteroscedastic errors — $\mu_t\nu_{i,j,t}$ and $\phi_t\eta_{i,j,t}$.

The restricted income profile was described by specification without individual heterogeneity ($\sigma_\beta^2 = 0$). Individual income differentials are statistically and quantitatively significant according to PSID data for 1968–1993. The autoregression coefficient in the restricted income profile model was 0.99, and in heterogeneous model — 0.8. This means that at retirement age, 65 to 80% of income inequality is associated with heterogeneous individual effects. The article concludes that the estimation of the autocorrelation coefficient in the model with a restricted income profile is overestimated. The bias is caused by the fact that a person with too high or low income will systematically deviate from the average income profile. Then, in the proposed econometric model, these biases will be interpreted as the result of positive income shocks.

In addition, this article criticizes the test proposed in [13] for low power in relation to higher autocorrelation orders. Using the Monte Carlo method, the author showed that the test points to RIP for a process generated as HIP.

The paper [18] used administrative data from Germany on quarterly earnings of employees over the 27 years of their career. Estimates were given for those individuals who dropped out or had just graduated from school, as the covariance matrix for this educational group was comparable to data from the USA. T. Hoffmann suggested modification of the specification [17], which took into account the age effects of the covariance matrix. In a simple specification without heterogeneous feedback, i.e. when $\sigma_\beta^2 = 0$, autocorrelation coefficient ρ was equal to 0.98, in modified specifications estimates range from 0.8 to 0.9.

Most of the approaches described above are based on fairly simple time series models. Empirical studies suggest that household incomes are asymmetric and non-linear, so researchers also propose flexible models that take this evidence into account.

In [15] the authors rejected the assumptions about equally distributed independent income shocks in favor of models with conditional variance. In addition to ARCH effects, shocks depended on age, time, and unobserved heterogeneity. The authors also suggested that the incomes of people with different levels of education may be subject to different processes. According to the article conclusions, the unit root specification better describes the process of labor income, and the variance of shocks is state-dependent and heterogeneous among agents.

In the work [19] the heterogeneity of the whole process of income generation is assumed: in initial value, variance of shocks, MA and AR process parameters, deterministic trends, convergence rate, measurement error. The authors' results show that the variances of shocks and measurement errors differ significantly among employees and refute the hypothesis that the wage process has a unit root.

However, to be included in the structural model, it is important that the specification not only is flexible and good at describing the reality, but that its conclusions can be used without significantly complicating the general equilibrium model and increasing the calculation time. In [20] authors proposed a non-parametric model that could be used in macroeconomic models with heterogeneous agents. Instead of estimating and discretizing the Markov process, the authors proposed to evaluate the age-specific Markov chain directly from the data. The model was evaluated on PSID data and on synthetic data that correspond to tax data on income in the USA. The authors included the estimated age-specific matrix in the standard life cycle model and compared its conclusions with those of a similar model where the standard AR (1) process was assumed for wages. In comparison with the standard model, the method of estimation proposed by the authors results in greater inequality of consumption, which better corresponds to the

real data. The left tail of the distribution looks more realistic than standard specification model. However, the proposed specification has the same disadvantage as the specification with AR (1): in a life cycle model without a bequest motive or entrepreneurial sector, the right tail of the generated distribution is still not sufficiently thick compared to the actual distribution.

In addition to the idiosyncratic risk, there may also be an aggregate risk in the general equilibrium model with heterogeneous agents. The problem is that panel data is usually not long enough. In [16] is offered method based on generalized method of moments, taking into account and addressing the macroeconomic history of family members. The stochastic earning process was modeled as ARMA (1, 1) with a regime-switching component in conditional variance. The results showed that the idiosyncratic risk of labor income is counter-cyclical. Autocorrelation estimates were high — from 0.94 to 0.96, and the variance of shocks during the recession is reduced by 75%: from 0.12 to 0.21.

Modern research also takes into account the nature of changes in income and distinguishes between external shocks and endogenous responses of individuals to them. So, in [21], the combined model is estimated, which takes into account wages, working hours, transitions between employment and unemployment, changing jobs. In addition to many conclusions about the reasons for the change of work, the authors find that the income of individuals, though stable, but still not characterized by random walk.

The following conclusions can be done from the literature review. Wage modeling is important for many areas of economic research. First, it is an important input for macroeconomic models with heterogeneous agents. Second, understanding the process and risks of income generation is important for household consumption research. In addition, some studies focus on the income process itself: finding the right specification, formulating stylized facts, identifying the main factors influencing household labor income.

EMPIRICAL PART

In the first step, the stochastic earnings process is disposes of the influence of demographic and geographical determinants. To do this, the Mincer regression of the logarithm of wages in real prices of a set of individual and geographical characteristics and binary variables for periods is estimated:

$$\ln W_{i,t} = X_{it}\beta + \theta Year_{it} + y_{i,t}\ , \qquad (2)$$

where $\ln W_{i,t}$ — logarithm of real labor income (hourly wage or wage for the last 30 days); X_{it} — set of individual (age, age squared, binary variables for level of education) and geographic characteristics; $Year_{it}$ — binary variable vector for each period from 2001 to 2019.

Residuals of this equation $y_{i,t}$ represent a stochastic component of labor productivity. It is assumed that it is the sum of three orthogonal components — individual effects α_i, autoregression shock $\epsilon_{i,t}$ and transitive shock $\nu_{i,t}$:

$$\begin{aligned} y_{i,t} &= \alpha_i + \epsilon_{i,t} + \nu_{i,t}, \\ \epsilon_{i,t} &= \rho\epsilon_{i,t-1} + \eta_{i,t}. \end{aligned} \qquad (3)$$

This specification was used, for example, in the work [17] on the USA and [18] on data for Germany.

In this model $\eta_{i,t}$ and $\nu_{i,t}$ are taken from normal distributions with zero expectation and variances σ_η^2 and σ_ν^2 respectively. The initial autoregression shock $\epsilon_{i,0}$ — is a random variable distributed with zero mathematical expectation and variance σ_{ϵ_0}. Individual effects α_i have zero mathematical expectation and variance σ_α^2. In a model without individual effects, it is assumed that $\sigma_\alpha^2 = 0$.

The true value measurement errors cannot be directly estimated from the data, so researchers usually assume that it does not depend on time. Then the variance of measurement error enters the variance of transitory shocks $\nu_{i,t}$.

It can be shown that for specification (3) the theoretical second moments of the distribution are given by formula:

$$E\left[y_{i,t}y_{i,t+h}\right]=\begin{cases}\sigma_\alpha^2+E\left[\varepsilon_{i,t}^2\right]+\sigma_\nu^2, & if\ h=0\\ \sigma_\alpha^2+\rho^h E\left[\varepsilon_{i,t}^2\right], & if\ h>0,\end{cases} \quad (4)$$

where h — integers from 0 to $T-t$; T — maximum period under consideration; $E\left[\epsilon_{i,t}^2\right]=\rho^{2t}\sigma_{\epsilon_0}^2+\sum_{k=1}^{t}\rho^{2(t-k)}\sigma_\eta^2$.

Parameter estimation is made by minimizing the distance between empirical moments $\widehat{M}$ and their theoretical counterparts $M(\theta)$, given by (4):

$$\min_\theta\left[M(\theta)-\widehat{M}\right]^T W\left[M(\theta)-\widehat{M}\right].$$

Nelder-Mead algorithm was used to minimize. Newton, Broyden-Fletcher-Goldfarb-Shanno (BFGS), algorithms, the conjugate path method converged over more time, and the differences in the numerical optimum values were negligible. Since the confidence intervals for the parameters were based on a bootstrap, which requires multiple finding of the optimum, it was decided to favor the Nelder-Mead algorithm. The valuation suggested that matrix W — is the identity matrix because in [22] it is shown that the optimal matrix of weights W leads to bias of estimates.

Standard errors were calculated using a bootstrap with 500 replications. Each pseudo-sample included as many households (or individuals) as the original sample. First step regression was evaluated for each pseudo-sample. Stochastic process parameters (3) were estimated based on regression residuals (2). Confidence intervals were calculated from the derived distribution of estimates.

In general equilibrium models with heterogeneous agents, the labor supply can be either inelastic (exogenous) or elastic (endogenous). Depending on this, estimates should be made based on different time series: monthly or hourly wages. To complete the analysis, we will provide estimates based on several alternative specifications.

In the case of a household, it is not clear what is meant by its earned income. In some works, labor income refers to the income of the head of household, which can be defined differently. For example, in a work [23] also based on the RLMS, a household was sampled if it had at least one individual aged 25–60. The head of household was the oldest man of working age or the oldest woman if there were no men. This was the approach used in this work.

Thus, eight specifications are estimated that differ in the following characteristics:

- model specification: with or without individual effects;
- unit of observation: individual or head of household;
- dependent variable: hourly wages or wages for the last 30 days.

The estimations were based on RLMS data from 2001 to 2019. In order to form a representative sample for panel analysis, the latest 28th wave was selected as the baseline. Household data from representative sample of this wave were used for further analysis.

Two samples were selected for analysis: a household sample and an individual sample. Employed individuals were included in the sample of individuals. The lower age limit was 25 years, and the upper age limit was equal to the age of retirement: 60 years for men and 55 years for women. Households in which at least one individual is over 25 years of age and below retirement age. The head of household was the oldest man of working age. If not, the oldest woman of working age was appointed head. This approach was used in similar works on both the USA [24] and Russian [23] data.

The individual's wage was calculated as the sum of payments for the last 30 days of the main and additional work. Household data and individual data were used to construct a sample of households. Wages were converted to 2019 prices using the consumer price index (CPI). Hourly wage calculated as ratio of wages to hours worked over the last 30 days.

Data pre-processing and model estimation were carried out using the Python programming

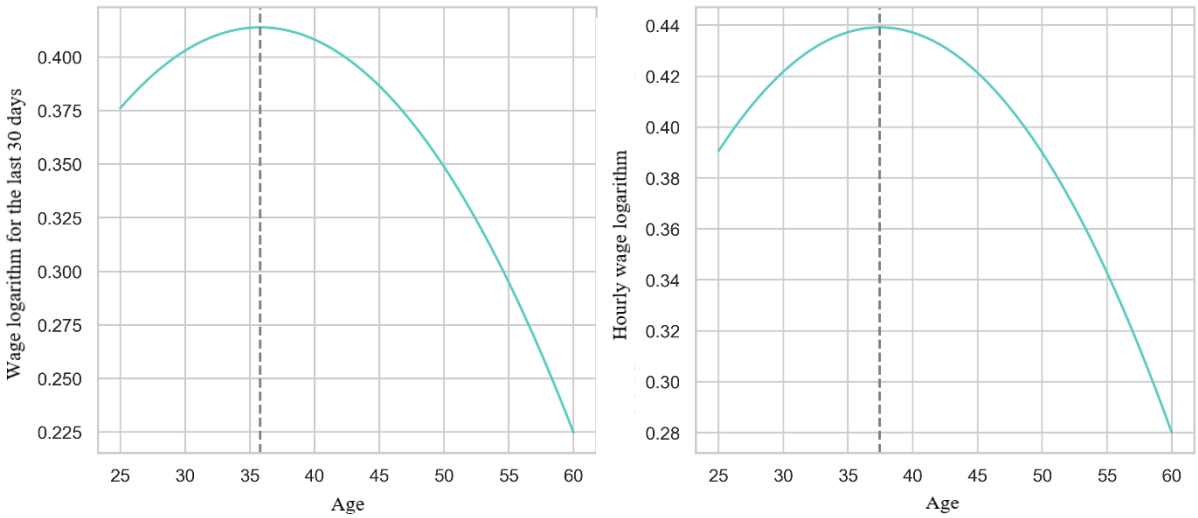

Fig. 1. **Wage dependence on age**

Source: Authors' calculations based on RLMS-HSE and Rosstat data.

language.[2] The Statsmodels library was used to build econometric models, NumPy — or matrix calculations, and SciPy — to find minima of functions.[3]

RESULTS

The results of the first step regression evaluation are presented in *Table 1*. All signs of coefficient are as expected and the estimates are statistically significant at any reasonable level of significance.

Other things being equal, the wages of individuals living in the city are 31–33% higher than those in rural areas. Monthly wages for residents of Moscow and the Moscow region are 55–57% higher than those of rural residents, and hourly wages are 61–62%.

Workers with higher education, all other things being equal, earn 35% per month and 41% per hour more than those with incomplete secondary education. In addition, the wages of workers with specialized secondary education are higher than those with secondary education. It is worth noting that estimates of binary variables for education levels are statistically higher for regressions in which the dependent variable is hourly wage. That is, the higher the level of education, the less people work. This may be due, for example, to the specificity of the work or to the fact that the income effect of an increase in the hourly wage is greater than the substitution effect — individuals prefer additional leisure hours to higher labor incomes.

Age and age squared coefficient estimates were significant, indicating a quadratic dependence. Based on the signs of coefficients, the wage depends nonlinearly on age — has the inverted U shape (*Fig. 1*). Depending on the specification, all things being equal, wages go up to 35 to 37 years, and then they fall. This result is consistent with the empirical evidence presented in [25] that this age-specific wage profile is a characteristic and stable Russian feature. While wages in foreign countries grow monotonously and at a slowing rate throughout life, in Russia the maximum wages reach up to 40 years. V. Gimpelson attributes this empirical fact to a lack of investment in human capital after completion of formal education and the resulting decline in cognitive abilities, deteriorating health, and declining in personal characteristics such as "openness to new experience".

The results of the estimation by the generalized method of moments are presented in *Table 2*. As can be seen from the results obtained, the addition of individual effects leads to a lower estimate

[2] Python 3.8.8 version.

[3] Statsmodels 0.12.2 version, NumPy 1.20.1 version, SciPy 1.6.2 version.

Table 1

Estimates of regression coefficients of real wages for demographic variables

Variable	Dependent variable: last 30 days' wages		Dependent variable: hourly wages	
	Individuals	Heads of households	Individuals	Heads of households
	(1)	(2)	(3)	(4)
Constant	8.181*** (0.075)	8.215*** (0.088)	3.010*** (0.076)	3.027*** (0.088)
Urban area	0.310*** (0.007)	0.330*** (0.008)	0.305*** (0.007)	0.330*** (0.008)
St Petersburg	0.355*** (0.018)	0.349*** (0.021)	0.366*** (0.019)	0.357*** (0.022)
Moscow and Moscow region	0.574*** (0.010)	0.555*** (0.011)	0.623*** (0.010)	0.610*** (0.011)
Higher education	0.346*** (0.0128)	0.354*** (0.014)	0.414*** (0.013)	0.411*** (0.014)
Secondary special education	0.077*** (0.013)	0.081*** (0.014)	0.119*** (0.013)	0.120*** (0.014)
Complete secondary education	0.036*** (0.013)	0.039*** (0.014)	0.056*** (0.013)	0.057*** (0.014)
Age	0.023*** (0.003)	0.024*** (0.004)	0.023*** (0.003)	0.024*** (0.004)
Square age	−0.0003*** (0.000)	−0.0003*** (0.000)	−0.0003*** (0.000)	−0.0003*** (0.000)
R^2	0.318	0.326	0.326	0.330
R^2_{adj}	0.318	0.325	0.326	0.330

Source: compiled by the authors based on regression analysis.

Notes: standard errors are shown in parentheses. Estimates for binary variables for each year are omitted. *** — significance at the 1% level.

of autoregression ρ in most of the proposed specifications, which, by and large, corresponds to the conclusions of work [17], although the difference is not so great. The autoregression coefficient does not change much depending on the dependent variable (hourly or wage for the last 30 days) and on the sample (all individuals or heads of households). In work with similar specifications made on the USA data, the autoregression coefficients are slightly higher: in [13, 14, 17] they were about 0.97–0.99, while in the *Table 2* estimates range from 0.89 to 0.93. It can be concluded that the stability of labor incomes in Russia is somewhat lower than in the USA.

Table 2

Estimates of the parameters of the stochastic component of wages

	Dependent variable: last 30 days' wages				Dependent variable: hourly wages			
	Individuals		Heads of households		Individuals		Heads of households	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ρ	0.931	0.886	0.931	0.886	0.931	0.886	0.903	0.916
	(0.922, 0.935)	(0.87, 0.893)	(0.923, 0.935)	(0.869, 0.893)	(0.923, 0.935)	(0.872, 0.892)	(0.894, 0.909)	(0.898, 0.926)
σ_v^2	0.017	0.014	0.024	0.050	0.076	0.100	0.090	0.00
	(0.017, 0.018)	(0.014, 0.015)	(0.024, 0.025)	(0.05, 0.052)	(0.076, 0.079)	(0.1, 0.103)	(0.089, 0.093)	(0.000, 0.000)
σ_η^2	0.083	0.079	0.072	0.071	0.069	0.079	0.097	0.047
	(0.081, 0.086)	(0.077, 0.081)	(0.071, 0.075)	(0.069, 0.074)	(0.067, 0.071)	(0.077, 0.081)	(0.095, 0.1)	(0.046, 0.049)
σ_ϵ^2	0.017	0.079	0.100	0.086	0.052	0.036	0.021	0.016
	(0.017, 0.018)	(0.079, 0.081)	(0.1, 0.103)	(0.086, 0.088)	(0.052, 0.053)	(0.036, 0.037)	(0.021, 0.022)	(0.011, 0.011)
σ_α^2		0.079		0.086		0.057		0.100
		(0.078, 0.081)		(0.086, 0.088)		(0.057, 0.059)		(0.1, 0.103)
$\sigma_\alpha^2 = 0$	-	+	-	+	-	+	-	+

Source: compiled by the authors based on the estimation of the model by the generalized method of moments.

Note: The lower and upper bounds of the confidence intervals calculated with the bootstrap are given in parentheses.

As for shock variance σ_η^2, that the estimates of this variable are not too different depending on the specification. An exception is the case where the dependent variable is the hourly wage, and the sample includes heads of household. Compared to similar specifications estimated on the USA data, for example [17], the variance of shocks in Russia was higher. It can be assumed that households in Russia face greater uncertainty in labor income than households in the USA.

GENERAL EQUILIBRIUM MODEL

This section presents a neoclassical general equilibrium model based on a model from [26] extended by the introduction of social security contributions and lump-sum taxes (transfers) into the model. The model has three sectors: firms, households and the government. Calibration of the model is described, which uses estimates from previous sections. There is no aggregate uncertainty in the model. Households maximize utility by making decisions about their supply of labor and consumption in an elastic-supply model, and only in a consumption — in the model variant with an inelastic labor supply defined exogenously. At the same time, households are exposed to idiosyncratic shocks to productivity and employment that cannot be insure. Firms maximize profits and produce goods using labor and capital as factors of production. The government collects revenue from taxes and spends it on government consumption and

unemployment benefits. The government balances the budget with lump-sum taxes or transfers to households.

HOUSEHOLD

The economy has a continuum of households with a measure of one. They differ in employment status, labor roductivity ϵ and asset stock k. Productivity follows a first-order Markov process with the transition matrix $\pi(\epsilon'|\epsilon)$, which specifies the probability of transition from the current state ϵ to the new state ϵ'. In a model with an inelastic supply of labor, the household maximizes its utility and decides only on current consumption, taking into account the current stock of capital k and the productivity ϵ, of labor, in a model with elastic labor — also relatively the supply of labor n.

The instantaneous utility function of households is a function with constant relative risk aversion (CRRA):

$$u(c_t, n_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma} - \gamma_0 \frac{n_t^{1+\gamma_1}}{1+\gamma_1},$$ where c_t — household consumption during t; n_t — hours worked; σ — elasticity marginal utility by consumption (relative measure of risk aversion); γ_1 — parameter reflecting the elasticity of hours worked to the wage rate (inverse value to labor supply elasticity by Frisch); γ_0 — normalization coefficient.

The household budget constraint is:

$$k' = -T_{lump\ sum} + (1+r)k + (1-\tau_{income})w\epsilon n - (1+\tau_{consumption})c + I_{state=unemployed}b,$$

where k' — household asset stock in the next period; k — stock of assets in the current period; $T_{lump\ sum}$ — lump-sum taxes; r — real interest rate; τ_{income} — labor income tax; w — hourly rate of individual wages; ϵ — Individual productivity as measured by changes in hourly wage rates and described by the Markov chain of the first order; $\tau_{consumption}$ — consumption tax; $I_{state=unemployed}$ — indicator function equal to one if the agent is unemployed; b — unemployment benefit.

FIRM

Firms maximize profits based on labor and capital demand:

$$\max_{N_t, K_t} \left\{ F(K_t, N_t) - (1+\tau_{insurance}) w_t N_t - R_{K,t} K_t \right\},$$

where $F(K_t, N_t)$ — production function; K_t — total capital stock in the economy; N_t — cost effective labor; w_t — wage; $\tau_{insurance}$ — social security contribution rate paid by the firm per employee. User capital costs are defined as

$R_{K,t} = \frac{r_t}{1-\tau_K} + \delta$, where τ_K — rental tax on capital (counterpart of profit tax in the model); r_t — real interest rate; δ — rate of capital depreciation.

Production is described by the Cobb-Douglas function:

$$F(K, N) = AK^{\alpha} N^{1-\alpha}.$$

In equilibrium, firms' profits are zero and factor prices are equal to their marginal product:

$$r_t = (1-\tau_K)\left(\alpha A \left(\frac{N_t}{K_t} \right)^{1-\alpha} - \delta \right),$$

$$w_t = \frac{(1-\alpha)A}{1+\tau_{insurance}} \left(\frac{K_t}{N_t} \right)^{\alpha}.$$

GOVERNMENT

The government has a balanced budget in each period. The government revenue consists of lump-sum taxes $T_t^{lump\ tax}$, income taxes T_t^K, defined as a rental tax on capital for firms τ_K, final consumption taxes $T_t^{consumption}$, employee insurance payments $T_t^{insurance}$. Expenses consist of government consumption of G_t, which is a fixed share γ_g of the output, and unemployment benefits B_t:

$$G_t + B_t = T_t^{lump\ tax} + T_t^K + T_t^{income} + T_t^{consumption} + T_t^{insurance}.$$

The government balances the budget with lump-sum taxes (transfers).

STATIONARY EQUILIBRIUM

Stationary equilibrium in the proposed model for a given tax policy is the value function $V(\epsilon, k)$, set

of decision rules for consumption $c(\epsilon,k)$, labor supply $n(\epsilon,k)$ and capital stock in the next period $k'(\epsilon,k)$, time-invariant prices for labor w and capital r, as well as set of variables K,N,B,T,C such as:

1. Total capital stock and volume of efficient labor, consumption, tax revenues and unemployment benefits are calculated as:

$$K=\sum\nolimits_{\epsilon\in\mathcal{E}}\int_0^\infty kf(\epsilon,k)dk,$$

$$N=\sum\nolimits_{\epsilon\in\mathcal{E}}\int_0^\infty \epsilon n(\epsilon,k)f(\epsilon,k)dk,$$

$$C=\sum\nolimits_{\epsilon\in\mathcal{E}}\int_0^\infty c(\epsilon,k)f(\epsilon,k)dk,$$

$$T=T_{lump\,tax}+\tau_K\left(F(K,N)-(1+\tau_{insurance})wN-\delta K\right)+$$
$$+\tau_{income}wN+\tau_{consumption}C+\tau_{insurance}wN,$$

$$B=\int_0^\infty bf(\epsilon_0,k)dk.$$

2. $c(\epsilon,k),k'(\epsilon,k),n(\epsilon,k)$ — optimal decision functions of the household, which are the solution to its problem.

3. Labor and capital prices equal marginal productivities.

4. The goods market clears.

5. The government budget is balanced.

6. Distribution of household variables is stationary.

PARAMETER CALIBRATION

To construct the transition matrix $\pi(\epsilon'|\epsilon)$, the estimations of the stochastic process of wages, obtained in the previous sections of the article, were used. Thus, for a model with an inelastic supply of labor, estimates ρ and σ_η^2 were taken from a column (4) (*Table 2*), and for a model with elastic labor supply — from a column (8). The estimates ρ and σ_η^2 served as input parameters for the discretization algorithm proposed in [12], which produces a productivity distribution and a transition matrix for employed workers at the output.

Since the estimates in the previous sections were given conditional upon the employment of the head of household, the matrix also takes unemployment separately. The productivity of the unemployed was equal to zero. Two facts were taken into account in the simulation of transition from employment to unemployment. First, the long-term unemployment rate was assumed to be 6%. Second, the average time taken to find a job was 6 months.[4] In addition, it has been suggested that households at all levels of productivity are equally likely to be unemployed. If an unemployed person finds a job, he falls into one of the classes with a probability proportional to the stationary distribution of employed workers.

The final distribution of productivity was normalized so that in the stationary state the sum of the productivity of the work was equal to one. As a result, for models with inelastic and elastic labor supply, productivity in different states was defined as follows:

$$\mathcal{E}_m=\{0,0.2823,0.5044,0.9011,1.6098,2.8759\},$$

$$\mathcal{E}_h=\{0,0.2894,0.5121,0.906,1.6029,2.8359\}.$$

The unemployment benefit in the model was set at 33.75% of the wage since in Russia the unemployed receive a benefit of 75% of their previous earnings for the first three months and 60% for the next three months, not more than six months.

The selected elasticity coefficients of marginal utility of consumption σ and output elasticity of capital α in the Cobb-Douglas function are standard in the literature that uses general equilibrium models. The depreciation rate δ was based on the average depreciation rate of fixed capital in Russia.[5]

The discount rate β is chosen so that the real interest rate in the stationary state in the base model with inelastic labor supply is 5%, which corresponds to the real interest rate in Russia in

[4] Federal State Statistics Service. Employment and unemployment in the Russian Federation in October 2020. URL: https://rosstat.gov.ru/storage/mediabank/wFtwOnek/zanyatost-i-bezrabotitsa.pdf (accessed on 11.11.2021).

[5] Penn World Table version 10.0. URL: https://www.rug.nl/ggdc/productivity/pwt/?lang=en (accessed on 17.11.2021).

Table 3

Calibration of general equilibrium model parameters

Parameter value	Description
$\beta = 0,94$	Discount factor
$\sigma = 2$	Elasticity of the marginal utility of consumption
$\gamma_0 = 1,57, \gamma_1 = 4$	Parameters of disutility of labour
$A = 0,63$, $\alpha = 0,35$	Total factor productivity and capital elasticity coefficient in Cobb-Douglas functions with constant returns
$\delta = 0,03$	Capital depreciation rate
$\gamma_g = 0,2$	Share of government expenditure in output

Source: compiled by the authors.

recent years.[6] Coefficient A was selected so that the interest rate is targeted and $F(K,L) = 1$.

Along with a specification with an inelastic labor supply, we are considering a scenario with an elastic labor supply in which the Frisch elasticity of labor supply is calibrated at a sufficiently moderate level of 0.25, which was used in similar works [27]. An estimate of the Frisch elasticity of labor supply proposal for married women of 0.16 was obtained from [28] based on RLMS-HSE data. In the work [29] the estimations of the labor supply elasticity were negative. Under these conditions, the selection of an elasticity value of 0.25 seems appropriate in order to compare model results with the case where the labor supply elasticity is zero. The chosen value agrees with the notion that in the Russian economy there is a low elasticity of the labor supply on wages.

Normalization coefficient γ_0 was selected based on the first-order condition for on labor supply:

$$-\frac{u_n'(c,n)}{u_c'(c,n)} = \frac{(1-\tau_{income})\epsilon w}{(1+\tau_{consumption})},$$

i.e.

$$\gamma_0 = \frac{(1-\tau_{income})\epsilon w c^{-\sigma}}{(1+\tau_{consumption})n^{\gamma_1}},$$

where w and c were used out of equilibrium of the base model with an inelastic labor supply, ϵ assumed to be equal to one, taking into account the productivity ratios, the labor supply of n was also equal to one.

The share of government expenditure in output was assumed to be 0.2 according to statistics on GDP by expenditure.[7]

The final calibrated parameters are presented in *Table 3*.

DESCRIPTION OF THE EXPERIMENTS

After the model calibration stage, we compare the stationary equilibrium parameters for the four tax policy options:

1. Initial parameters of tax policy: final consumption tax (value added tax, VAT) — 18%, rate of insurance premiums 30%, profit tax rate (rental tax on capital) — 20%.
2. Increase in final consumption tax rate to 20%, which occurred in the Russian Federation in 2019.
3. Increase of the final consumption tax

[6] The World Bank. Real Interest Rate (%) — Russian Federation. URL: https://data.worldbank.org/indicator/FR.INR.RINR?locations=RU (accessed on 08.11.2021).

[7] Federal State Statistics Service. On the production and use of gross domestic product (GDP) for 2020. URL: https://www.gks.ru/bgd/free/B 04_03/IssWWW.exe/Stg/d02/18.htm (accessed on 08.11.2021).

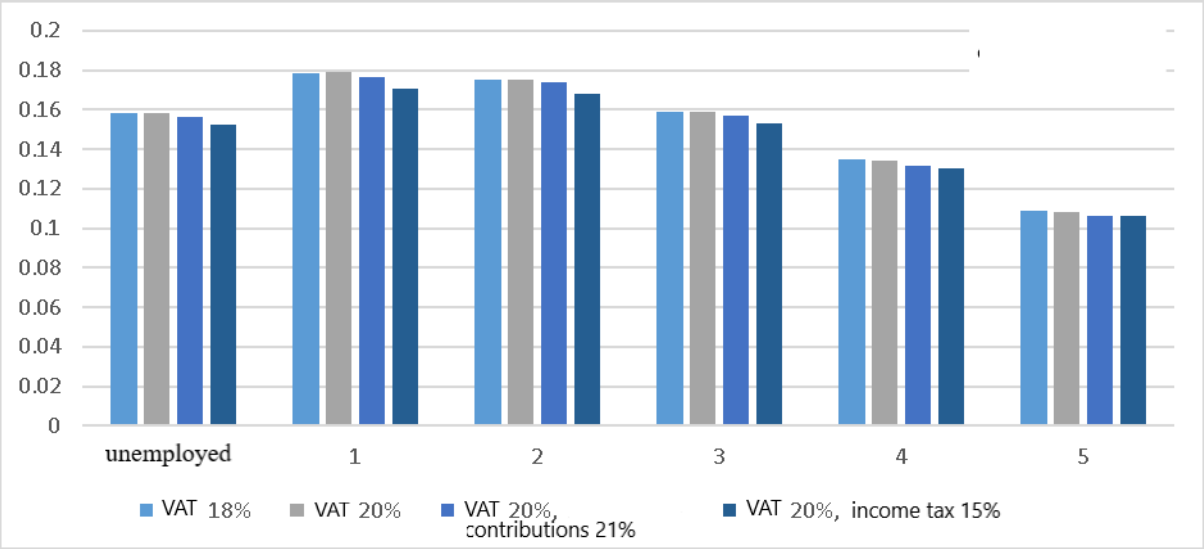

Fig. 2. **Share of consumption in household expenditures depending on tax policy**

Source: author's calculations.

rate to 20% while reducing social security contribution rate to 21% in the context of the option of tax maneuver corresponding to "fiscal devaluation" discussed at the time [30].

4. Increase the final consumption tax rate to 20%, while reducing the profit tax (rent tax) rate to 15%.

RESULTS

The stationary equilibrium of the model was calculated by solving the Bellman equation by value function iteration and finding stationary equilibrium in the asset market. Calculations were made using the Python programming language using NumPy libraries, as well as QuantEcon and Numba to speed up the calculations. Results are presented in *Table 4*.

When the VAT rate increases and other taxes remain unchanged, tax revenues increase, which, according to the construction, increase the lump-sum transfers. Since transfers are lump-sum, all individuals have the same increase in transfers in absolute terms. For rich individuals, however, the increase in VAT tax is greater in absolute terms than for poor people because they spend more resources on consumption. This scenario therefore shows a decline in inequality. In a model with an inelastic labor supply, although aggregate labor is fixed, there is nevertheless a slight decline in output due to the decline in capital in the economy. This is because the rich invest more of their income and consume less (*Fig. 2*), and this tax manoeuvre redistributes aggregate income to the poor, which reduces aggregate capital. In the case of elastic labor supply, the increase in VAT increases the distortion of the limit for the substitution of leisure consumption, which leads to a reduction in the supply of labor. Accordingly, in the model with endogenous labor we see a more significant decline in output and capital in the economy.

If, along with the increase in VAT from 18 to 20%, social security contribution rate is reduced from 30 to 21%, budget revenues will fall against the base scenario, which will consequently cause a decrease in transfers and increase in inequality. This will increase capital as rich individuals are more likely to save and thus increase output (by about 1%). In the specification with endogenous labor this will also increase the hours worked (about 8%), as the reduction of social security contribution rate firms will increase demand for labor , which will have an additional positive impact on capital accumulation and output (output increases in this scenario by about 1.5). The effects are quite moderate as we have

Table 4

Stationary equilibrium in the model depending on tax policy

	Inelastic Labor Supply				Elastic Labor Supply			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Insurance premiums, %	30	30	21	30	30	30	21	30
Income tax, %	20	20	20	15	20	20	20	15
VAT rate, %	18	20	20	20	18	20	20	20
Output index	100	99.82	100.95	101.88	100	99.58	101.55	101.50
Consumption index	100	99.85	100.69	101.29	100	99.62	101.38	100.95
Index capital	100	99.47	102.74	105.45	100	99.29	103.19	105.02
Labour input index	100	100	100	100	100	99.75	100.67	99.65
Interest rate, %	5.09	5.12	4.96	5.14	4.97	4.99	4.85	5.02
Wage index	100	99.82	108.46	101.88	100	99.84	108.37	101.85
Income tax benefit index	100	99.82	108.46	101.88	100	99.58	109.10	101.50
Index of VAT payments	100	110.94	111.88	112.54	100	110.68	112.64	112.16
Profit tax payment index	100	99.98	100.11	75.14	100	99.73	100.75	74.85
Insurance premium payment index	100	99.82	75.92	101.88	100	99.58	76.37	101.50
Compensation transfer index	100	107.65	89.40	102.10	100	107.54	89.98	101.95
Gini coefficient	0.244	0.241	0.253	0.244	0.246	0.242	0.254	0.245

Source: compiled by the authors.

suggested a low value for labor supply elasticity.

In the case of a simultaneous increase in VAT and a reduction in income tax, the increase in tax revenue relative to the base scenario is still positive, which contributes to a negligible reduction of inequality through a small increase in lump-sum transfers. Reducing the user cost of capital due to the reduction of income tax acutely stimulates capital accumulation, which increases by about 5%, leading to an increase in output of about 1.5%. Households become richer and, in endogenous specifications,

aggregate labor use declines despite real wage growth, as the income effect exceeds the substitution effect.

CONCLUSION

The paper attempted to provide a broad range of estimates of the stochastic wage process based on RLMS microdata. The estimation included two steps. In the first step the regression of wages of Mincer type was estimated. In the second step, the autocovariance matrix was estimated on the basis of the regression residuals, and then on the basis of this, estimates of the parameters of the stochastic component of wages were made using the generalized method of moments.

Signs of coefficients of Mincer regression obtained in the first step correspond to theoretical representations. Age dependency of wages takes the inverted U shape: wages rise to the age of 35–37 and then fall. With regard to education, the monthly salary of university graduates is 35% higher than that of those who have not completed secondary education and — 41% higher by the hour. Graduates of secondary institutions receive more students who have completed secondary education.

With regard to the estimation of the stochastic component of wages, depending on the specification and the sample, the estimates of the autoregression coefficient vary between 0.89 and 0.93, which is slightly lower than the estimates from similar specifications in the USA data. This suggests that labor incomes in Russia are less stable. In addition, variance of shocks of the stochastic income component is higher for Russian households, which leads to the conclusion that they face greater uncertainty in labor incomes.

The results obtained can be used for the calibration of models with heterogeneous agents. Estimates of autoregression parameters ρ and variance of shocks η are input parameters for discretizing the AR (1) process sampling using methods suggested in the works [10, 11].

The last section of the article presented an example of using the econometric estimates obtained on the example of the model with heterogeneous agents, calibrated with Russian data. On the basis of the theoretical model, alternative tax policies were compared: increase in VAT rate, increase in VAT rate with simultaneous reduction of the rate of insurance payments per employee, increase of VAT rate with simultaneous reduction of income tax.

According to the model, the increase in the VAT rate led to a decrease in total output, consumption, wages, capital stock, and in a model with an elastic labor supply, and a decrease in the use of efficient labor. However, economic inequality in this model was the smallest.

Higher VAT rates and lower rates of insurance premiums have led to an increase in total output, consumption, wages, capital stock, and in a model with elastic labor supply — and the cost of efficient labor. However, inequality in both variants of the model was the highest, which could be explained by the decline in lump-sum transfers to households in the context of declining tax revenues.

An increase in the VAT rate to 20% and the simultaneous reduction of income tax to 15% led to an increase in output, consumption, capital and wages. However, in a model with an elastic labor supply, the volume of efficient labor decreased by 0.35% due to the prevalence of income effect over substitution effect in labor supply, inequality in the model decreased slightly compared to the basic tax policy option.

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ORIGINAL PAPER

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Examining Behavioural Aspects of Financial Decision Making: The Working Women Perspective

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ABSTRACT

In the challenging and volatile financial markets, an investor needs to change his financial objectives frequently, leading to a diversified portfolio of investments. The financial future of the individual investor depends on his rational decision-making. This research **aims** to evaluate various determinants of financial decision-making concerning working women in the National Capital Region, India. It examines the association of financial literacy, personal finance planning, and risk behaviour with the financial decision-making of working females. The research also studies the different exogenous variables of financial literacy, including financial attitude (FA), financial behaviour (FB) and financial knowledge (FK). It utilises a quantitative approach for predicting relationships between the identified variables. The study is based on primary data collected through a structured questionnaire designed on a 5-point Likert scale and was analysed through a partial least square-structural equation modelling (PLS-SEM) approach. The **study results** suggest a positive and significant association of financial literacy and personal finance planning with financial decision-making by working women. On the other hand, risk behaviour negatively affects financial decision-making. The findings also reveal that all three exogenous variables, financial attitude, financial behaviour and financial knowledge, have a strong relationship with financial literacy. The research is relevant for individual women investing in various financial avenues to take better decisions. This study also benefits financial managers and institutions to target as women are potential investors in a developing country like India.

Keywords: financial decision-making; financial literacy; personal financial planning; risk behavior; working women

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INTRODUCTION

In the competitive market forces, the intricacy of the variety of financial products expands the scope of the entire financial market. Individual investors must have a thorough knowledge and awareness of the world of finance to make better choices [1]. The study of financial decision-making is a diverse field, not just limited to individuals or organisations but covers various market anomalies [2]. It is evident that financial decision-making is not an easy process — multiple factors like risk, return, market volatilities, financial knowledge, regulatory framework, and many other constructs affect an individual's decision-making process. However, there is a widespread opinion about an innate difference in men's and women's financial decision-making.

A broad perspective regarding financial decision-making is that women are more risk-averse than men, which creates stereotypical statistical discrimination against women and belittles their successes [3]. Other than the genetic variations, various researchers have found a conservative approach of women towards taking any financial decisions compared to men [4]. As there is an anticipation that women investors are generally over-cautious about their investments than men, they are typically offered low-risk financial opportunities and consequently low returns [5]. As we hear, change is the only constant, but in this unprecedented and dynamic global economy, change is the rule. The world is also witnessing a noticeable shift from men leading the world to women leading the economy. Women have come out of the four walls of their houses and started contributing equally to family income. According to research by IMF, women's engagement in financial services will benefit in reducing gender inequality and will stabilise the banking system. This active participation of women in financial markets will also boost economic growth [6].

This research has specifically chosen working women as their primary discussion point for the following reasons. First, there are evident changes in the decision-making behaviour of women due to their increased and active involvement in family financial decisions. Secondly, there is a substantial disparity in the financial decision-making of men and women. Thirdly, working women are a significant market segment for financial institutions in India. Thus, this study analyses the financial decision-making of working women regarding their spending, borrowing and investment pattern. It identifies the financial literacy of working women in India by analysing its exogenous variables: financial attitude, financial behaviour, and financial knowledge. It also tries to understand the personal financial planning of working women and their risk behaviour. Thus, it studies different behavioural aspects affecting the financial decision-making of working women in India.

The research will be structured in the following sequence: Section 2 will deliver a literature review regarding financial decision-making, financial literacy, financial information, and personal financial planning. Next, Section 3 covers research data and methodology, whereas Section 4 discusses the measurement model, structural model, and hypothesis testing. Section 5 gives the conclusion to the study, including the theoretical observations, practical implications, limitations, and future scope of the study.

LITERATURE REVIEW

Financial Decision-Making

The art of financial decision-making requires a broad understanding of financial markets. It entails gathering information, comprehending financial affairs, and conducting asset research and analysis [7]. In different financial decision environments, males and females apply different strategies, not influencing their performance; these differences should be treated as general traits [8]. Most of the investment decisions of women are influenced by family needs and professional associations [9]. Gender disparity in the decision-making roles in early-stage funding further contributes to the gender gap in funding for women entrepreneurs [10]. Women who earn more in a family solely take major financial decisions than those who earn less [11]. Various variables like socio-demographics, financial literacy, economic and circumstantial forces, and psychological constructs significantly impact women's financial planning [12]. Due to the gender identity norms, women's role in intrahousehold financial decision-making is limited, which leads to a smaller impact of her information contribution to the family finances [4].

Financial Literacy

Financial literacy is considered an essential element for stable economic and financial growth. It has become increasingly important in developed and emerging nations in the recent decade. While the need for financial planning is well recognised, financial literacy is generally underappreciated, particularly among women [13]. Women are ignorant of the financial markets' recent financial innovations and upgrades [14]. Working women invest their benefits in multiple savings options and avoid taking unnecessary risks [15, 16]. They also appear to struggle with fundamental financial concepts and have lower financial knowledge, making it harder to make sound financial decisions [17]. This study analyses the gap in the financial literacy of working women and its effect on their financial decision-making. Thus, this study proposes the following hypothesis:

H1: Financial literacy of working women impacts their financial decision-making.

OECD defines financial literacy as "A combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and ultimately achieve individual financial well-being." [18]. Thus, the research identifies three critical determinants of financial literacy, i.e., financial attitude, financial behaviour and financial knowledge, as recommended in previous studies.

Financial Attitude

Financial attitude is the personal orientation of an individual towards his financial matters [19]. Men may have better financial behaviour or knowledge scores, but women hold better financial attitudes [20]. Women are more likely to be stressed about their finances and other financial issues [21]. Financial decisions are innately risky, and the preconceived notions about female investors' risk attitude may be more prejudiced than the fact [22]. Women's financial attitudes are concerned with capital investment safety, regular and

consistent income, and little investment risk [23]. Thus, it can be said that financial attitude is an essential determinant of financial literacy. Therefore, the research formulates and tests the following hypothesis:

H1a: Financial attitudes of working women significantly affect their financial literacy level.

Financial Behaviour

Individuals who engage in positive financial behaviour, such as proper budgeting and financial stability, improve their financial literacy. In contrast, those who engage in poor financial behaviour, such as relying heavily on credit and loans, deteriorate their economic well-being [18]. Women are more conscientious about budgeting and keeping track of their funds, but they lack financial expertise, impacting several aspects of their financial behaviour [17]. Women who are self-assured about their financial management capacities are most likely to opt for savings and investment products and less likely to opt for debt products [24]. Thus, with this changing global economy and the inclusion of working women in the world financial markets, it has become essential to understand how working women's different aspects of financial behaviour like spending, borrowing and investing affect their financial decision-making. Thus, this study proposes the following hypothesis:

H1b: Working women's financial behaviour significantly affects their financial literacy level.

Financial Knowledge

Another behavioural aspect of being financially literate is applying financial knowledge while making a saving or investing decision [25]. Increased financial knowledge will change individuals' risk perception towards various investment avenues [26]. Women have a dearth of financial knowledge and skills and are risk-averse in nature [27]. It has been found that two-thirds of the gender gap found in financial literacy is due to lower financial knowledge and one-third is slate to reduced confidence [28]. Women's financial knowledge regarding various financial instruments like debit cards, credit cards, shares, mutual funds, and debts is deficient [14].

Therefore, the aforementioned literature supports that financial knowledge is essential for financial literacy. Thus, the following hypothesis is proposed:

H1c: Financial knowledge of working women significantly impact their financial literacy level.

Personal Financial Planning

Personal financial planning is a strategy for efficiently planning for future household financial needs [29]. It is a continuous process that requires regular monitoring and reevaluation. Managing and preparing for economic security is a task for working women. A change in attitude is found in women who understand comprehensive long-term financial planning, which helps in effective money management [30]. Women with high financial self-efficacy are found to plan their finances by being more likely to hold savings and investment products and less likely to have debt products [24].

Most women are responsible for daily budget management, which exacerbates concerns about financial stability in the short term and has a detrimental influence on savings goals. It is found true even when women, rather than males, control the household's long-term investments [31]. As women are becoming more affluent in their financial decision-making, the need for personal finance planning increases. Thus, the following hypothesis is formulated:

H2: Personal Financial Planning of working women significantly impact their financial decision-making.

Risk Behaviour

Individual investors plan their finances, considering the risk involved in the various investment opportunities. In the risk homeostasis theory, it is found that individuals have a target level of risk, and they involve themselves in activities that give a high benefit-to-losses ratio to reach that level [32]. Thus, individuals' risk perceptions reflect their behaviour [33]. There is a vast literature stating men are the risk-takers with their money, whereas women are risk-averse [34–36]. Working women are loss averse but are positive in their expectations regarding their investments [37]. Despite being well-off in their income, women do not feel confident with their investments and have a moderate risk appetite [38]. In a study including wealthy individual investors, it was found that rich women consider themselves conservative and allocate a large number of their investments into cash compared to men [39]. Therefore, the aforementioned literature suggests that risk behaviour is an essential element of the financial decision-making process. Thus, the following hypothesis is proposed:

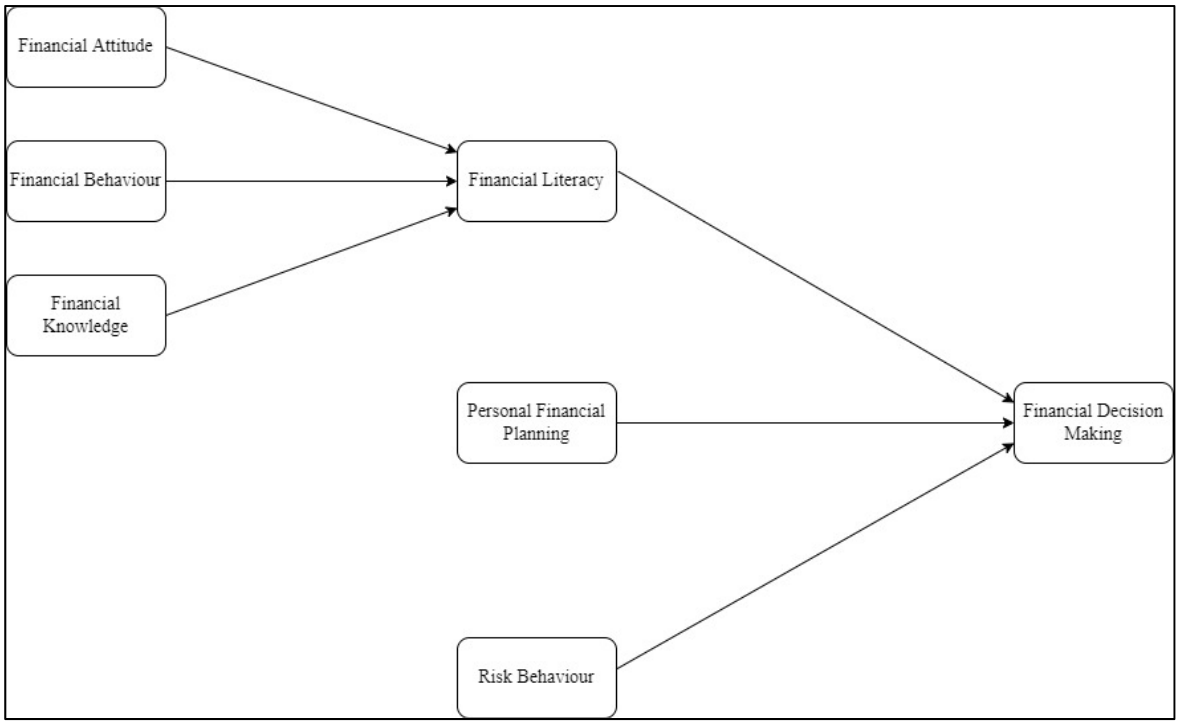

Fig. 1. **Conceptual framework**
Source: compiled by the authors.

H3: Risk Behaviour of working women significantly affects their financial decision-making.

Figure 1 represents different variables which are studied in this research. It is a conceptual model to understand antecedent variables of financial literacy, personal financial planning and risk behaviour, influencing the financial decision-making process.

RESEARCH DATA AND METHODOLOGY

Sample and Data Collection

This study is based on the target population of women who are 20 years or above and are engaged in a public or private organisation, i.e., working women. Using a cross-sectional research approach, the participants of this research are distributed demographically into various categories like age, education, level of income, and marital status. A well-structured questionnaire was designed to study the opinions of a dispersed population [40]. The questionnaires were distributed to individual women who belonged to National Capital Region, India, via messages and e-mails. Women participants voluntarily filled out the questionnaire and were well-informed about it. Though more than 500 women employees were approached with the questionnaire, only 420 responses were received, out of which 392 responses were complete and valuable for the research.

Measurement of the Variables

As the data collection is done through a well-structured questionnaire, this research uses different distinctive scales to measure the impact of the identified variables on financial decision-making. The research survey consists of three sections, first explaining the aim of the study and the steps to fill out the questionnaire. The second section was designed to collect the demographic data of participants. The third section included a research tool having items to be studied on a five-point Likert scale, with one being "Strongly Disagree" and five being "Strongly Agree". The exogenous and endogenous variables were adapted from previous studies and modified in the Indian context.

Financial literacy, an independent variable and its exogenous variables, financial attitude, financial behavior, and financial knowledge, are studied in the research through scales inspired by OECD [18] and S.S. Shockey [41]. The other two identified independent variables, personal financial planning, and risk behaviour are studied by Ellen Loix et al. [42] and C. Mayfield et al.

[43]. Financial decision-making is a dependent variable in the study for which statements were adapted from A. Bernasek & V.L. Bajtelsmit [44].

RESULTS

Demographic Profile

Table 1 shows the demographic characteristics of the individual participants. Out of the total 392 respondents, 44.6% of women were between the age group of 20–30 years, 16.2% were 30–40 years, 22.7% were 40–50 years, and 16.5% were 50–60 years of age. Most working women were post-graduated, including 67.2% of the total sample. About 50.76% of the sample data were single, 38.26% were married, 8.41% were divorced, and 2.55% were widowed. Most of the women in the sample, i.e., 32.14%, earned a monthly income between Rs. 51,000 — Rs. 75,000.

Data Analysis Using PLS-SEM

For analysis of the research, Partial Least Square — Structural Equation Modelling (PLS-SEM) using SmartPLS software is used. PLS-SEM is a non-parametric approach used in management and information systems. PLS-SEM is a second-generation exploratory method that examines the impact of exogenous variables on a single endogenous variable [45]. This analytical approach has been shown to produce notable analyses in banking and finance and is an excellent chance for behavioural finance research [46]. Thus, PLS-SEM is suitable for assessing and analysing this research model.

Measurement Model

To test the reliability and validity of the constructs, the measurement model was analysed. The item's outer loadings, i.e., the correlation of measure with their constructs, were analysed to assess the item reliability. *Table 2* shows the factor loading of 30-items of the measurement model. All the items were having a factor loading of more than 0.7, making the statement reliable to use for further analysis [47]. It also portrays a detailed reliability check, including Cronbach's Alpha test and composite reliability (CR), to analyse internal consistency and convergent reliability. The values of Cronbach's Alpha were within acceptable limits, above 0.7, thus, satisfying the internal consistency [48]. For ascertaining convergent reliability, the composite reliability of all the latent variables was found in between the range of 0.8 to 0.95, exceeding the threshold value of 0.7 [49]. Thus, CR is accepted.

Additionally, the average variance extract (AVE) was calculated to estimate the convergent validity, found above the permissible limit of 0.5. Thus, convergent validity is assured [49, 50]. The degree to which the constructs vary is measured using discriminant validity [47]. In a measuring model, the AVE square root of an identified construct should be larger than the inter-construct correlation [49]. *Table 3* shows the latent constructs' correlation matrix, and the off-diagonal value explains the AVE square root (*in italics*). As an outcome, the discriminant validity analysis results are accepted.

Structural Model

The structural model is analysed by examining the collinearity, significant structural model, and measuring coefficient of determination (R^2) [51]. Variation Inflation Factor (VIF) is determined for all exogenous variables to test multicollinearity among the constructs [47]. The value attained for VIF for the latent variables was below five, as shown in *Table 2*. As a result, it is ensured that multicollinearity does not exist [47]. We can infer that the relationship between the constructs was substantial since the values of collinearity were justified.

The PLS-SEM bootstrapping approach was used to examine the significance of constructs in the model. A random sample of 5000 cases was produced from the original cases to explore the relevance of the construct's relationships [47, 52]. *Figure 2* shows the path coefficients model and hypothesis testing. *Table 4* and *Table 5* show the hypothesis testing, path coefficients, and t-statistics values using bootstrapping techniques in PLS-SEM. After hypothesis testing, the coefficient of determination was found significant shown in *Table 6*.

DISCUSSION AND IMPLICATIONS

The PLS-SEM bootstrapping algorithm shown in *Fig. 3* tests the hypothesis and examines the relationships between the constructs. The results show a positive and significant association between working women's financial attitudes, financial behaviour, financial knowledge, financial literacy, and financial decision-making. Therefore, H1a (t = 9.299, p < 0.05), H1b (t = 7.509, p < 0.05) and H1c (t = 7.725, p < 0.05) is accepted. The findings suggest that working women's financial

attitudes, behaviour, and knowledge influence their financial literacy. The hypotheses are supported and portray a strong association of the three exogenous variables with the latent variable. The results also signify that financial literacy, personal financial planning and risk behaviour are three important determinants of financial decision-making. Therefore, H2 ($t = 8.886$, $p < 0.05$), H3 ($t = 9.326$, $p < 0.05$) and H4 ($t = 3.103$, $p < 0.05$) is also accepted.

The primary goal of this study was to discover the elements that influence working women's financial decision-making in India. The three primary aspects of financial decision-making — financial literacy, personal financial planning, and risk behavior — were identified as critical. The results of this study are supported by various research [53–55]. It was also found that various exogenous variables, financial attitude, financial behaviour and financial knowledge are the determinants of financial literacy, as supported by previous work [19, 56]. The research concluded that not just mere financial understanding is essential while making a financial decision, but financial literacy and planning the finances significantly and positively impact the whole process. The findings reveal that working women have high financial literacy; as a result, they have control over their finances and feel that to make a return on their investments, they need to perform financial planning. The study finds a significant but negative impact of risk behaviour on working women's financial decision-making process, asserting the previous work of Faff et al. [57]. This indicates that women are less confident with decisions while managing their finances and do not want to take a high risk with their investments.

The investment motivation of working women is based on their income earned and their financial literacy on how to employ their funds for investment. For a long time, women have been considered to do their house chores and not interfere in other family financial matters. Women's income has been regarded as secondary income in the family and is generally considered consumers, not producers [58]. But in present times, working women's spending habits and household decision-making should be considered while planning for gross domestic consumption and production [59]. In particular, given the prevalence of financial illiteracy among women, a one-time financial education session is unlikely to influence long-term planning and saving decisions.

Table 1

Demographic Profile

Characteristics	Frequency	Percentage
Age		
20–30 years	175	44.6%
30–40 years	63	16.2%
40–50 years	89	22.7%
50–60 years	65	16.5%
Educational Qualification		
Diploma	45	11.4%
Graduate	84	21.4%
Post-graduate	263	67.2.%
Marital Status		
Single	199	50.76%
Married	193	49.23%
Monthly Income		
Below Rs. 25,000	98	25.0%
Rs. 26,000 – Rs. 50,000	108	27.55%
Rs. 51,000 – Rs. 75,000	126	32.14%
More than Rs. 76,000	60	15.3%

Source: compiled by the authors.

On the other hand, women-specific initiatives should be more adapted to address fundamental disparities in their tastes, saving requirements, and financial expertise. Creating awareness and cultivating an investment culture is essential because investment promotes and fosters economic development and growth. Before making a financial decision, women should be aware of the facts that affect their investment decisions and carefully analyse investment considerations using fair business experience. They should evaluate all environmental conditions rather than relying on only one of them. Women investors must diversify their portfolios through multiple industries and avenues available to reduce uncertainties and other fluctuations while optimising returns by building a portfolio of assets that corresponds to their financial interests.

Table 2

Factor Loadings of the constructs

Constructs and Items		Outer Loadings	AVE	Composite Reliability	Cronbach's Alpha	VIF
Financial Attitude	FA1	0.849	0.662	0.907	0.872	1.771
	FA2	0.794				
	FA3	0.823				
	FA4	0.829				
	FA5	0.77				
Financial Behaviour	FB1	0.892	0.747	0.937	0.916	1.862
	FB2	0.822				
	FB3	0.901				
	FB4	0.876				
	FB5	0.828				
Financial Knowledge	FK1	0.705	0.57	0.868	0.808	2.738
	FK2	0.712				
	FK3	0.794				
	FK4	0.815				
	FK5	0.827				
Financial Literacy	FL1	0.735	0.563	0.837	0.741	1.573
	FL2	0.732				
	FL3	0.784				
	FL4	0.747				
Personal Financial Planning	PFP1	0.731	0.568	0.795	0.727	1.771
	PFP2	0.724				
	PFP3	0.884				
Risk Behaviour	RB1	0.766	0.502	0.834	0.752	1.497
	RB2	0.759				
	RB3	0.708				
	RB4	0.733				
Financial Decision-Making	FDM1	0.886	0.746	0.921	0.886	-
	FDM2	0.835				
	FDM3	0.839				
	FDM4	0.893				

Source: compiled by the authors.

Table 3

Discriminant Validity

	Financial Attitude	Financial Behaviour	Financial Knowledge	Financial Literacy	Personal Financial Planning	Risk Behaviour	Financial Decision Making
Financial Attitude	0.813						
Financial Behaviour	0.407	0.864					
Financial Knowledge	0.658	0.678	0.755				
Financial Literacy	0.712	0.688	0.701	0.75			
Personal Financial Planning	0.467	0.434	0.698	0.578	0.754		
Risk Behaviour	0.355	0.325	0.375	0.462	0.549	0.708	
Financial Decision Making	0.552	0.561	0.635	0.668	0.672	0.346	0.864

Source: compiled by the authors.

Table 4

T-statistics

	Path Coefficients	T Statistics	P Values	Decision
Financial Attitude -> Financial Literacy	0.358	9.299	0.00	Supported
Financial Behaviour -> Financial Literacy	0.307	7.509	0.00	Supported
Financial Knowledge -> Financial Literacy	0.347	7.725	0.00	Supported

Source: compiled by the authors.

Table 5

T-statistics

	Path Coefficients	T Statistics	P Values	Decision
Financial Literacy -> Financial Decision Making	0.446	8.886	0	Supported
Personal Financial Planning -> Financial Decision Making	0.482	9.326	0	Supported
Risk Behaviour -> Financial Decision Making	–0.124	3.103	0.002	Supported

Source: compiled by the authors.

CONCLUSION

Financial market activities are revamped after the advent of the internet and globalisation; thus, they are technologically and geopolitically developed [60]. Financial decision-making and awareness of one's financial abilities are vital for avoiding financial mistakes [61]. Various researchers have studied gender differences in financial decision-making. Many women are working, and their attitudes toward investment opportunities are also changing. Instead of sitting

Table 6

Coefficient of Determination (R^2 Value)

Variables	Coefficient of Determination (R^2 Value)	
	R^2	R^2 Adjusted
Financial Literacy	0.741	0.739
Financial Decision Making	0.579	0.576

Source: compiled by the authors.

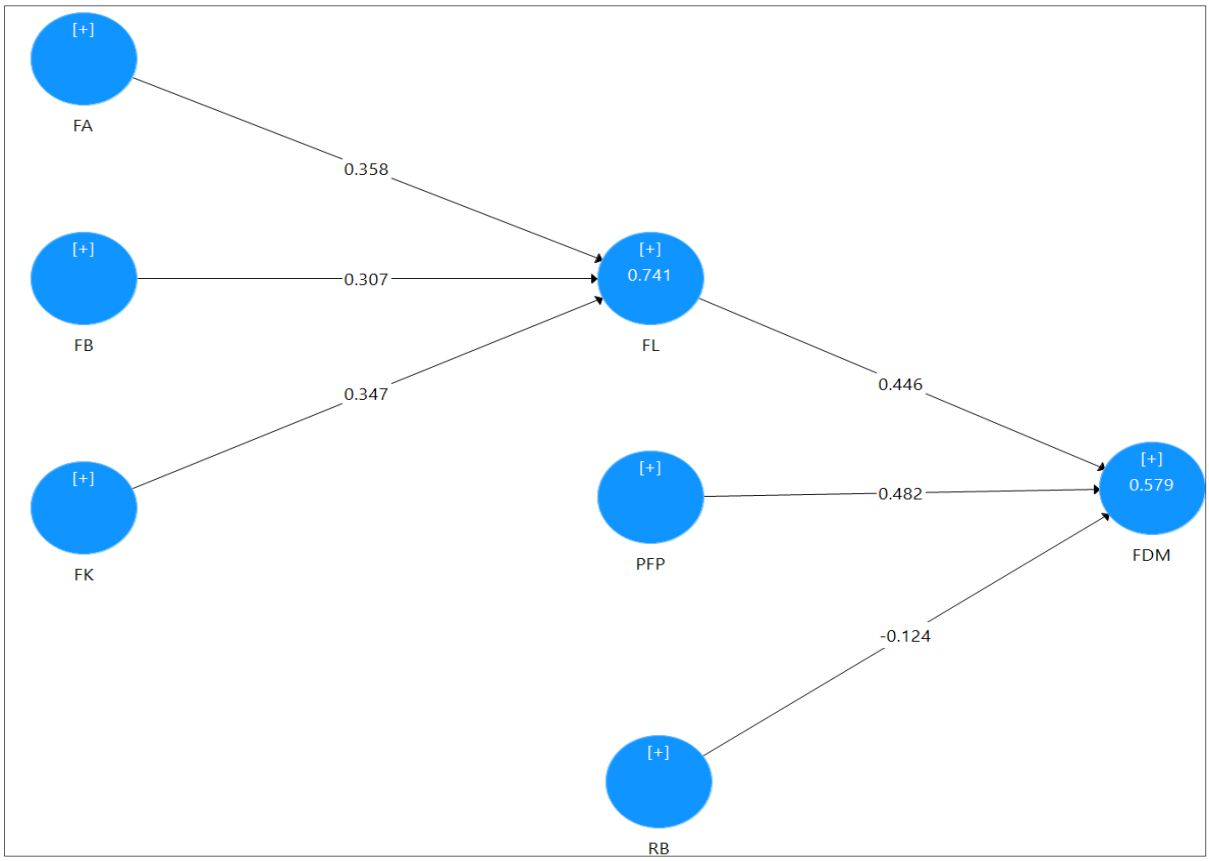

Fig. 2. **PLS-SEM full model with path coefficient**

Source: compiled by the authors.

on their savings, women show a strong interest in investing their money in various investment avenues to earn returns and meet certain current and future expenses.

Women play a crucial role in uplifting the global economy but are still treated as underutilised assets. This research examines the impact of various determinants on the financial decision-making of working women in the national capital region. The current study has collected data from 392 working women 20 years and above. This study contributes in numerous ways to the literature and has different implications. It identifies different variables, including financial literacy, personal financial planning, and risk behaviour, which significantly impact the financial decision-making process. It also helps understand the changing attitudes, behaviour, and financial knowledge on literacy levels in the NCR region.

The various goals of this research investigation were laid out, including identifying determinants and the impact on working women investors' financial decision making, all of which were thoroughly examined and tested. The results suggest that women should invest a lesser portion of their money in riskier assets, thereby exacerbating the wealth gap between men and women.

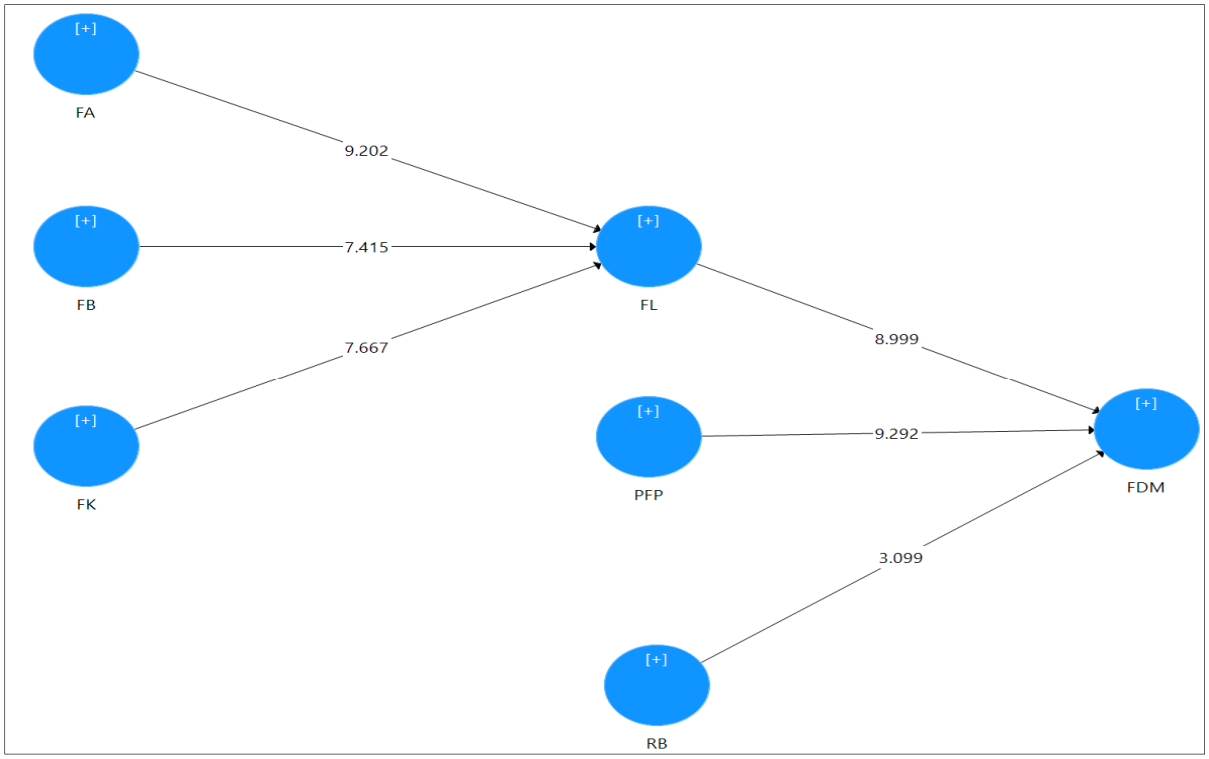

Fig. 3. **PLS analysis of the structural model with t-value**

Source: compiled by the authors.

However, income disparities between men and women are likely to remain a significant concern. Women generally have different learning preferences regarding various investment avenues and distinctive mindsets regarding money matters [62]. The findings have ramifications for programmes that increasingly put individuals in charge of their retirement funds. Personal finance budgeting will assist working women in better understanding their financial condition, and they are a crucial variable in identifying financial components while saving time.

LIMITATIONS AND FUTURE SCOPE OF STUDY

The current research follows some limitations. First, the survey participants are part of one region of India, i.e. National Capital Region. The results found may not be applicable in other places and thus, cannot be generalised. Secondly, this study is only based on working women's perspective; thus, the financial attitude, financial behaviour, and financial literacy of non-working women may be different. Third, the sample size taken for the study is minimal. Lastly, only three determinants have been studied to understand financial decision-making.

Further samples can better measure these determinants, like gender differences, working or non-working women, students, individual and retail investors, etc. Other variables like social-economic characteristics, cultural differences, family issues, or environment can also influence decision-making. Researchers can eliminate these constraints in future studies by including a large sample size.

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C. Gautam — formulation of research problem, justification of hypothesis and evaluation of theoretical and practical framework's consistency.
R. Wadhwa — critical analysis of the literature and validation of methodology.
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