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Editorial address:

53, Leningradsky prospekt, office 5.4

Moscow, 125993

tel.: **+7 (499) 553-10-71 (internal 10-79)**

E-mail: **isdovgal@fa.ru**

Site: **financetp.fa.ru**

Subscription in editorial office

tel: **+7 (499) 553-10-71 (internal 10-80)**

e-mail: **sfmihajlova@fa.ru**

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The Impact of the Ruble Exchange Rate on Foreign Direct Investment from the EU to Russia in the Period 2014–2020

Yu.K. Zaytsev
Russian Academy of National Economy and Public Administration, Moscow, Russia

ABSTRACT

The purpose of this study is to explain the impact of fluctuations in the exchange rate of the Russian currency on the inflow of FDI from the European Union to the Russian Federation in the period 2014–2020 in order to provide practical recommendations for the development of investment policy and FDI attraction. The author used a three-stage methodology, including theoretical, statistical and empirical analyses. The theoretical positions of the influence of the value of the currency on the inflow of various types of FDI into the national economy are determined. It has been established that the increase in the value of the currency has a positive effect on the inflow of FDI and on industries focused on the domestic market of the country. The weakening of the real exchange rate of the ruble generally had a negative impact on FDI inflows into the Russian market. With the fall in the exchange rate, foreign firms targeting the Russian market have reduced their investments. At the same time, export-oriented firms have increased their presence in the form of fixed investment in Russia. Empirical confirmation of theoretical provisions allows using the obtained results when making decisions regarding investment policy and attracting FDI to the national economy.

Keywords: foreign direct investments; European Union; economic sanctions; exchange rate; Russian Federation

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INTRODUCTION

For many years the European Union (EU) has been one of the most significant investment partners for the Russian Federation. Investment cooperation has intensified since the EU expanded in 2007 and the Russian Federation and the EU launched the bilateral institutional "Partnership for Modernization" in 2010. The goal of the partnership was to assist in solving the problems of modernizing the economies of both Russian Federation.[1] However, it was stopped in 2014.

Despite the mutual sanctions and drop in the volume of foreign direct investment (FDI) inflows, EU countries kept their FDI in the Russian economy. This tendency can be explained by many institutional characteristics of the Russian economy, including its high dependence on technology from EU countries as a part of FDI projects, as well as a long track record of investment cooperation. However, most of these institutional factors have long-term effects, which often do not change in the short or even medium term. As a result, investors consider these factors (including governmental institutions and international agreements) in their long-term decision-making.

Unlike institutional factors, factors such as inflation or exchange rates can affect FDI flows in the short run. The exchange rate is one severe economic factor that could impact investment decisions depending on foreign investors' expectations in the short term [1]. It also could explain the fluctuations in statistical data during the ups and downs in EU-Russia economic relations during the period of 2010–2020, especially in highly volatile times of sanctions and relevant political risks.

[1] EU and Russia launch new partnership for modernization. European Commission (2010). Brussels, 1 June, 2010. URL: https://ec.europa.eu/commission/presscorner/detail/en/IP_10_649 (accessed on 20.12.2021).

The goal of this study is to explain the effect of fluctuations in the Russian currency exchange rate on the inflow of the FDI from the European Union to the Russian Federation during the period 2014–2021 in order to provide practical recommendations for investment and FDI attraction policy-making.

The methodology uses a three-step approach. First, theories characterizing the connection between FDI and currency exchange rates, as well as relevant empirical studies, will be analyzed. It will help identify key FDI strategies and incentives for foreign capital. Moreover, a theoretical and empirical literature review helps to reveal the methodologies and data employed to study FDI to analyze the Russian case study further.

Second, a statistical analysis of EU FDI to the Russian Federation will be conducted. It will help to reveal the main characteristics of the EU FDI and the main strategies employed by European investors in the Russian market.

Third, the research will focus on identifying if Russian data proves the theoretical provisions and if they are consistent with the empirical findings.

Thus, the methodology of research stipulates the respective research methods. The main research methods in this study are associated with a theory-based approach, statistical analysis and case study analysis. Statistical analysis primarily deals with the visual data analysis, calculation of averages. The study period includes 2014–2020. 2021 is not included in study due to 2020 low base effect.

INVESTMENT COOPERATION BETWEEN THE EUROPEAN UNION AND THE RUSSIAN FEDERATION: STATISTICAL EVIDENCE

The success of European companies in the Russian Federation is often associated with their experience since the mid-1990s. EU companies were investing in Russian market then thanks to Russia's budget surplus and positive growth in gross domestic product (GDP), as well as increasing demand for the transfer of new technologies required by many sectors of the Russian economy.[2] The 2010 Partnership for Modernization initiative launched in 2010 was intended to encourage new investment projects that would stimulate economic growth and innovation, trade, and the development of small and medium-sized enterprises (SMEs).

The initiative was in force until 2014. The "Vnesheconombank", the Russian development bank, and the European development institutions together created an investment project portfolio with a finance facility of USD 1 billion. It was done to stimulate business activities in the Russian Federation in partnership with the EU.[3] According to the CBR, for 2009–2013 the volume of FDI from EU member states to the Russian Federation increased from USD 16.5 billion to USD 58.3 billion (*Fig. 1*). The EU's share in Russia's total FDI rose from 56.1% to 84.2%. However, after sanctions were imposed, the flow of European investments fell sharply. In 2014 it fell by 86.7% (to USD 7.8 billion in absolute terms). In 2015 EU FDI decreased by 201.3% (a negative indicator of EUR 7.9 billion (USD 9.05 billion) was recorded).

After the FDI fall in 2014–2015 the recovery began in 2016 with USD 2.7 billion of EU FDI to the Russian Federation. The European Union's share in total FDI of the Russian Federation was only 8.3%. This trend continued with EU FDI of over USD 15.0 billion (50.3% of total FDI in the Russian Federation) in 2017 and USD 22.7 billion (71.2% of total FDI in Russian Federation) in 2019. As a result of the COVID-19 pandemic, 2020 was associated primarily with EU disinvestment from the Russian market. However, the Russian economy attracted USD 9.2 billion in FDI from non-EU countries.

In general, during the period of 2010–2020, different companies had different impacts on the Russian market, depending on the

[2] Diversification in Russia Potential for regional differences. European Bank for Reconstruction and Development EBRD, 2012. URL: https://www.ebrd.com/downloads/research/economics/publications/specials/diversifying-russia-russian.pdf (accessed on 20.12.2021) (In Russ.).

[3] EBRD Strategy for the Russian Federation. Document of EBRD. URL: https://www.ebrd.com/downloads/country/strategy/russia.pdf (accessed on 20.12.2021).

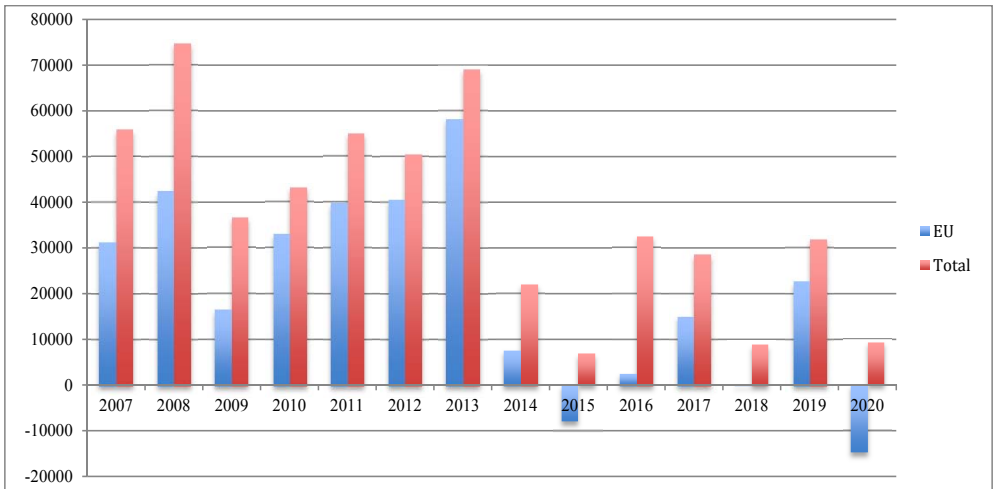

Fig. 1. **FDI Inflows from the European Union to the Russian Federation (2009–2020) in USD Million**
Source: CBR, 2021.

industry. For instance, European manufacturers significantly changed the structure of consumption in the Russian automotive market. In 2001, 92% of all new cars sold in the Russian Federation were domestic models. By 2007 this figure dropped to 42%, and by 2015 to 25% [2].

Other market-oriented investors, such as Bayer, Tönnies Lebensmittel GmbH & Co, Unilever, Bionorica, IKEA, Leroy Merlin Vostok and Auchan, were active in Russia's food, retail trade, wholesale and chemical industries. German companies such as Henkel and Volkswagen have had a significant impact on Russia's mechanical engineering and the chemical industries, with Germany's share in FDI stock in the Russian industrial sector making about 30%. More than 2,600 German enterprises operate in the Russian Federation, with a total volume of FDI in 2018 that exceeded EUR 3.2 billion.[4]

As mentioned, different factors affect the FDI inflow in the short and long run. This study primarily concentrates on the exchange rate as a factor affecting the FDI inflow in the short run. However, during the period considered for this research, other positive and negative factors can be identified.

Sanctions imposed by the EU as well as Russian counter-sanctions should be also considered negative factors. They have especially affected such sectors as energy, ICT, banking and defense. EU sanctions are mostly associated with restricting access to primary and secondary EU capital markets for some Russian banks, such as Sberbank, VTB, Gazprombank, Vnesheconombank and Rosselkhozbank, and for companies associated with the military-industrial complex. The EU also banned arms trade with the Russian Federation and exports of dual-use goods that can be used for military purposes, reducing Russia's access to European technologies and services for oil production and exploration. Russian economic counter-sanctions imposed in August 2014 are associated with embargos on agricultural products from countries that imposed unilateral restrictions against the Russian Federation and limited government purchases of light industry goods from foreign suppliers [3]. For most sectors in the Russian economy, sanctions have become a significant barrier to investment cooperation between the parties.

[4] Deutsche Welle (2019). Direct investments of Germany in Russia exceeded 3 billion euros. (In Russ.). URL: https://www.dw.com/ru/%D0%BF%D1%80%D1%8F%D0%BC%D1%8B%D0%B5-%D0%B8%D0%BD%D0%B2%D0%B5%D1%81%D1%82%D0%B8%D1%86%D0%B8%D0%B8-%D0%B3%D0%B5%D1%80%D0%BC%D0%B0%D0%BD%D0%B8%D0%B8-%D0%B2-%D1%80%D0%BE%D1%81%D1%81%D0%B8%D1%8E-%D0%BF%D1%80%D0%B5%D0%B2%D1%8B%D1%81%D0%B8%D0%BB%D0%B8–3-%D0%BC%D0%BB%D1%80%D0%B4-%D0%B5%D0%B2%D1%80%D0%BE/a-48341991 (accessed on 20.12.2021).

THE OVERVIEW OF FOREIGN DIRECT INVESTMENT THEORIES AND EMPIRICAL FINDINGS

FDI theories in international economics became extremely important in 1960 as the role of the FDI flows increased [4]. There are three main areas of FDI research in the modern literature: FDI at the micro and macro levels, and modern mixed (eclectic) theories that combine different approaches. This research concentrates on the macro-level theories given that they mainly explain the economic connection between FDI inflows and exchange rate fluctuations.

Cushman proposed a dynamic model of exchange rate expectations to deal with this issue [5]. He showed that the expected devaluation of the host country's currency can be positively or negatively correlated with the flow of FDI. He divided FDI into two groups: market-oriented (horizontal) and export-oriented (vertical). Similarly, foreign investors could be divided into firms providing horizontal and vertical FDI. Horizontal FDI includes investments made by a company in a foreign enterprise with a similar production and technological type. Thus, horizontal FDI focuses on the host country's domestic market in order to reduce costs, including those associated with transportation and trade barriers (customs tariff and non-tariff restrictions) [6].

Vertical or resource-oriented FDI refers to international companies that divide the production process vertically (into production stages) in a geographical region. If a company acquires or creates an enterprise in a foreign country to supply production factors such as raw materials and labour, it is known as backward vertical FDI. Thus, vertical FDI is associated with exporting goods used in production from foreign branches of TNCs, as part of the value chain of the parent company.

Cushman showed that there is a negative relationship between the expected currency devaluation in the host country and market-oriented FDI in that country, as well as there is a positive relationship between the expected depreciation of the host country's currency and export-oriented FDI [7]. Cushman, as well as other authors [8], argued that the depreciation of the country's currency can slow down the flow of horizontal FDI into that country, but promote the inflow of vertical FDI. As a result, different types of investments respond differently to changes in the exchange rate.

The main differences between market-oriented FDI and resource-oriented investment are summarized in *Table 1*.

Another way to distinguish horizontal and vertical investments is to use a sectoral approach to FDI analysis. Herger and McCorriston used in the standard industrial classification (SIC) to classify vertical and horizontal FDI based on cross-border acquisitions (CBAs) analysis from Thomson Reuter's SDC Platinum Database, which covers all merger and acquisition transactions from 1990 to 2012. The authors studied how firms are connected through the supply chain in the industries in which they operate. They found that the primary sector of the national economy (which includes agriculture, mining, fishing, forestry and hunting) is associated with vertical FDI, whereas manufacturing, transportation, wholesale and retail services relate mostly to horizontal FDI.

FOREIGN DIRECT INVESTMENT FROM THE EUROPEAN UNION TO THE RUSSIAN FEDERATION

The research analyzed above uses different data for revealing the empirical connection between the FDI inflow and exchange rate, such as GDP, inflation, the real effective exchange rate (REER), portfolio investments, the value of real interest rates on loans, corruption perception indexes, sovereign credit ratings and REER volatility. However, given the focus of this study, it uses REER and FDI data for the Russian Federation.

According to *Fig. 2*, FDI data (total volume and from the EU) and REER data seem to be positively correlated. The Russian currency depreciated first in 2014 as a result of the Ukrainian crisis and the start of CBR's free-floating exchange rate policy in November 2014. The next year the Russian currency continued its

Table

The Main Characteristics of Horizontal and Vertical FDI

Characteristics	Horizontal (market-oriented) FDI	Vertical (resource-oriented) FDI
The objectives	Access to new (foreign) markets; high transportation costs and trade barriers	Cheap factors of production
The main motives	How to sell products to foreign markets?	How best to minimize costs?
Increase of the national currency value	Positive reaction	Negative reaction
Decrease of the national currency value	Negative reaction	Positive reaction

Source: Compiled by the author based [9].

devaluation. The REER decreased by 16.5 points. In 2015 two main factors affected the exchange rate of the Russian currency: sanctions and the oil price. The cumulative effect of a wide range of EU and US economic and political sanctions on the ruble depreciation against the US dollar and the euro constituted about 8–15% of its devaluation [10]. There was a sudden drop in oil prices in November 2014 (to USD 70 per barrel) and December 2015 (to USD 38 per barrel). These drops led to a year-end close of USD 53.45 per barrel in 2014 and USD 37.13 per barrel in 2015.

As seen in *Fig. 2*, the ruble devaluation during this period coincided with a sudden drop in FDI. As a result of the sanctions, capital outflow from the Russian Federation amounted to USD 20 billion (2014–2015), which was 1.5% of GDP [11]. The transfer of the Russian capital offshore accounted for 40% of this outflow [11].

From 2016 through 2019, inward FDI increased except for a sudden decline of EU FDI in 2018 (to USD 214 million). Several factors caused the EU FDI recovery. First, EU investors launched some systematically important investment projects in the Russian Federation. The German company Daimler began construction of a Mercedes-Benz passenger car plant in the Esipovo industrial park. At that time, with total capital of USD 255 million, Esipovo was the largest project of western companies in the Russian Federation since the imposition of sanctions.[5] In 2019 the largest transaction in the energy sector was Russia's Novatek sale of a 10% stake in the Arctic LNG-2 project to the French company Total for USD 2.5 billion.[6]

Second, during this period some agricultural and food industry companies (previously importers to the Russian Federation) localized their production in Russia because of its counter-sanctions. The decision to localize production was attributed to EU companies experiencing direct losses caused by the Russian embargo, estimated at EUR 2 billion per year [12]. French food retailer Auchan opened a meat production plant in the Tambov region in August 2017.[7] Austrian bakery manufacturer Backaldrin Kornspitz opened a production plant on October 13, 2017, in the Stupino Kvadrat SEZ.[8]

[5] Daimler to invest over € 250 million in a 20,000 passenger car plant. 2017. (In Russ.). URL: https://www.vedomosti.ru/auto/articles/2017/02/22/678713-daimler-zavod (accessed on 20.12.2021).

[6] Total entered Arctic LNG-2. Kommersant, 05.03.2020. (In Russ.). URL: https://www.kommersant.ru/doc/3903534 (accessed on 20.12.2021).

[7] Auchan (2017). Auchan Russia has launched a Meat Distribution Center in the Tambov Region. 01.08.2017. (In Russ.). URL: https://www.auchan.ru/ru/press/762 (accessed on 20.12.2021).

[8] An Austrian company for the production of bakery products has opened a plant in the Moscow region. TASS, Russian news agency. 13.10.2017. (In Russ.). URL: http://tass.ru/moskovskaya-oblast/4643972 (accessed on 20.12.2021).

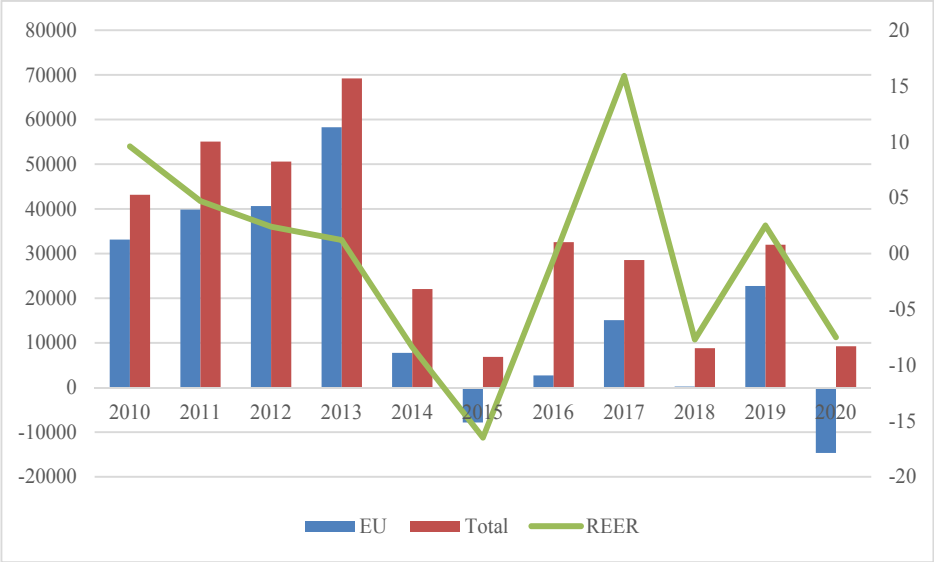

Fig. 2. **Inward FDI to the Russian Federation from the EU and from the World (Net Position, in USD Million) and the REER of the Russian Currency (2010–2020)**

Source: Compiled by the author based on CBR data (CBR, 2021a).

In 2017, the French cheese producer Savencia Fromage & Dairy acquired a controlling stake in the Russian Belebey dairy plant, one of the biggest cheese manufacturers in the Russian Federation.[9] Between 2015 and 2017, companies in the agricultural sector increased the volume of their FDI to the Russian Federation by 80%, to USD 26.78 million [3].

A positive FDI inflow in 2017 can be also attributed to some regulatory initiatives to support foreign investors, including the simplification of the import of foreign raw materials for the production of goods in the Russian Federation and subsequent export customs duties and VAT exemption.[10]

FDI fluctuations were accompanied by similar movements of REER. In 2016–2017 the ruble recovered as a result of the surge in oil prices. Oil prices by year end increased by 44.76% (up to USD 53.75) in 2016 and 12.48% (up to USD 60.46) in 2017. In 2018 oil prices dropped by 25.32% (at year end) with a corresponding ruble depreciation. The demand for foreign currency in the Russian Federation was increasing, while its supply was decreasing. The drop in foreign currency supply was associated with a decline in FDI inflows and in oil and gas revenues. However, the demand for foreign technology imports was increasing because of the production plans of the Russian manufacturers. The demand for foreign currency was increasing because of the high degree of dollarization of the energy sector and the private debt of the companies nominated in USD [13].

THE ANALYSIS

As seen in *Fig. 2*, the Russian case study is in line with theory that assumes a positive link between FDI and the value of the national currency. According to this theory, the depreciation of the national currency decreases the volume of horizontal FDI, whereas vertical FDI reacts positively to the currency's loss in value [7]. This theoretical counter-argument creates the need to analyze the sectoral structure of FDI in the Russian Federation so as to identify vertical and horizontal FDI. Based on the SIC approach identified by Herger and McCorriston, vertical

[9] 10 European companies localizing production in Russia this year. 27.10.2017. URL: https://www.rbth.com/business/326551-european-companies-localize-russia (accessed on 20.12.2021).

[10] The government intends to improve export conditions for foreign investors. 31.10.2017. (In Russ.). URL: https://www.vedomosti.ru/economics/articles/2017/10/31/739940-pravitelstvo-uluchshit-usloviya-eksporta (accessed on 23.12.2021).

and horizontal FDI can be classified by key sectors of a country's economy.

Vertical FDI is usually associated with separate stages of the production process in a particular country [14]. It therefore could be attributed to extractive industries, financial and insurance services, etc. Horizontal FDI, by contrast, is associated with a full production process [8]. It relates to wholesale and retail trade, construction, ICT, real estate property, etc. CBR's statistical classification is harmonized with NACE and SIC.[11] According to Herger and McCorriston's approach, horizontal FDI in Russia includes such industries as agriculture, forestry, hunting, and fisheries; construction; wholesale and retail trade; hotels and catering; ICT; real estate; scientific and technical activities; health; and education. Sectors such as mineral resource extraction, financial and insurance activities, transportation, and storage can be considered vertical investments. However, the manufacturing sector cannot be considered equally vertical or horizontal FDI given that manufacturers' business strategies can vary.

In further analysis, the theoretical assumptions for vertical and horizontal FDI will be checked against the Russian data. First, horizontal FDI will be discussed. Herger and McCorriston find the greatest portion of horizontal CBA deals are food production, chemical products, machinery and electrical equipment. This finding facilitates preliminary estimates for the total volume of the EU's horizontal FDI in Russia, which exceeds USD 197.6 billion (as of 1 January 2021). This figure constitutes about 60% of the total volume of EU FDI in Russia. The overall stock of horizontal FDI in Russia averages 60% of the total volume of FDI from the EU to the Russian Federation (*Fig. 3*).[12] However, EU horizontal FDI fell by 14.6% from 2014 to 2015 and by 24.6% from 2017 to 2018, when the ruble's REER fell to 16.5 points and to 7.7 points by respective year end.

According to theoretical provisions, the volume of horizontal FDI rises with the national currency's appreciation. Most of the empirical cases, analyzed in section 3, proved this assumption [15]. Moreover, in relative terms the share of horizontal FDI in the total FDI volume decreased from 40.01% to 36.87% between 2014 and 2020.

Some of the EU FDI projects described previously are associated with horizontal FDI. The Russian chemical industry, the food and agriculture sector, and transport engineering, with few exceptions, prove the theoretical considerations and empirical results.

In the chemical industry, the effects of sanctions and the general economic downturn in Russia led to a sharp increase in the outflow of FDI. However, the balance of FDI inflows and outflows remained positive. Some European chemical companies (such as Bayer and Bionorica) decided to stay in the Russian market and implement investment projects in the Russian Federation [16].

In the food and agriculture sector, some EU companies left the Russian market to focus on the supply of food products in the EU [17]. However, the imposition of counter-sanctions boosted EU FDI into the Russian food and agriculture sector. European food companies have opened new production facilities and increased the capacity of their plants already operating in different regions of Russia.[13]

In transportation engineering, the outflow of EU FDI from the Russian Federation was caused mainly by the ruble's devaluation and decreased purchasing power. Nevertheless, the largest European companies (such as Daimler

[11] OK 029–2014 Russian Classification of Economic Activities adopted by Order of Rosstandart of 01.31.2014 No. 14-st) (as amended on 08.12.2021). URL: http://www.consultant.ru/document/cons_doc_LAW_163320/ (accessed on 20.12.2021) (In Russ.).

[12] Authors' calculations based on CBR data. External Sector Statistics / Bank of Russia. URL: https://www.cbr.ru/eng/statistics/macro_itm/svs/ (accessed on 20.12.2021).

[13] European Parliament. Russia's and the EU's sanctions: economic and trade effects, compliance and the way forward. Directorate-general for external policies policy department, p. 57. 2017. URL: https://www.europarl.europa.eu/RegData/etudes/STUD/2017/603847/EXPO_STU(2017)603847_EN.pdf (accessed on 20.12.2021).

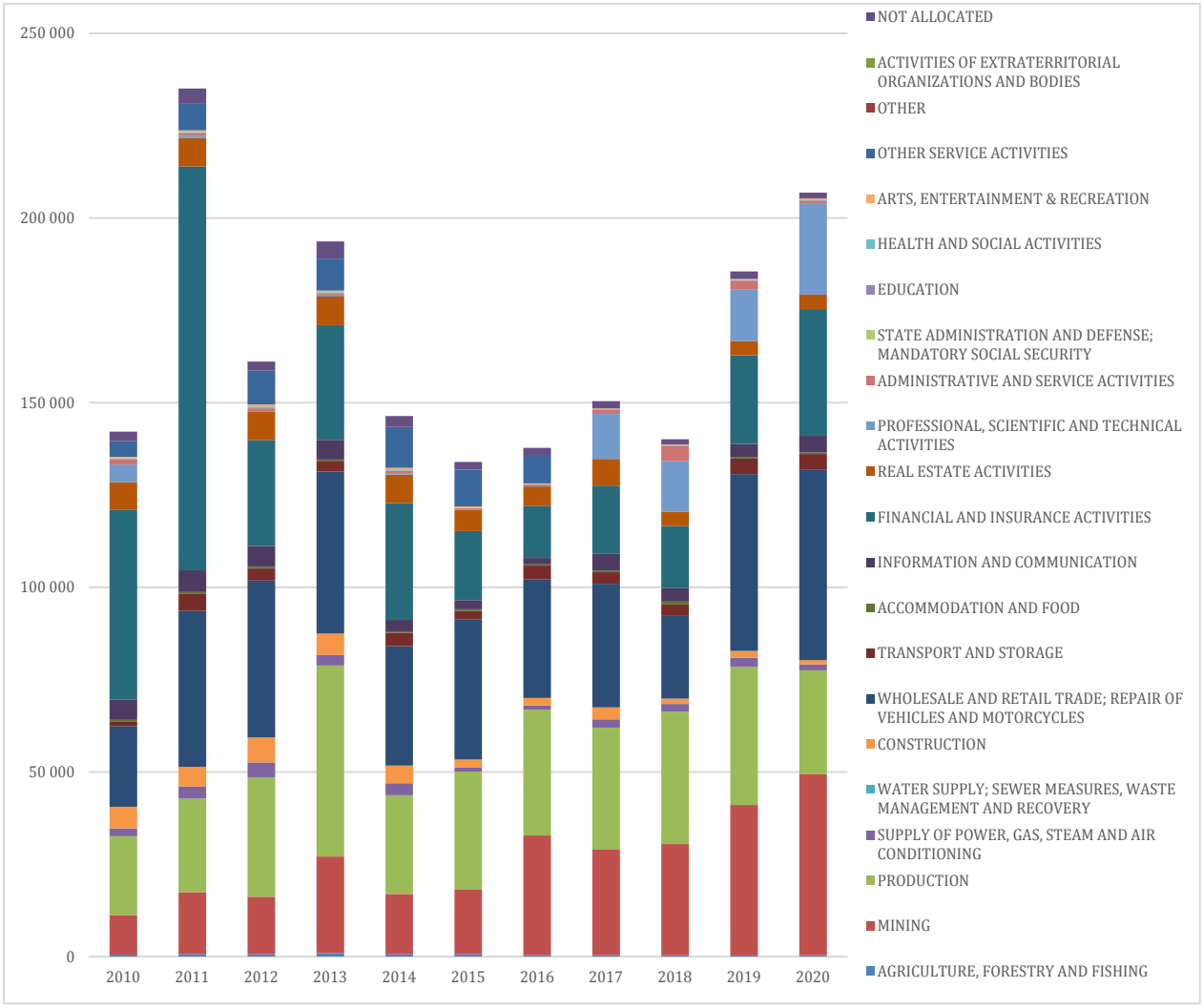

Fig. 3. **Distribution of Incoming FDI by Economic Sector in the Russian Federation, USD Million**

Source: Compiled by the author based on CBR data (CBR, 2021). CBR (2021b). Nominal volume of federal loan bonds (OFZ) owned by non-residents and the share of non-residents in the market. URL: https://cbr.ru/search/? Text=credit+statistics++ОФЗ&PageNum=0&Category=Any&Time=Any (accessed on 01.01.2022).

AG) continued to increase production in Russia and expand their product lines.[14]

Vertical FDI constitutes a substantial part of total FDI inflows for the Russian Federation, with mining and quarrying sectors having increased from 11.2% in 2014 to 23.7% in 2020 along with the ruble depreciation. Vertical FDI from the EU increased to USD 180.2 billion by the end of 2020 from USD 146.25 billion in 2014. In relative terms the share of vertical FDI in total FDI inflows constituted 52.7% in 2014 and 54.8% in 2020. The increase occurred in spite of the fact that the fuel and energy complex had become a main target for sanctions. In 2014, the US and the EU limited the access of the largest Russian banks, oil and gas companies to financing. They also prohibited the transfer of technology and equipment for oil and gas companies, as well as for the fuel and energy complex of the Republic of Crimea. Further, the sanctions were extended to the transport industry and oil and gas pipelines. Currently, western companies cannot participate in projects to develop shelf deposits or produce hard-to-recover shale oil and gas

[14] Daimler starts building a plant in the Moscow region. Vedomosti, 20.06.2017. URL: http://www.vedomosti.ru/auto/galleries/2017/06/20/695254-daimler-nachal-zavod (accessed on 20.12.2021). (In Russ.).

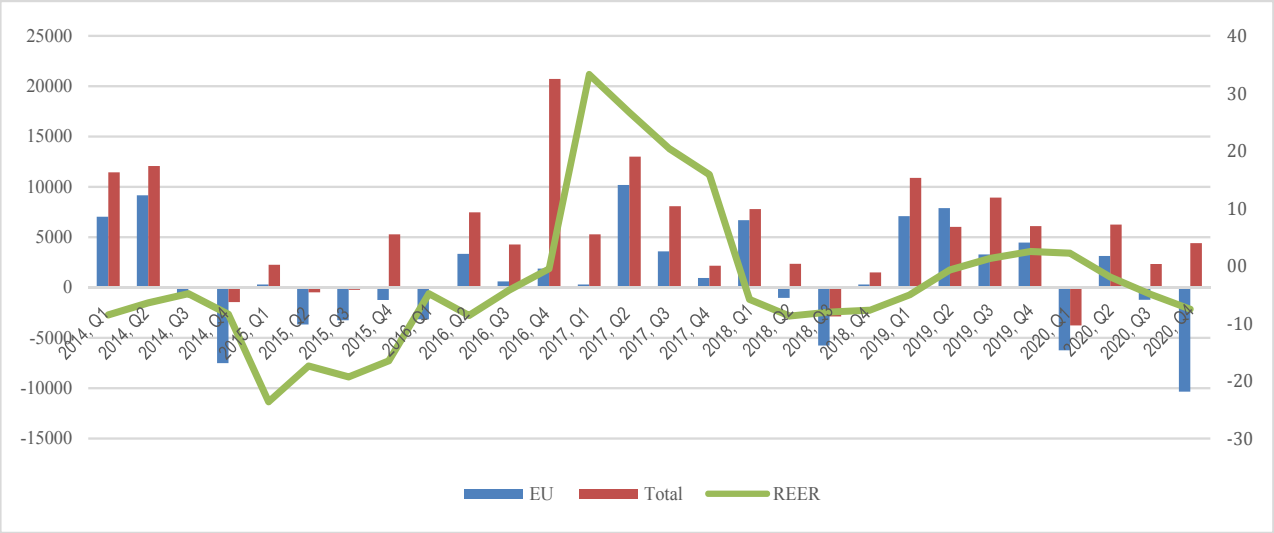

Fig. 4. **FDI into the Russia Federation from the EU and the World (Net, in USD Million) and the REER of the Russian Currency (Quarterly Data, 2014–2020)**

Source: Compiled by the author based on CBR data.

on the Russian territory. The sale of related equipment and the transfer of technologies are also prohibited [18].

The increase of vertical FDI with the parallel devaluation of the ruble is also in line with the theoretical provisions and empirical evidence [5]. This can be proved by a few cases from the financial and energy sector of the Russian economy.

For energy companies operating in the Russian Federation, it was relatively easier to keep up with new sanctions regulations and to support FDI in existing projects.

In the financial and insurance services sector, despite the downward dynamics of FDI from the EU to the Russian Federation in the early years of sanctions, there was a slight increase and a gradual recovery in 2020. According to CBR data, in that sector, the balance of FDI from the EU was 16.6% of the total volume of FDI inflow in 2020 in comparison to 10.3% in 2014. There was also an increase in the share of non-residents in Russia's federal loan bonds (OFZ) market, despite the ban on the sale and purchase of bonds, shares and other financial instruments of Russian state-owned banks to EU citizens and companies.

Another empirical relationship between FDI and currency volatility can be confirmed with Russian data. The negative relationship between exchange rate volatility and FDI established by Schmidt and Broll was evident for the Russian economy for the period of 2014–2017 (*Fig. 4*). In 2018 the exchange rate of the Russian currency became more stable, and 2019 demonstrated a robust FDI inflow with the EU's share exceeding 70% of the total volume.[15]

The economic sanctions introduced in 2014 forced the majority of foreign investors to revise their investment strategies. Most companies working in the Russian market joined the import substitution and localization trend, which was officially supported by the Russian government [19]. However, in practice, EU firms behaved in different ways. Thus, the dynamic model considered above, with firms classified as oriented to the domestic market (horizontal FDI) and oriented to exporting products from the host country (vertical FDI), makes it possible to subdivide foreign firms into two categories, depending on their reaction to exchange rate fluctuations.

With the fall in the exchange rate, foreign firms oriented to the Russian market reduced

[15] Author's calculations based on CBR (2021). External Sector Statistics / Bank of Russia. URL: https://www.cbr.ru/eng/statistics/macro_itm/svs/ (accessed on 20.12.2021).

their investments, while export-oriented firms increased their presence in the form of investments in fixed assets in the Russian Federation. However, some cases also demonstrate deviations from the theoretical and empirical provision, as mentioned in section 3. These deviations could be explained by localization strategies of EU companies as a result of Russia's embargo on food and agricultural products and increased import prices as a result of the ruble's devaluation.

CONCLUSION

The study has addressed the research question if the Russian currency exchange rate developments can explain the FDI inflows from the European Union to the Russian Federation.

The main theoretical conclusion from the analysis in this study is that the appreciation of the currency has a positive effect on the inflow of FDI. At the same time, the more export-oriented an industry is, the less attractive it becomes for foreign investment when the currency rises. But an increase in the currency's value has a positive effect on industries oriented to the domestic market.

The theoretical arrangements were supported by an overview of the findings of the empirical literature, as well as empirical data from the Russian Federation. First, the weakening of the ruble's real exchange rate generally had a negative effect on the inflow of FDI into the Russian market. Second, the depreciation of the ruble had a positive effect on export-oriented FDI in Russia. EU investors providing vertical FDI would have benefited less from a stronger national currency because of reduced competitiveness.

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ABOUT THE AUTHOR

Yury K. Zaytsev — Cand. Sci. (Econ.), Senior Researcher, Russian Academy of National Economy and Public Administration, Moscow, Russia
http://orcid.org/0000-0003-2458-7419
zaitsevyk@ranepa.ru

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Modification of the Three-Factor Fama-French Model and its Application to Assess the Efficiency of the Portfolio Management of Russian Investment Funds

E.R. Bezsmertnaya, E.A. Kolganova
Financial University, Moscow, Russia

ABSTRACT

The subject of the paper is the activity of managers of Russian investment funds. **The aim** of the paper is to determine the possibility of using widely applied abroad methods of assessment of the managers' diving abilities in the Russian practice, adaptation to the conditions of the Russian market of the three — factor Fama-French model. The **methods** of analysis and synthesis, quantitative assessment, including in relation to the study of the assessment of the portfolio managers picking abilities, are used as the main research methods. **The relevance** of the research is to make proposals on the transformation of the Russian approach to assess the performance of collective investment fund managers and its subsequent practical use. The article presents the results of a statistical assessment of the effectiveness of the activities of Russian managers of open-end investment funds shares from the perspective of micro-forecasting. According to the **results** of the research, conclusions are drawn that both the multifactorial Fama-French regression and CAPM, traditionally used in foreign practice, tested on the data of the Russian stock market, have sufficient predictive abilities and allow to obtain statistically significant estimations of variables and finally can be **recommended** for practical use in Russia. **The novelty** of the research consists in the development of the author's modification of the three-factor Fama-French regression (a model with the SPX-factor), which allows to obtain better regression factors estimations in comparison with the basic model, more accurately explains the process of excess returns generation of Russian open-end investment funds and can be recommended for practical use. **The result** of the statistical analysis is the conclusion that the processes of portfolio management of Russian investment funds in 2009–2019 were characterized by a lack of managers' skill for successful picking, the profitability received by the funds was more ensured by random factors.
Keywords: investment funds; micro-forecasting; picking; multifactor regression; Fama-French alpha; Jensen alpha

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INTRODUCTION

The effectiveness of the Russian institutions of collective investment today is assessed extremely low, despite the implementation of a wide range of measures, over which the research started more than twenty years ago, and the potential of Russian institutional investors remains unfulfilled. The current state of the regulatory system, problems of information transparency as well as and market factors have led to the stagnation of the Russian mutual funds' sector and have largely led to a shortage of long-term sources of financing, is a key constraint on the development of the Russian economy.

In the absence of a statutory responsibility of the manager for the reduction of the market value of the property transferred to management, the risks of changes in the value of assets of mutual investment funds (hereinafter — MIF) are transferred to fund shareholders. These risks are not only realized for external reasons, but are also directly caused by management actions, including behavioral factors, the so-called "management abilities".

It is entirely possible that, when choosing an investment fund as an investment object, the measure of the effectiveness of the MIF portfolio management should be considered

in the quantitative evaluation of the factors, affecting the outcome of the investment. This approach will separate fortuitous circumstances management result from effective management achieved through the application of managerial skills and competencies.

In contrast to foreign practice, Russian experience in assessing the effectiveness of the collective investment segment is extremely limited. Moreover, the available domestic developments in the field of multifactor modelling [1] that could be used to assess the activities of MIF managers, have no practical application in Russia. Consequently, in most cases the assessment of the results of portfolio management in Russia is based on a coefficient analysis (in particular, the Sharpe ratio, Sortino ratio etc.) as well as on the subsequent ranking of the funds by the values of the calculated coefficients and other indicators (for example, on the value of net assets, annual returns, etc.).

The practical application of the above ratios concerning the assessing the results of portfolio management of investment funds is limited in terms of econometric modeling that both foreign authors and some Russian researchers have repeatedly pointed out [2–6]. This conclusion is due to the fact that the methodology of calculating these coefficients assumes the execution preconditions on the stationarity and parameterity of MIFs income generation process, which in practice is difficult to implement, and therefore rarely occurs [7, 8]. Moreover, the application of different ways to get rid time series from non-stationary (using, for example, DSGE models) gives rise to a distortion logic of the calculation of Sharpe ratio, Sortino etc. as a result, such time-series adjustments cannot be used in order to calculate these metrics in terms of investment fund efficiency [9].

From the point of view of the comprehensive analysis of the performance of MIF portfolio management, the use of coefficient analysis metrics as a unified determinant of the performance of fund portfolio management cannot be recommended because of the high probability of incorrect interpretation payments. This may lead, among other factors, to the investor's misperception of market conditions and may lead to the distortion of their investment priorities.

ADAPTION OF MULTI-FACTOR METRICS TO ASSESS THE EFFECTIVENESS MANAGEMENT OF MUTUAL INVESTMENT FUNDS

Considering the abovementioned, the purpose of this paper is (1) to determine the feasibility of using foreign multifactor metrics, widely used abroad to assess the effectiveness of MIF's portfolio management, and applying management specific management skills as determinants of efficiency (in particular to successful market picking); (2) to test these methods on data of the Russian market, and (3) to adapt the 3-factor regression of Fama-French to the conditions of the Russian market for the possibility of its subsequent practical use in the Russian practice.

The logic of constructing factor modeling metrics, traditionally used in foreign practice, is largely based on the results of E. Fama and M. Jensen studies [10], conducted with the purpose of seeking a new approach to assessing the effectiveness of fund management and leveling the problem of obtaining "imaginary" estimates of regression factors that inevitably arise when using single factor estimation methods for this purpose. As a result, the authors of the attribution approach proposed to decompose the factors affecting the assessed performance of portfolio management of collective funds. At the same time, the significance of the influence of individual factors E. Fama and M. Jensen made it necessary for managers to have the ability to predict, i.e. picking skills and (selection of undervalued assets, the future return on which will exceed the expected market return) the ability to

successful timing the market (successful management of systemic portfolio risk) [10].

It was later empirically proved that these indicators could be assessed independently [11]. Furthermore, E. Fama and M. Jensen's assumption that it is impossible to use only one-factor metrics to assess the results of portfolio management funds, as they cannot be characterized by a constant level of risk, which is determined by the investment nature of collective investment funds, was also proved [12].

The most common factor metric used in foreign practice to assess managers' ability to pick a market is based on the CAPM Jensen alpha excess return concept (α) [13] (1):

$$\alpha = r - \left(r_f + \beta_p \bullet \left(r_m - r_f\right)\right), \quad (1)$$

where r — portfolio return; r_f — risk-free profitability; r_m — return on the market portfolio; β_p — portfolio market risk.

The picking indicator, called in this concept "alpha", allows to determine a part of the investment portfolio actual yield, obtained as a result of manager's actions, which allowed to surpass the market, i.e. its skill in managing the fund's portfolio is to accept a non-diversified risk component and at the same time to earn above-market return. Thus, the positive Jensen alpha indicates the ability to micro forecasting, while the negative — the lack of it.

The proposed approach was further modified, subsequently the addition of previously unaccounted factors to the basic model contributed a lot of the explanatory abilities of Jensen's alpha. At the same time, the main changes in the logic of the proposed metrics affected mostly the choice of the benchmark profitability model.

In particular, Fama and French proposed a three-factor alpha model in 1993, adding SMB and HML factors to Jensen's metric, as a result of which the explanatory strength of regression increased significantly [14]. The authors of the three-factor model, based on the analysis of North American stock market data for the period from 1962 to 1990, empirically proved that, all other things being equal, return of a security is influenced by the size of the issuing company along with compensation for market risk, ratio of price and balance sheet value of assets. Thus, in order to assess picking-ability of portfolio managers of investment funds, they supplemented the parametric model by these two factors (2):

$$\alpha_{FF} = \left(r_p - r_f\right) - \beta_1\left(r_m - r_f\right) - \beta_2 SMB - \beta_3 HML, \quad (2)$$

where: *SMB* — size factor defined as the difference between companies of small and large capitalization; *HML* is calculated as the difference between yield of companies' share with a high and low balance-to-market ratio.

The conclusion about the presence (absence) of management ability to successful picking the market is based on the interpretation of three-factor alpha (α_{FF}): positive alpha indicates the presence of the ability to pick the market, negative — lack of it, as a result, the explanation of the profitability obtained by the factor of "success".

The three-factor alpha model, further tested in foreign markets [15–17], in most cases was statistically significant, owned sustainable explanatory and sufficiently explained the MIF return variation (on average at 35%, in some cases up to 70% of variation in profitability [17]).

In 1997 M. Carhart improved the predictive abilities of this model by supplementing its specification with a momentum factor [18] [M. Carhart's four-factor model (3)]:

$$\alpha_C = \left(r_p - r_f\right) - \beta_1\left(r_m - r_f\right) - \beta_2 SMB - \beta_3 HML - \beta_4 WML, \quad (3)$$

where: *WML* — momentum effect, is the amount of variation of economic returns between the papers with the best and worst rates of return over the period.

The effectiveness of investment strategies with momentum effect has been repeatedly

confirmed in later researches. At the same time, such factors, as the capital market degree of development, on which the realization of the momentum-strategy remains contentious issue is expected. In particular, empirical studies have demonstrated that the presence of momentum is questionable in emerging markets [19, 20], as well as the quality of the Carhart regression is often insufficient for both the parametric model and its individual regressions [21].

However, the implementation of the momentum-strategy objectively implies a substantial, systematic rebalancing of the portfolio, so that this type of investment strategy can be sensitive to the factor of liquidity [22].

Thus, the inclusion of a factor in the base regression that would determine the share of portfolio return due to the impulse effect could theoretically have a positive impact on the quality of regression modelling. Especially since the tested by M. Carhart method on sample data showed lower regression errors than not only CAPM, but also the three-factor model Fama and French [18].

In 2014, based on this metric, E. Fama and K. French proposed a five-factor alpha [23] model, supplemented the regression specification with *RMW* (low profit premium), and *CMA* factors (low investment premium) (4):

$$\alpha_{FF5} = \left(r_p - r_f\right) - \beta_1\left(r_m - r_f\right) - \beta_2 SMB - \\ - \beta_3 HML\beta - \beta_4 RMW - \beta_5 CMA. \quad (4)$$

This model has better explanatory capabilities than their previous three-factor alpha model and provides the researcher with better estimations of the overall alpha and individual factors influencing the excess portfolio return. However, at the same time, the method of calculation of 5-factor alpha involves the implementation of estimation by a more complex algorithm, which seems to be critical when developing the tools, accessible and easily replicable by private investors in the process of selecting investment funds for investment.

MATERIAL AND METHODS

The possibility of practical use in the Russian practice the above mentioned multi-factual metrics in order to assess the picking-abilities of MIF managers is determined in this paper by testing on the data of the Russian market three-factor Fama-French model and Jensen alpha. The quality of the Fama-French regression is correlated with the CAPM indicators.

Empirical analysis of MIF portfolio management efficiency is based on evaluation of panel multi-factor regression based on the econometric package Eviews 8. This appears to be the more illustrative and more representative than the bootstrap modeling procedure, widely tested in foreign research of the investment funds market [18, 24, 25], as well as described in the works of some Russian authors [3, 26].

As the determinant of the fund's portfolio management efficiency, we consider the presence (absence) of managers selected for the research 47 open-end investment funds shares (OEF) of micro-forecasting skills for a 10-year period of research (2009–2019).

To obtain more representative results, the evaluation period was split into five sub-periods (*Table 1*), whose length corresponds to key trends in the evolution of the benchmark chosen for the research — *RTSI* index (*Fig. 1*). The additional sixth sample is taken to be equal to the length of the entire research period (08.06.2009–31.05.2019). In the future, such a breakdown of the evaluation period will allow to determine the strength of the explanatory abilities of the tested metrics at different stages of the business cycle, which are traced in the dynamics of *RTSI* at a selected time period.

For the further calculations, we use weekly values of OEF sample profitability, *RTSI* index, risk-free rate of return. The choice of frequency of calculation data is due to the fact, that weekly data are least affected by the

Table 1

Sub-Periods for Models Testing

No.	Period	Description of the period
1	08.06.2009–08.04.2011	Unrestrained growth
2	09.04.2011–09.07.2014	Gradual decline
3	10.07.2014–16.12.2014	Sharp decline
4	17.12.2014–20.01.2016	Recovery
5	21.01.2016–31.05.2019	Stabilization
6	08.06.2009–31.05.2019	Entire evaluation period

Source: Compiled on the data from MOEX (accessed on 12.11.2019).

Fig. 1. ***RTSI*** **Dynamics, 06.08.2009–05.31.2019**

Source: Compiled on the data from MOEX (accessed on 12.11.2019).

volatility of the market in comparison with the daily profitability and at the same time less manipulative than the monthly or annual profitability.

Note that calculation of factors *SMB* and *HML* is determined as the differences in market indices (*MSCI* Russia), not by the original methodology:

1) *HML* counted by subtracting the weekly profitability of the *MSCI* growth index from the corresponding profitability of the *MSCI* Value index;

2) *SMB* calculated as the difference between the weekly profitability of *MSCI* Large Cap and *MSCI* Small Cap.

We consider the estimation based on this algorithm of finding the second and third factors of Fama-French model can be possible due to the high concentration of the Russian financial market, as well as the specifics of the calculation of national stock indices.

Besides, we take into the consideration, that the key factor in the *MIF* sample construction was the direction of investment (i.e. the stock), but not the type of management strategy, and the presence of a strong correlation between the *MIF* returns of the sample and the benchmark (*Fig. 2*). To eliminate the negative effect of the false correlation of the returns of individual funds with the return of *RTSI*, we rank the funds on the increase of the index of gross return of portfolios for the evaluation period.

Thus, portfolio managers' picking-abilities in this study we determine both for the whole sample and for the funds grouped into four quartiles (Q1–Q4) by the average annual actual return of MIF portfolios for the entire observation period.

The statistical characteristics of the received quartiles, including the nature of return distribution (adjusted for average and median values), as well as the correlation with the benchmark, generally correspond to the characteristics of the MIF sample (*Table 2*).

RESULTS

The testing and approbation of three-factor Fama-French regression allowed us to make the following conclusions.

The model has sufficient predictive abilities, the quality of regression (*Adj* R^2) in some periods significantly exceeds the quality of CAPM (in the 4th and 5th crisis and post-crisis samples, the Fama-French regression quality was estimated at average at 22.0% against 7.2 and 23.3% calculated at CAPM), which suggests that the three-factor model demonstrates the better results. Moreover, the estimated parameters of the regression are statistically sustainable (*Fig. 3*).

The quality of both regressions tends to improve on the upstream phases of the business cycle, confirming the finding that portfolio managers' skills are subject to change in different phases of the business cycle [27].

The β-coefficient in both models is stable for the entire sample size and for the funds of each quartile Q1-Q4. The greater statistical significance of β is observed in the estimations of the three-factor model (the value of the index "*Std. Error* β" on average for the research period at 0.0017; the index "*Probability* β" — at the level of 0%). At the same time the observed values of this factor, estimated using CAPM have minimal influence on the actual profitability of the sample funds (beta value in CAPM is minimal on the 3rd and 4th sample, takes values from 0.11 to 0.32).

Fig. 2. **Correlation Profitability of Open-End Investment Funds and *RTSI*, 06.08.2009–05.31.2019**

Source: Compiled by the authors based on the calculation in Eviews 8.

The influence of *HML* and *SMB* factors of the Fama-French model on the profitability of MIF and the quality of regression in general in the sample seems to be ambiguous. For the whole sample these factors have different degrees of influence (HML takes values in the range from –0.004 to 0.005; *SMB* — from –0.034 to 0.033), as well as different type of influence on the final profitability of mutual funds (on the relevant sample estimation of these factors are predominantly opposite signs). The estimated values of *HML* and *SMB* factors are distributed near zero point, with no apparent correlation with stages of the economic cycle (*Fig. 4*).

We consider that the practical application of the three-factor Fama-French model in order to evaluate Russian managers picking abilities is justified. During the study, we managed to collect all the needed data in order to construct the regression variables, our estimations are statistically significant and the model has sufficient predictive abilities at a higher level than the quality of the CAPM.

Table 2

Distribution of Open-End Investment Funds Profitability by Quartile Q1–Q4

Indicator	All Funds	Q1	Q2	Q3	Q4
Median	0.2136%	0.1197%	0.1977%	0.2357%	0.3017%
Maximum	25.4406%	17.5454%	24.0333%	25.4406%	17.4819%
Minimum	–23.0194%	–21.3457%	–23.0194%	–19.1262%	–20.8283%
Std. Dev.	0.028035	0.029485	0.027755	0.026514	0.028148
Skewness	–0.253332	–0.410004	–0.177167	–0.156385	–0.206904
Kurtosis	6.864838	6.740433	6.953679	7.188413	6.527841
Jarque-Bera	77509.93	19098.88	20523.67	21062.18	16433.51
Probability	0	0	0	0	0
Observations	122435	31260	31260	28655	31260

Source: Compiled based on the calculation in Eviews 8.

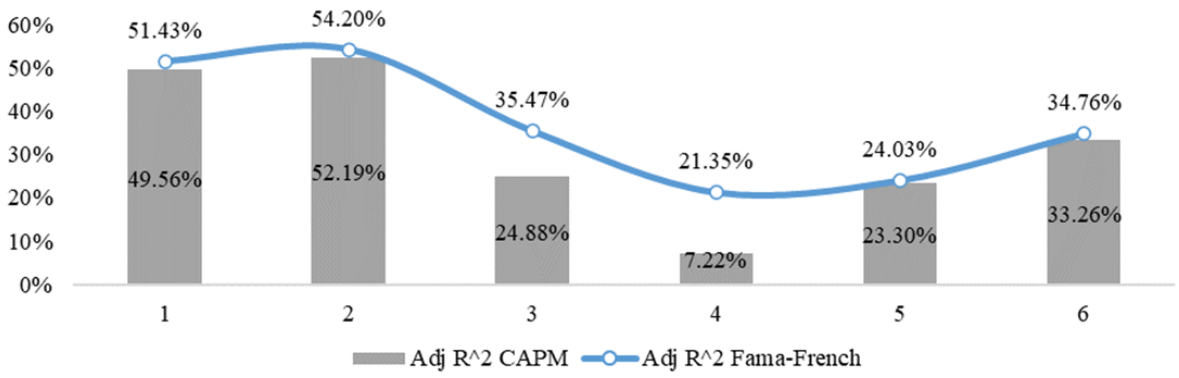

Fig. 3. **Quality of CAPM and Fama-French Model on the Samples 1–6**

Source: Compiled based on the calculation in Eviews 8.

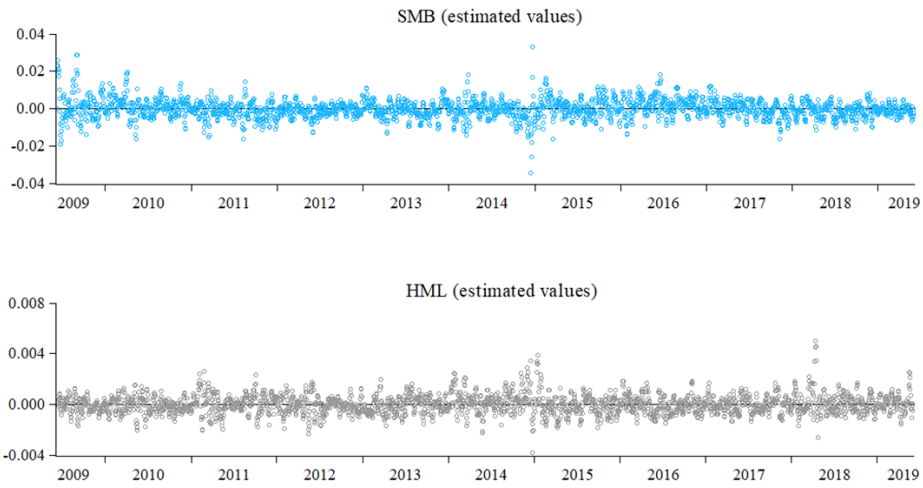

Fig. 4. **Distribution of *HML* and *SMB* Factor of Fama-French Model, 2009–2019**

Source: Compiled by the authors based on the calculation in Eviews 8.

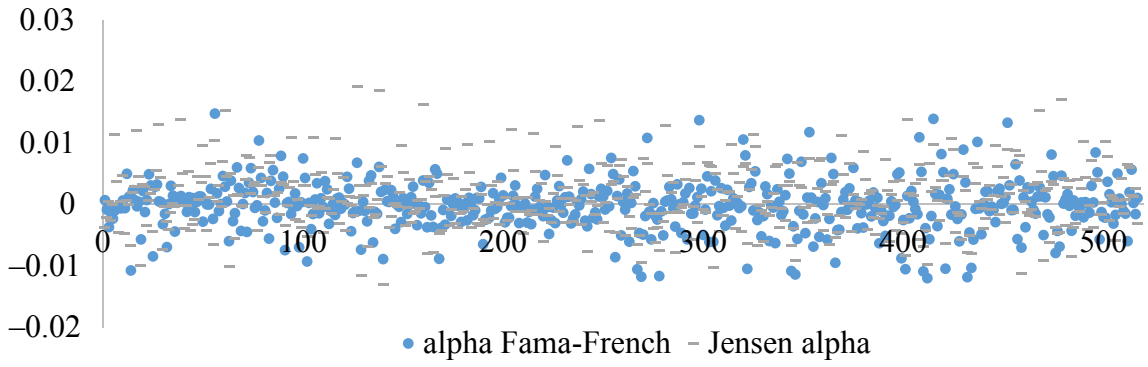

Fig. 5. **Distribution of Fama-French Alpha for Open-End Investment Funds of the Sample**

Source: Compiled based on the calculation in Eviews 8.

More than that, the proposed simplification of the *HML* and *SMB* factors calculation methodology did not have a significant effect on the results interpretation: evaluations are comparable to previous researches (D. M. Murav'ev [3], P. A. Parshakov [26]). Therefore, we consider the possibility of these factors' calculation according to our proposed methodology.

It is noteworthy that both the average annual Fama-French alpha and Jensen alpha are grouped around the zero point. However, there is not any constant trend and alpha distribution dependency (*Fig. 5*).

According to the results of our statistical assessment, the positive excess return, which could indicate the effectiveness of the management of MIF's portfolios, was determined in most cases by random factors. On average, less than half of MIFs (49.1%) crushed the market while only 10 funds have shown a positive excess return for at least 7 periods.

One of the main trends observed in the Russian collective investment market in recent years is a significant rebalancing of MIFs investment portfolios, in particular OEF stock portfolios, in which the share of foreign bonds in 2014–2019 has doubled (up to 38.0% portfolio by 2019).

Perhaps, taking into the consideration the factor of foreign investments will have some impact on the explanatory abilities of Fama-French 3-factor regression. We propose to test the following model and to compare its results with the estimations of the Fama-French alpha (5):

$$\alpha_{\text{mod}} = (r_p - r_f) - \beta_1 (r_m - r_f) - \beta_2 SMB - \beta_3 HML - \beta_4 SPX, \quad (5)$$

where β_1, β_2, β_3 — coefficients under the factors of the three-factor model Fama-French; β_4 — coefficient, reflecting the influence of the foreign investments (hereinafter — *SPX*-factor, as part of this research — weekly profitability of the S&P 500 Index) on the return of Russian MIF shares.

Testing an *SPX*-factor model provided us with some unexpected results. On the one hand, the modification of basic model with this factor did not have significant influence on its quality: *Adj* R^2 basic and *SPX*-factor models are comparable for the MIF of the entire sample and for the funds of quartiles Q1-Q4 on all samples (*Fig. 6*).

The marginal impact of the foreign investment factor on the MIF excess return distribution of the sample cannot be described as significant (for the whole sample between 0.00029 and 0.02271), even there are no sign of the stochastic process in its distribution, unlike other model factors. Besides, there is an obvious presence of the trend in the *SPX*-factor distribution (*Fig. 7*), which supports the assumption that the rebalancing of OEF portfolios during the valuation period was significant.

At the same time, the results of a residuals testing procedure demonstrate that *SPX*-factor

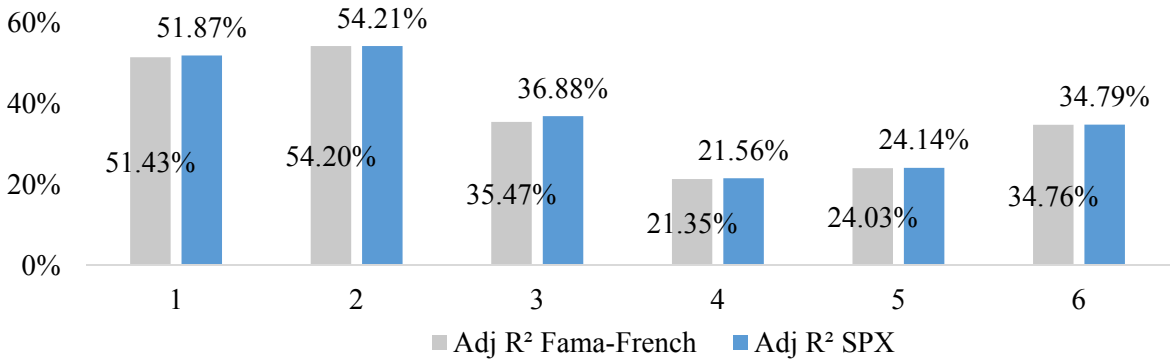

Fig. 6. ***Adj R²*** **for Fama-French Model with *SPX*-Factor, Estimation for Samples 1–6**

Source: Compiled based on the calculation in Eviews 8.

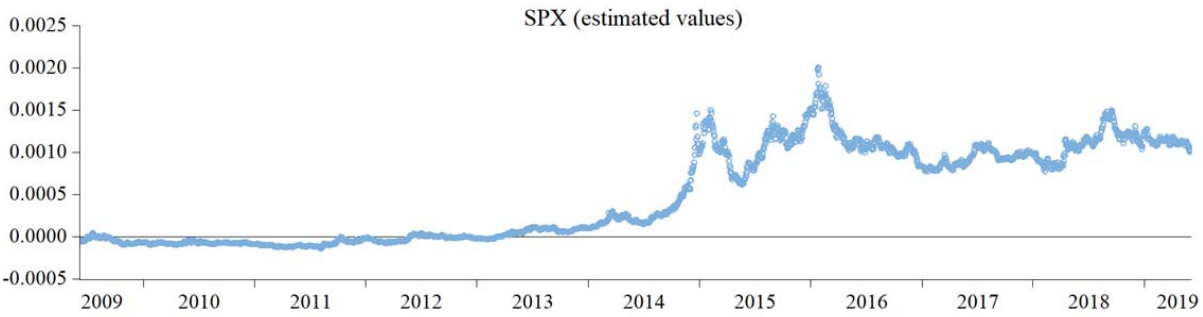

Fig. 7. **Distribution of the Estimated SPX-Factor, 06.08.2009–05.31.2019**

Source: Compiled based on the calculation in Eviews 8.

still allows obtaining more accurate results of factors' estimation than the basic 3-factor model.

In this case, the actual values of the modified alpha allow judging the more modest (even in comparison with the alpha Fama-French) ability of the Russian managers to pick the market: 48–90% of the sample stocks have confirmed this proficiency by year (additional data may be provided).

However, it seems to be obvious that the *SPX*-factor, "delaying" on itself a certain share of MIF profitability, allows to obtain better clarification in order to explain the process of mutual funds' excess return generating, and its consideration in the construction of the appraisal model of the dive is somewhat reasonable.

CONCLUSION

Evaluation of the effectiveness of portfolio management of Russian investment funds is still poorly studied. Results of existing research in this field are not used in the Russian practice of evaluation and public disclosure of results of MIF portfolio management. Most often Russian managers use metrics, which don't allow an objective assessment of the effectiveness of portfolio management.

As part of this study, the traditional for a foreign practice metrics of the attribution approach were tested in terms of the assessment of managers' skills in micro-forecasting. The possibility of their practical use in order to assess the performance of investment portfolios of the Russian MIF is also shown.

We consider that the calculation of the considered metrics (possibly at the level of self-regulated financial market organizations) and disclosure of this data

as well, as the other officially published indicators of the MIF portfolio process, will help to reduce the level of uncertainty that arises around the activities of MIF management companies. Besides, we believe that this will positively affect the process of selection of funds for investment, which can cause a positive reaction from potential investors and lead to the development of competition in the Russian collective investment market to a qualitatively new level.

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ABOUT THE AUTHORS

Ekaterina R. Bezsmertnaya — Cand. Sci. (Econ.), Assoc. Prof., Dean of the Faculty of Economics and Business, Financial University, Moscow, Russia
https://orcid.org/0000-0001-5238-0605
Corresponding author:
EBezsmertnaya@fa.ru

Ekaterina A. Kolganova — Postgraduate student, Department of Financial Markets and Financial Engineering, Financial University, Moscow, Russia
https://orcid.org/0000-0002-2425-1213
ea-kolganova@yandex.ru

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ORIGINAL PAPER

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Examination of the Relationship Between Economic Growth and Research and Development Expenditures in Azerbaijan, Kazakhstan and Kyrgyzstan

N. Huseynli
Azerbaijan State University of Economic (UNEC), Baku, Azerbaijan

ABSTRACT

The article is devoted to topical issues related to the impact of investment in research and development (R&D) on the acceleration of economic growth on the example of Azerbaijan, Kazakhstan, and Kyrgyzstan. All three countries need to modernize and diversify their economies, especially in the context of unstable conditions in the world fuel and raw materials markets and the trend towards decarbonization of the world economy. The relationship between economic growth and R&D expenditures was studied through econometric analysis (Granger test), which increases the accuracy and reliability of the results. The relationship between R&D and economic growth is examined using the annual GDP data of the respective countries and the ratio of R&D expenditures to GDP for the period 2005–2018. The data were analysed using EViews statistical package. It was found that GDP growth in Kyrgyzstan is the reason for cost increases on research and development. At the same time, a causal relationship was not found in Azerbaijan or Kazakhstan. According to the results of the correlation analysis, there is a very high positive correlation (0.92) between the growth data given in Azerbaijan and R&D expenditures. However, in Kyrgyzstan (–0.69) and Kazakhstan (–0.33), on the contrary, there is a moderate relationship in the negative direction. It is concluded that one of the ways to increase economic growth in the long term is to investment in R&D. The results of the research can be used by official institutions to assess the economic profiles of the countries under consideration and in the real sector of the economy.

Keywords: economic growth; research and development (R&D); investments; Granger test; Azerbaijan; Kazakhstan; Kyrgyzstan

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INTRODUCTION

Economic growth it is the most important economic phenomenon that increases income in countries, reduces unemployment in general, and raises the welfare level of citizens, and is one of the primary goals of all governments. Decreased economic growth; by reducing unemployment and per capita income, it brings together poverty and a decrease in the level of welfare in countries. For this reason, economic growth is very important for countries.

Today, the creation of innovation by creating new products and production processes and the development of innovative approaches depend on advanced technologies. For this reason, R&D activities are needed to support economic growth. Realizing R&D investments offers various outputs at the macro level. At this point, the concept of the knowledge economy, which focuses on innovation activities, comes first. The transformation of the knowledge economy into practice is possible by allocating the necessary shares for R&D and realizing these expenditures.

In developing countries, sufficient funds and time cannot be allocated to R&D activities in improving production processes and achieving innovation. This situation causes the desired results not to be achieved as a result of R&D activities in developing countries [1–3]. The literature on R&D activities and economic growth is quite rich. However, when the studies dealing with this subject are evaluated in a general perspective, a common empirical finding cannot be obtained. Researches are generally based on causality and cointegration tests, which include panel data analysis, time series or panel data analysis as a method.

The authors present their views on opportunities and mechanisms for the development of innovative business of Kazakhstan within the Eurasian Economic Union (EAEU), considering that the basis of the competitiveness of the modern economy is the existence of a dynamically developing innovative business. The article is based on the work done in 2015–2017: and briefly reveals the main problems

of the innovative business of Kazakhstan [4]. In a research study by [5], problems related to environmental security and quality of life of the population, which can accelerate or, conversely, slow down socio-economic progress in the Central Eurasian region, are analyzed. Based on international research, the article reveals the difficulty of the socio-ecological situation in Russia and even more worrying in Central Asia. In another research paper [6], the features that determine the development of the Central Asian region countries are discussed, the poverty level, demographic indicators, natural characteristics of the region and individual indicators of economic development are analyzed. A research paper by [7] compares the political institutions responsible for the formulation and implementation of state economic policy in the countries of the Central Asian region (Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan).

In this study, the relationship between economic growth and R&D expenditures in Azerbaijan, Kazakhstan and Kyrgyzstan was examined by econometric analysis. Although there are no comprehensive studies on the subject in Kazakhstan and Kyrgyzstan, there have been few studies on Azerbaijan [8–9].

THEORITICAL BACKGROUND

Economic Growth

Economic growth comes first among the macroeconomic indicators of countries. For this reason, countries around the world are preparing their future plans by accepting this variable as a goal. If the economic growth should be explained in the simplest way, it refers to the increase in the amount of goods and services produced in total or per capita. In the literature, economic growth it is explained as the increase in per capita income from the continued increase in Gross National Product (GDP). Economic growth is measured by the concept of "average growth rate", which expresses the annual variation in per capita income over a long period of time. [10]. According to the definition made by Joseph Schumpeter and widely used in the literature: "Economic growth is not a short-term static, but on the contrary, a long-term dynamic phenomenon" [11]. The aim of every economy is to provide economic development by providing social and cultural development in a way that will raise living standards along with economic growth [12]. Economic growth constitutes the first step of development. There are many indicators of economic growth in an economy. Some of these indicators are natural resources, industrial production and employment level. The increase in these indicators causes an increase in GDP, GNP, national income, disposable income and per capita national income [13].

One of the most important goals of economic policy is the realization of economic growth. In this sense, the realization of economic-economic growth, which is defined as the outward expansion of production possibilities, is an important prerequisite for increasing the welfare level of the society.

Research & Development

There are different conceptual explanations about the term research and development (R&D) in the literature. According to Jones and Williams, while R&D is described as "an important determinant of long-term productivity and well-being", according to the Frascati Manual it is defined as "a process involving significant transfers of resources between units, institutions and sectors, particularly the government and other enablers" [14]. In addition, it is expressed in the guide as "creative work carried out on a systematic basis to increase the knowledge of people, culture and society and to use this knowledge to design new applications" [13].

As a transformation process with high added value, the way for knowledge to become tangible products and create technology is to allocate resources to R&D [15]. Along with education, R&D investments are accepted as one of the basic criteria in evaluating a country's competitiveness and economic development. It is thought that R&D investments have an impact on economic growth through many factors such as innovation, capital accumulation and development of human capital [16]. R&D, which is defined as innovative studies that allow the increase of human, cultural and social knowledge, also refers to all of the systematic studies aimed at introducing a new product or production process [17]. According to OECD, R&D is defined as "creative work carried out on a systematic basis to increase the knowledge of people, culture

and society and to use this knowledge to design new applications" [14].

The realization of R&D activities aimed at increasing profitability and productivity with the use of technology depends on R&D expenditures. Expenditures on R&D activities, which form the basis of innovation, show a quality that encourages economic growth [18]. While R&D expenditures stand out as the key strategy that ensures innovation and economic growth, the decreasing return resulting from the externalities and overflows that occur as a result of the investments made for R&D expenditures at the macro level is transformed into an increasing return. R&D expenditures contribute to the development of technological capability and allow foreign direct investments to enter the country.

R&D activities are described as a new method or perspective for the service, application and problem solving that a country needs in order to meet its economic and social needs. Increasing production capacity in the 21st century, developments in information, communication and transportation technologies, changes in the expectations of individuals and society, and the applicability of production processes based on new technology have led to a rapid transformation in all areas. Countries have started to give more importance to R&D activities in order to keep up with this transformation wave. At this point, R&D expenditure, which is one of the most important indicators of R&D activity, attracts attention as a factor commonly used to define the technological capacities of countries or companies. R&D expenditures constitute the dynamics of activities such as developing new products and production methods, using existing or imported technologies more effectively, updating or transforming them [19].

THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND R&D

There are different studies in the literature examining the relationship between R&D expenditures and economic indicators. However, the number of studies examining the effects of R&D expenditures on stock returns on a firm basis is quite limited.

R&D expenditures provide significant competitive advantage to businesses by creating positive effects on business efficiency and profitability in the long run. In addition, in today's markets, R&D studies of enterprises are seen as a necessity. While the effective execution of R&D expenditures affects the profitability of the enterprise, this situation also reflects positively on the capital markets. R&D expenditures, which strengthen the position of the enterprise in the capital markets, will also increase the income of the investors. This will support the entry of foreign direct capital into the country in the long run [20, 21]. This shows that R&D expenditures not only increase business profitability and investor income, but also contribute to the country's economy.

The recognition of R&D as the driving force of endogenous growth models has led the private and public sectors to attach importance to R&D expenditures. This situation has led to the creation of a large literature on the relationship between R&D expenditures and technological innovation, productivity and growth [19]. Technological change, which is accepted as the main factor of success in economic activities, also allows the development of new markets. Technology, which is one of the most important determinants of human progress and economic development, offers both productivity and quality increase [22].

Factors such as R&D expenditure, number of R&D personnel, number of patents and number of scientific publications are at the forefront of determining the intensity of countries' R&D activities. Innovations created by the R&D expenditures made accelerate economic growth. Studies conducted in recent years also reveal the importance of the role played by innovation in industrial areas in economic development and regional development. In addition, studies examining the relationship between R&D activities and the competitiveness of firms have found that in the long run, firm productivity is in line with the level of R&D expenditures. Companies that increase their productivity in the long term with their R&D expenditures gain a serious advantage over their current and potential competitors. In parallel with this, growth occurs at both micro and macro levels [23].

There are studies conducted by different researchers in different countries in the literature between R&D expenditures and economic growth. In the study conducted by Inekwe on effect on economic growth in upper middle-income developing countries, while

it has an insignificant effect on economic growth in low-income countries [24]. In the study conducted by Freimane and Balina in 27 European Union countries, it was found that a 1% increase in R&D expenditures led to an increase of 0.02% in economic growth in the short term and an increase of 0.09% in the long term [25]. In a study by on G7 countries and Turkey, it was found that a 1% increase in R&D expenditures led to an increase in economic growth by 1.168% [26]. As a result of a study conducted by on 26 developed and developing countries, R&D expenditures were determined as the Granger cause of economic growth [27]. Technological development is directly related to R&D expenditures. R&D activities, which enable the emergence of new information about products and production processes, increase the quality of products on the one hand, and help reduce costs on the other hand. This situation leads to the development of the industry and subsequently to economic growth. In addition to providing long-term economic growth, it is seen that R&D expenditures stand out more than other factors with the externalities it creates [28].

METHODOLOGY

Purpose of the Research

In this research, it is aimed to show whether investments in R&D in Azerbaijan, Kazakhstan and Kyrgyzstan will accelerate economic growth. In this context, the relationship between R&D and economic growth was examined by making use of the annual data on the GDP of these countries and the ratio of R&D expenditures to GDP in the 2005–2018 period. Three Turkish state countries with the least research on the subject were selected. Although there are no comprehensive studies on the subject in Kazakhstan and Kyrgyzstan, studies on Azerbaijan have been made, albeit a little.

Data Set

The data required for the study were collected from the World Bank. The data set includes annual data from 2005 to 2018 for Azerbaijan, Kazakhstan and Kyrgyzstan. Since the 2019 and 2020 data of the countries in question were not available at the time of the research, the data for these years could not be included in the analysis. The data was analyzed by EViews program.

Analysis Method

In this research, time series approach was used as econometric method [28]. Since the data is not stationary, the data are stationary. Given has become stationary only from its second-order value. The stationarity of the variables was tested using the Augmented Dickey-Fuller (ADF) unit root test. Appropriate lag lengths of the data were found for later analysis. After finding the appropriate offset lengths, it was tried to determine the direction of the relationship between the variables using the Granger causality test. Granger method is widely used in causality testing [29, 30]. The cause-effect relationships between the variables were examined with the help of causality analysis, which was first introduced to the literature by Granger and later developed by Hamilton [29–31]. In Granger causality, the direction of the relationship between two variables such as X and Y is investigated. If the current value of Y can be better predicted by the values of the past period than the present value of the variable X, can be said of a Granger causality from variable X to variable Y [31]. It is important to determine the optimal lag length of the variables in the Granger causality method.

Granger-Causality Tests in the Framework of Co-Integration Analysis Economic time series are often not stationary when considered as levels. Regression analyzes using non-stationary time series can cause false or misleading regression relationships. This causes the estimated regression equation to have a high coefficient of determination (R^2) but a low Durbin-Watson statistic. In this regression, the error terms are not stationary and the apparently high explanatory power of the regression equation cannot be trusted [33].

If the non-stationarity of the time series is due to the deterministic time trend of the related series, then de-trending of these series can make the series stationary. However, if the time series contains a random trend, they will need to be differentiated until they become stationary. The number of times a series with a random trend needs to be differentiated until it becomes stationary is called the degree of integration of that series. For example, if the first difference $(\frac{X_t - X_t - 1}{X_t - 1})$ of a non-stationary variable X is

stationary, it is said that the variable X is integrated of the first order and is denoted by $X \sim I(1)$ [34].

It is possible to correct a non-equilibrium situation that may occur in the short term for any reason in the long term. This is because the difference (z) between X and Y is stationary in the long run, because the z term shows how much the system deviates from the long run equilibrium [34]. Granger demonstrates the expression of a cointegrated system as an error correction model in the following figure [35]. In the cointegration example given above:

$$z_t = \varepsilon_t = Y_t - \alpha - \beta X_t.$$

$$\Delta Y_t = \Sigma\delta_{1,i}\Delta Y_{t-1} + \Sigma\,\beta_{1,i}\Delta X_{t-1} + \gamma_1 z_{t-1} + \mu_{1t}, \quad (1)$$

$$\Delta X_t = \Sigma\delta_{2,i}\Delta Y_{t-1} + \Sigma\,\beta_{2,i}\Delta X_{t-1} + \gamma 2 z_{t-1} + \mu_{2t}. \quad (2)$$

The cointegration of X and Y variables requires that at least one of γ_1 and γ_2 is nonzero in models (1) and (2). Therefore, changes in the dependent variable in the error correction model are partially determined by the lagged value of z. However, since z_{t-1} includes X_{t-1} and Y_{t-1}, this leads to the conclusion that the cointegration relationship requires at least one variable to be the Granger-cause of the other [30].

RESULT

While analyzing, Azerbaijan, Kazakhstan and Kyrgyzstan, which are selected Turkish states, were examined. The relationship between the GDP in these countries and the research and development expenditure in the country is considered. In order to perform the analysis, it was first tested whether the data were stationary or not. It has been observed that they are not stationary given in the stationarity test. The Johansen cointegration test could not be performed because all the data did not become stationary in the first order. In order for the data to give statistically significant results, the stationarity test was carried out with the help of the ADF (Augmented Dickey-Fuller) unit root test. The non-stationary version of the data is presented in *Table 1*.

Vertical-Fuller unit root test results regarding the levels of unit root variables in the series for each country are shown with one percent, five percent and ten percent margin of error.

In general, growth and research and development expenditure values show that the data is not stationary. For this reason, it was tried to take the difference of the series in order to make it stationary. When only the quadratic difference is taken, the series become stationary. For this reason, the series that became stationary by retesting are presented in *Table 2*.

Table 2 shows that the variables used in the study are stationary at second differences in the 2005–2018 periods for all three countries ($p \leqslant 0.05$). The VAR model was established by using the level values of the variables and the appropriate lag number was determined with the help of Akaike (AIC), LL, LR, FBE, SC and HQ information criteria. The analysis results for determining the appropriate lag length are presented in *Table 3*.

As a result of the analysis, the most appropriate lag length was determined as two for Azerbaijan. In terms of Kazakhstan and Kyrgyzstan, the appropriate lag length was found to be three. The value with the most stars indicates the optimal delay length.

According to *Table 4*, it is revealed whether the total growth and research and development expenditure values in Azerbaijan, Kazakhstan and Kyrgyzstan are the cause of each other. According to the results of the analysis, only the realization of growth in Kyrgyzstan, that is, the increase in GDP, is the reason for the increase in research and development expenditure. In other words, GDP is the reason for research and development expenditure Granger. There is a bidirectional interaction between these two variables. In this case, it would be right to accept the H_1 hypothesis for these variables and reject the H_0 hypothesis. No causal relationship was found between the remaining two countries. In this case, the variables do not cause each other in these countries, so the H_0 hypothesis is accepted.

As a result of the Granger analysis, no causal relationship was found between the data in Azerbaijan and Kazakhstan (*Table 4*). Only in Kyrgyzstan, a two-way meaningful result was obtained. After the Granger analysis, correlation (*Table 5*) was used to determine whether there was any relationship between dependent and independent variables for all three countries, and regression analysis (*Table 6*) was used to determine whether there was any effect.

After the Granger analysis, the results of the correlation analysis performed to see in what direction and to what extent the other variable changes when one variable change are presented in *Table 5*.

Table 1

Level Values of Series in Azerbaijan, Kazakhstan and Kyrgyzstan

Country		GDP		Research and development expenditure	
		t-statistics	possibility	t-statistics	possibility
Azerbaijan					
ADF test statistic		0.266675	0.7463	1.156391	0.9261
Test Critical Values	%1	–2.771926		–2.754993	
	%5	–1.974028		–1.970978	
	%10	–1.602922		–1.603693	
Kazakhstan					
ADF test statistic		6.001239	1.0000	–0.594241	0.4404
Test Critical Values	%1	–2.754993		–2.754993	
	%5	–1.970978		–1.970978	
	%10	–1.603693		–1.603693	
Kyrgyzstan					
ADF test statistic		5.203867	1.0000	–1.900818	0.0578
Test Critical Values	%1	–2.754993		–2.792154	
	%5	–1.970978		–1.977738	
	%10	–1.603693		–1.602074	

Source: Prepared by the author in the EViews program.

Table 2

Second Differential Values of Series in Azerbaijan, Kazakhstan and Kyrgyzstan

Country		GDP		Research and development expenditure	
		t-statistics	possibility	t-statistics	possibility
Azerbaijan					
ADF test statistic		–2.335878	0.0248	–6.396019	0.0000
Test Critical Values	%1	–2.792154		–2.792154	
	%5	–1.977738		–1.977738	
	%10	–1.602074		–1.602074	
Kazakhstan					
ADF test statistic		–4.928156	0.0002	–4.848599	0.0002
Test Critical Values	%1	–2.816740		–2.792154	
	%5	–1.982344		–1.977738	
	%10	–1.601144		–1.602074	
Kyrgyzstan					
ADF test statistic		–6.597625	0.0000	–5.436863	0.0001
Test Critical Values	%1	–2.792154		–2.847250	
	%5	–1.977738		–1.988198	
	%10	–1.602074		–1.600140	

Source: Prepared by the author in the EViews program.

When *Table 5* is examined, a very high positive correlation (0.92) was found between the growth data given in Azerbaijan and the research and development expenditure. However, in Kyrgyzstan (–0.69) and Kazakhstan (–0.33), on the contrary, a moderate relationship was found in the negative direction.

Table 3

Appropriate Delay Length in Azerbaijan, Kazakhstan and Kyrgyzstan

Lag	LogL	LR	FPE	AIC	SC	HQ
Azerbaijan						
0	22.09032	NA	8.89e-05	−3.652785	−3.580440	−3.698388
1	38.60023	24.01442*	9.40e-06*	−5.927314*	−5.710281*	−6.064124
2	40.37624	1.937464	1.58e-05	−5.522952	−5.161229	−5.750968
3	46.55861	4.496270	1.46e-05	−5.919747	−5.413335	−6.238969*
Kazakhstan						
0	14.78004	NA	0.000336	−2.323644	−2.251299	−2.369247
1	39.65828	36.18652	7.76e-06	−6.119687	−5.902653	−6.256496
2	44.52409	5.308164	7.43e-06	−6.277108	−5.915385	−6.505124
3	64.25251	14.34794*	5.86e-07*	−9.136819*	−8.630407*	−9.456041*
Kyrgyzstan						
0	23.21735	NA	7.25e-05	−3.857701	−3.785356	−3.903304
1	44.18446	30.49761	3.41e-06	−6.942629	−6.725596	−7.079439
2	59.44402	16.64679*	4.93e-07	−8.989822	−8.628099	−9.217838
3	67.61692	5.943927	3.18e-07*	−9.748531*	−9.242119*	−10.06775*

Source: Prepared by the author in the EViews program.

Note: * indicates the appropriate lag length for the relevant test.

As a result of the Granger analysis, since there is no causality relationship between the data in Azerbaijan and Kazakhstan, the regression method was also used to determine the causality between the dependent and independent variables of all three countries. As seen in *Table 6*, the explanatory power of the regression analysis applied to explain the effect of research and development expenditures on GDP was 82% (p = 0.00) in Azerbaijan and 47% (p = 0.01) in Kyrgyzstan. In the analysis made in Kazakhstan, the results of the regression analysis were not evaluated, since the independent variable did not yield significant results (p = 0.26).

CONCLUSION

This research was analyzed using the Granger method in order to see whether investments in R&D in Azerbaijan, Kazakhstan and Kyrgyzstan would accelerate economic growth, and some findings were reached by testing several hypotheses. According to the results of the Granger analysis, only the realization of growth in Kyrgyzstan, that is, the increase in GDP, is the reason for the increase in research and development expenditure. In other words, GDP is the reason for research and development expenditure Granger. There is a bidirectional interaction between these two variables (p < 0.05). A causal relationship was not found in Azerbaijan and Kazakhstan. In this case, the variables in these countries are not the cause of each other.

After the Granger analysis, correlation was used to determine whether there was any relationship between dependent and independent variables for all three countries, and regression analysis was used to determine whether there was any effect. According to the results of the correlation analysis, a very high positive correlation (0.92) was found between the growth data given in Azerbaijan and the research and development expenditure. However, in Kyrgyzstan (−0.69) and Kazakhstan (−0.33), on the contrary, a moderate relationship was found in the negative direction. According to the results of the regression analysis, the explanatory power of the regression analysis applied to explain the effect of research and development expenditures on GDP was 82% (p = 0.00) in Azerbaijan and 47% (p = 0.01) in Kyrgyzstan. In the analysis made in Kazakhstan, the results of the regression analysis were not evaluated, since the independent variable did not yield significant results (p = 0.26).

As a result of this research, which was carried out with Granger causality analysis with data covering the years 2005–2018, a significant bidirectional result was found between R&D expenditures and economic

Table 4

Granger Causality Test Results in Azerbaijan, Kazakhstan and Kyrgyzstan

Hypotheses	F-Value	Probability value (p)	Decision at 5% significance level
Azerbaijan			
Research and development expenditure is not a reason for GDP	0.201120	0.9043	Rejected
GDP is not a reason for research and development expenditure	2.891806	0.2355	Rejected
Kazakhstan			
Research and development expenditure is not a reason for GDP	0.895985	0.6389	Rejected
GDP is not a reason for research and development expenditure	2.977140	0.2257	Rejected
Kyrgyzstan			
Research and development expenditure is the cause of GDP	22.63884	0.0000	Accepted
GDP is a reason for research and development expenditure	37.29067	0.0000	Accepted

Source: Prepared by the author in the EViews program.

Table 5

Correlation Analysis Results in Azerbaijan, Kazakhstan and Kyrgyzstan

	GDP	Research and development expenditure
Azerbaijan		
GDP	1	0.92
Research and development expenditure	0.92	1
Kazakhstan		
GDP	1	–0.33
Research and development expenditure	–0.33	1
Kyrgyzstan		
GDP	1	–0.69
Research and development expenditure	–0.69	1

Source: Prepared by the author in the EViews program.

Table 6

Regression Analysis Results in Azerbaijan, Kazakhstan and Kyrgyzstan

GDP			
	Azerbaijan	Kazakhstan	Kyrgyzstan
Multiple R	0.91	0.32	0.68
R Square	0.82	0.10	0.47
Adjusted R Square	0.81	0.03	0.42
Significance F	0.00	0.26	0.01
Research and development expenditure			

Source: Prepared by the author in the EViews program.

growth in Kyrgyzstan, and no causal relationship was found in Azerbaijan and Kazakhstan. These results are similar to the results of research conducted with Granger causality analysis in the literature. Namely, in a study conducted by Hong [36] in Korea between 1988 and 2013, a bilateral causality was found between economic growth and R&D (based on information and communication technologies) investment. In the study conducted by Sokolov-Mladenović, Cvetanović and Mladenović on 28 EU countries covering the years 2002–2012, it was determined that R&D expenditures (GDP%) positively affected the real growth rate [3]. In the study conducted by Börü and Çelik with data between 2004–2016 in Turkey, a strong causality relationship was found between R&D expenditures and economic growth variables [37].

The findings of the analysis offer some suggestions to policy makers, entrepreneurs and researchers: one of the ways to increase economic growth in the long run is through investments in R&D. It is predicted that

investments in R&D will have a significant contribution to economic growth in the long run. However, in future research, the effect of R&D expenditures on the economic growth of all Turkish states can be examined and qualitative studies on the content of R&D expenditures can be made.

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ABOUT THE AUTHOR

Nigar Huseynli — PhD in Finance, Lecturer, Department of Business Administration, Azerbaijan State University of Economic (UNEC), Baku, Azerbaijan
https://orcid.org/0000-0001-7817-6485
nigar.f.huseynli@gmail.com

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Management of Investment Processes in the Regions of the Russian Federation on the Basis of a Balanced System of Indicators

V.N. Myakshin[a], V.N. Petrov[b], T.N. Pesyakova[c]
[a] M.V. Lomonosov Northern (Arctic) Federal University, Arkhangelsk, Russia;
[b] S.M. Kirov St. Petersburg State Forestry University, St. Petersburg, Russia;
[c] Department of the Federal Tax Service, Arkhangelsk, Russia

ABSTRACT

The **purpose** of the research is to develop, based on the concept of a balanced system of indicators, a methodology for assessing investment processes in the constituent regions of the Russian Federation, which makes it possible to track the relationship between the dynamics of the investment attractiveness of each region and the balance of investment policy. The **relevance** of development a practice-oriented methodology, on the basis of which it is possible to determine the effectiveness of decisions when choosing investment directions, is conditioned by the limited investment resources in the current conditions of the impact of politics on the economy. The **scientific novelty** consists in the original balanced system of indicators and the balanced evaluation methodology proposed by the authors as a tool for managing. The main research **methods** are systematic and balanced approaches, the methodology of the balanced system of indicators, the method of multidimensional average (for determining integral indicators) and correlation analysis (to analyse the relationship between investment attractiveness calculated on the basis of the developed system of indicators, and investment activity) are used as private methods. The main **result** of the research: the creation on the basis of the developed balanced system of indicators of an economic model for assessing the balance of investment policies as a mechanism for coordination the interests of private investors, public administration and the population. On the basis of approbation of the developed economic model (on the example of one of the regions of the Arctic zone — the Republic of Komi), the authors **concluded:** the imbalance of investment processes, revealed on the basis of the multidirectional dynamics and differentiation of the values of indicators by components of the proposed assessment system, limits the implementation of the investment potential of the Republic of Komi and reinforces the structural imbalances. The proposed model of assessment allows diagnose the investment problems in the regions of the Russian Federation, finding investment growth reserves, identifying investment priorities and improving the sustainability of investment management.

Keywords: investment policy; investment activity; investment attractiveness; investment significant factors; balanced system of indicators

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INTRODUCTION

Analysis of the structure of investments in the Arctic zone of the Russian Federation (hereinafter — AZ) can come to the conclusion about concentration of investment resources mainly in export-raw materials production and underdevelopment of the sector for deep processing of natural resources, for which domestic demand remains high. Such an inconsistency between demand and supply points to the spontaneous development of economies in many regions, mainly raw materials-oriented regions.

This structural imbalance has arisen and has persisted for a long time in AZ due to the lack of science-based investment policies in the region. An economic mechanism for reconciling the interests of private investors, the State and the population is needed to redress imbalances. Such a mechanism should be based on a system of indicators reflecting the economic relationship between the State and private business in terms of a balance of interests. It is about a balanced scorecard (hereinafter — BSC).

The problem of assessment of investment activity in AZ and its regulation on the basis of consideration of interests of various groups of participants in the investment process is not paid due attention in the studies, which explains the urgency of developing a balanced evaluation system of social and economic indicators.

This paper proposes a new methodological approach to assessment of investment activity: to consider the possibility of using the developed BSC as a tool for integrated assessment of the activities of regional governments and investment flows management.

In regional economic researches, factor approach is the most common, determining the investment attractiveness of regional economic systems [1, 2]. The purpose of most modern assessment methods is construction of ratings that demonstrate a significant differentiation of investment attractiveness of the regions of the Russian Federation and allow investors to get an idea of the advantages of some regions over others. Meanwhile, the analysis of the effectiveness of regional investment policy at the initial stage of the study requires an analysis of the dynamics of the investment attractiveness of individual regions.

Available results of investment ratings of regions are not comparable. Main reason — imperfection of the methodological apparatus. Thus, the use in many methods of [3] points, mainly expert assessment, and statistical (not expert) assessment in the research of factors of investment attractiveness leads to ignoring the real variation of actual values of the indicators of assessment, should not depend on the opinion of experts. In addition, for most methods are characterized by a lack of objective criterion of reliability (relationship with the investment activity of the region), which is a significant methodological shortcoming. The results of these ratings do not fully correspond to the information requests of all groups of users. In addition, the use of these ratings for management decision-making is limited by the structural differences of regional economies. During the standardization procedure in modern methods the normalizing indicator is mainly used by the average Russian values of indicators, so the results of the assessment are dependent on all-Russian data.

In order to assess the balance of investment policy of a particular region, it is necessary to use measuring tools independent of changes in the investment attractiveness of other regions. The use of target values of indicators in the proposed BSC as normalizing indicator eliminates the influence of all-Russian data.

The identification of methodological shortcomings in the study of investment attractiveness of the regions of the Russian Federation served the basis for the search for new approaches to the assessment of the regional investment process, why it is necessary to create author's methods

of assessment on the basis of a balanced approach, that the results of the assessment correspond to the balance of interests of the investors.

METHODOLOGY AND RESEARCH METHODS

The concept of balanced scorecard is the conceptual basis of the author's methodology. BSC was originally introduced as a matrix approach to measuring organizational effectiveness. The financial indicators mainly used to assess business efficiency were supplemented by indicators of three other "prospects" (components): learning and growth, internal business process and customer component according to the interests of business participants [4]. A feature of the second generation of BSC was the definition of cause-and-effect relationships between indicators and strategic objectives as the main criterion for the choice of indicators. Based on the graphical presentation of the main relationships, strategic map models were created [5]. Kaplan and Norton reported that these changes allowed BSC to move from an improved assessment system to a basic performance management system. Development of balanced assessment methodology presented in sources [6–10].

Despite the rather wide use of BSC in individual enterprises efficiency management [11–17], researchers have not considered the possibility of applying BSC to the assessment of investment attractiveness of regions.

The principle of selection of BSC indicators based on the relationship with key investment relevant factors [18] allows to abandon the use of weight coefficients, which ensures equivalence of indicators and improves the objectivity of the assessment (independence from expert assessment).

In the definition of integral indicators, the formula of multidimensional average is used, when conducting the procedure of preliminary standardization as a normalizing indicator, target values of indicators are used, which eliminates the impact of the Russian average investment attractiveness.

In this paper, the term "indicator target value" refers to the desired level of the corresponding aspect of investment attractiveness, which is assessed against a specific indicator and can be achieved within the study objectives during the time gap. Target values of indicators developed by BSC are determined on the basis of research and comparative analysis of investment activity in AZ regions.

The results of the process of balanced estimate of the investment policy of one of the subjects of the AZ of the Russian Federation (Komi Republic) on the example of the component of the development of the BSC are presented in *Table 1*.

The composition of private indicators for the components of the developed BSC is presented on *Fig. 1*. The BSC configuration is determined by significant investment factors (production-financial, institutional, natural-resource, infrastructure, political-economic and social) and information needs of user groups.

The private indicators developed by BSC were selected on the basis of the relationship with the key factors that determine the situation in the investment sphere AZ regions of the Russian Federation, which allows the assessment to identify possible ways of influencing investment dynamics.

The selection of key investment significant factors was made on the basis of the criterion "maximum representativeness and investment value" taking into account the specifics of the AZ regions of the Russian Federation. The approach used in determining key success factors in the Balanced Scorecard management concept [4].

Indicators for FTA (foreign trade activities) "Mining", "Manufacturing industries" reflect the sectoral structure of the economy of the regions. First of all,

Table 1

Calculation of Indicators of the Development Component of the Balanced System of Indicators for Assessing the Balance of the Directions of Investment Policy of the Republic of Komi (2011–2018)

Indicator name	Target value of Піц indicators	Ratio of actual and target values of Пі/Піц indicators							
		2011	2012	2013	2014	2015	2016	2017	2018
1. Indicators of intellectual capacity									
1. Share of people with higher education	0.40	0.01	0.01	0.76	0.79	0.81	0.83	0.84	0.86
2. Skills ratio	0.50	0.31	0.26	0.29	0.28	0.26	0.28	0.09	0.09
Integral indicator		0.16	0.13	0.52	0.54	0.53	0.55	0.47	0.47
2. Indicators of innovation capacity									
3. Share of R&D expenditure	0.10	0.04	0.04	0.04	0.05	0.04	0.05	0.04	0.04
4. Share of costs of technological innovation	0.05	0.06	0.71	0.12	0.06	0.07	0.03	0.05	0.24
5. Information technology ratio	1.50	0.76	0.65	0.74	0.68	0.82	0.67	0.71	0.86
6. Rate of renewal of fixed assets	0.15	0.30	0.37	1.34	0.55	0.64	0.37	0.57	0.30
7. Investment capacity ratio of sold products	0.20	1.59	2.32	2.42	2.06	2.08	1.62	1.83	1.17
Integral indicator		0.55	0.82	0.93	0.68	0.73	0.55	0.64	0.52
3. Indicators of infrastructure capacity									
8. Density of communication	60.0	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.20
Integral indicator		0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.20
Integral indicator by component		0.39	0.55	0.72	0.57	0.60	0.49	0.53	0.47

Source: Compiled by the authors.

prospective economic specializations of AZ regions of the Russian Federation, defined in the Strategy of spatial development of the Russian Federation for the period up to 2025, are taken into account. To calculate a number of indicators the authors used the method of calculation of national and federal projects indicators.

Algorithm of application of the developed economic model:

1. Formalization of regional investment policy objectives in the form of a set of quantitative and qualitative indicators — target values of BSC indicators.

2. Calculation of the actual achieved values of BSC indicators, informatively reflecting the results of the implementation of the regional investment policy.

3. Determine the degree of achievement by comparing the actual and target values of the indicators.

4. Formation of investment policy of the region on the basis of revealed deviations of actual values of BSC indicators from the target (>25%).

The results of the developed assessment model are expected to be used by the regional management bodies of AZ regions in the formation of investment policy.

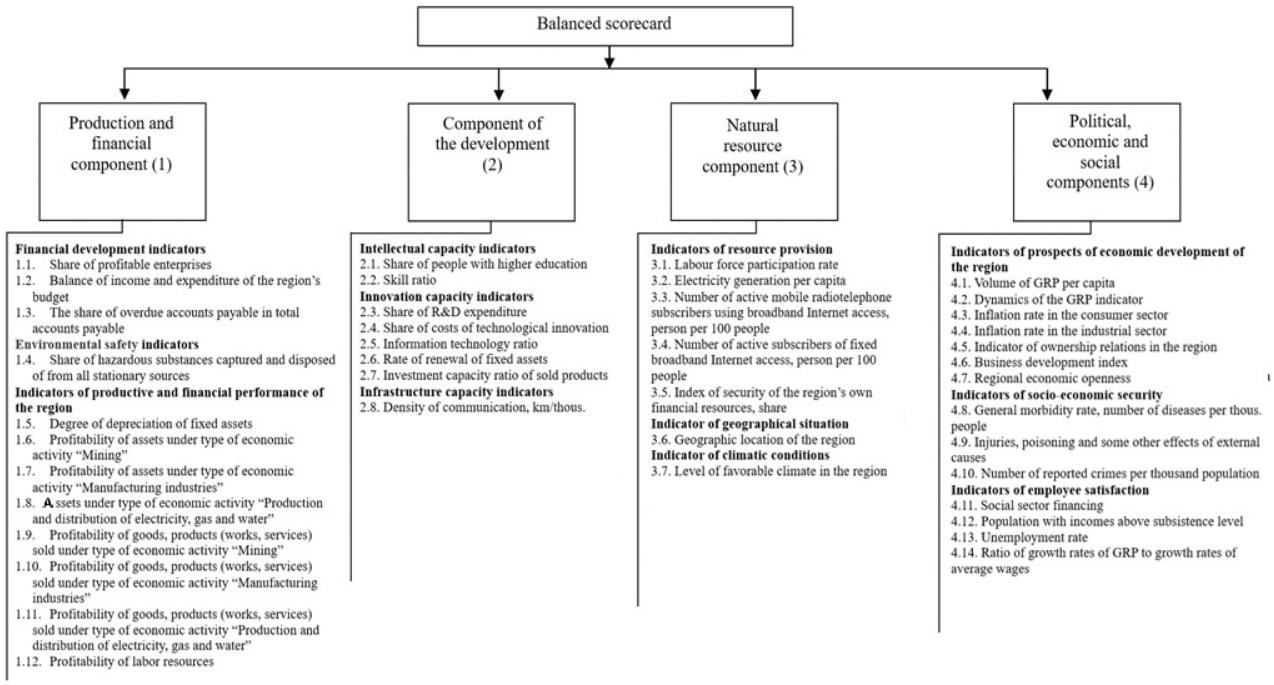

Fig. 1. **BSI Nomenclature to Assess the Balance of Investment Policy of the Regions of the Arctic Zone**

Source: Compiled by the authors.

RESULTS AND DISCUSSION

Investment attractiveness of AZ regions assessed on the basis of four components developed by BSC for 2011–2018 (2011 year was selected as the base period). The results of the estimate are presented in *Table. 2.*

The result of analysis of investment attractiveness of AZ regions, calculated on the basis of developed BSC, and investment activity in them, is considered as the main criterion of reliability of the developed methodology (within the time lag) (*Table 3*).

Investment activity reflects the region's use of investment attractiveness and should therefore be used taking into account the investment lag in the investment proposals (the investor's decision to invest) from investment demand (defined by changes in investment conditions).

This paper uses the simplest lag model

$$y_i = f\left(x_{t-\tau}\right), \qquad (1)$$

which means the following: the value of endogenous variable *y* (investment activity) at the moment *t* is determined by the value of exogenous variable *x* (investment attractiveness) at the moment $t-\tau$, where τ — time lag.

Different statistical models for lag values are used in the scientific literature. One is based on comparing data on interconnected values with a time shift over a sufficiently long period of time, with different values of possible lag. The lag value (two years) was determined by the nature of the impact curve, which met the selected connectivity requirements. Considering that statistical estimation methods are based on historical results and may not be sufficient to justify the solution of tasks in the new environment, this study also uses an expert logical approach, based on determining the time lag for different types of economic activity [19].

Investment activity is calculated on the basis of two indicators: the rate of change in real investments and per capita volume of these investments [20].

The Spearman correlation coefficient varies from 0.667 to 0.850, indicating an average and high correlation between investment attractiveness and investment activity. Fluctuation of correlation coefficient

Table 2

Dynamics of Integral Indicators of Investment Attractiveness of Arctic Zone Regions (2011–2018)

Year	Krasnoyarsk region	Yamalo-Nenets Autonomous District	Murmansk Oblast	Komi Republic	Arkhangelsk Oblast without NAD	Republic of Karelia	Republic of Sakha (Yakutia)	Chukotka Autonomous District	Nenets Autonomous District
2011	0.842	0.326	0.639	0.628	0.332	0.527	0.535	0.437	0.697
2012	0.745	0.490	0.612	0.623	0.389	0.511	0.579	0.408	0.656
2013	0.723	0.634	0.589	0.588	0.436	0.507	0.525	0.502	0.473
2014	0.793	0.591	0.663	0.557	0.500	0.512	0.529	0.502	0.415
2015	0.840	0.624	0.717	0.599	0.537	0.564	0.522	0.526	0.509
2016	1.016	1.039	0.650	0.618	0.642	0.577	0.592	0.466	0.546
2017	0.828	0.918	0.659	0.604	0.569	0.593	0.564	0.462	0.510
2018	1.664	1.036	0.706	0.655	0.642	0.631	0.577	0.502	0.488

Source: Compiled by the authors.

for the period 2014–2016 is noted, which is acceptable when conducting correlation analysis, identification of causes requires additional research. Bilateral significance for all correlation coefficients does not exceed 0.05 (minimum value 0.004, maximum — 0,050), indicating sufficient reliability of the calculated correlation coefficients. Correlation analysis data confirm the validity of the proposed methodology and the reliability of the evaluation results.

The paper demonstrates the analytical capabilities of the developed BSC for the Komi Republic. A similar analysis can be carried out for any region of the Russian Federation. Among the components of the BSC the maximum value takes the integral indicator by the natural-resource component (0.95), with positive dynamics, which is the basis for the conclusion about the determining role of resource factors in the formation of the investment attractiveness of the Republic of Komi. Private indicators, which are part of the natural resource component, are close to the target or exceed them (the exception is the level of the economically active population), which explains the high value of the integral indicator (*Fig. 2*).

Assessment of financial and production factors allows making a conclusion about the positive influence of these factors on investment attractiveness, the value of the integral indicator is close to the target (0.82). The production and finance component diagram (*Fig. 3*) illustrates deviations from the target values of actual private indicators of the share of profitable enterprises, overdue accounts payable, indicator of environmental

Table 3

Calculation of Correlation Coefficients Between Investment Attractiveness and Investment Activity of Arctic Zone Regions

Indicator	Investment attractiveness (*N* – 2 years) / Investment activity (year *N*)						
	2010/2012	2011/2013	2012/2014	2013/2015	2014/2016	2015/2017	2016/2018
Spearman correlation coefficient	0.483	0.717*	0.850*	0.783*	0.310	0.667*	0.762*
Bilateral significance	0.187	0.030	0.004	0.013	0.417	0.050	0.017

Source: Compiled by the authors

Note: * Is significant at the 5% level.

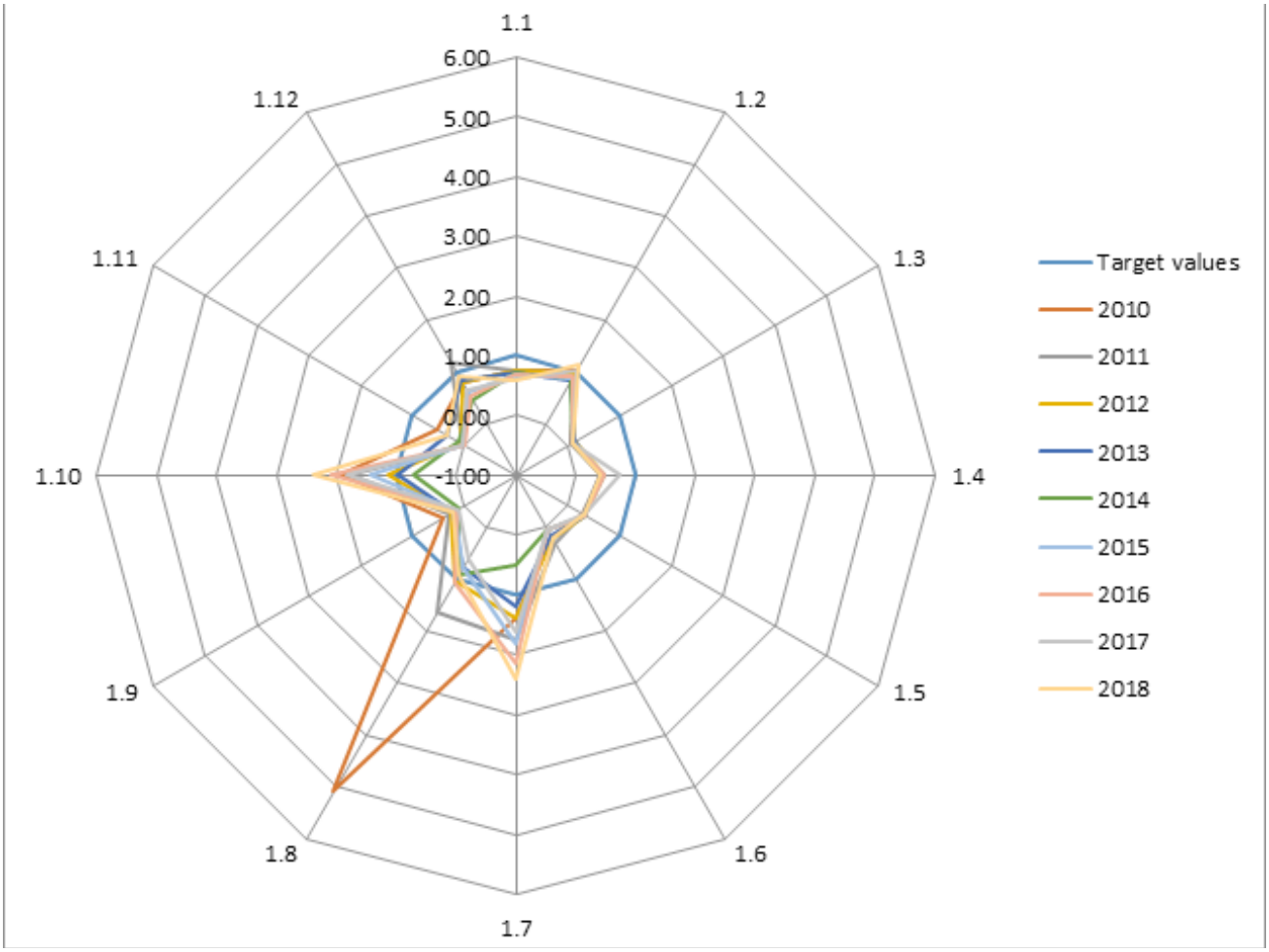

Fig. 2. **Diagram of the indicators of the production and financial component of the BSI evaluation of investment policy of the Republic of Komi for 2011–2018**

Source: Compiled by the authors.

Note: the order of indicators corresponds to the BSI nomenclature for the production and financial component (*Fig. 1*).

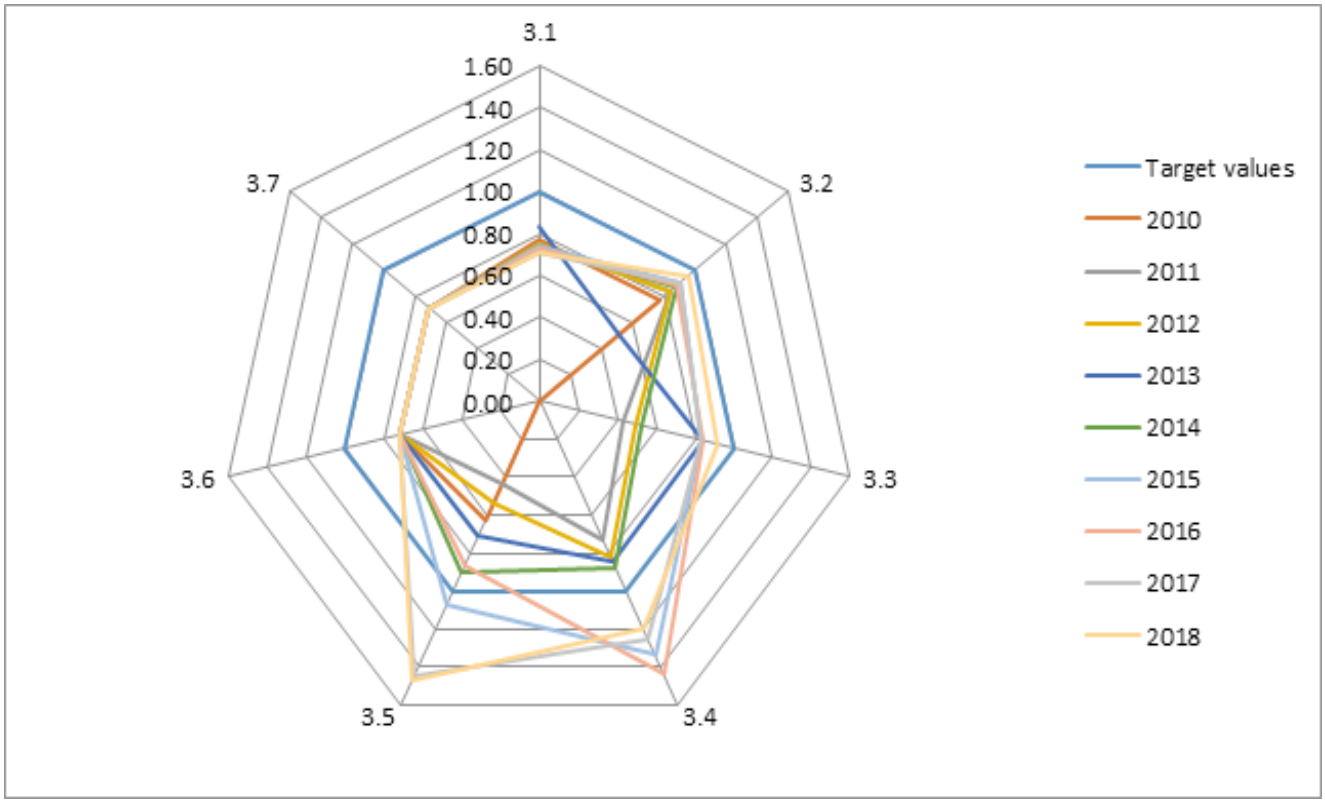

Fig. 3. **Diagram of indicators of the natural resource component of the BSI investment policy of the Republic of Komi for 2011–2018**

Source: Compiled by the authors.

Note: the order of indicators corresponds to the BSI nomenclature for the natural resource component (*Fig. 1*).

safety of production, depreciation of fixed assets.

For the political, economic and social component, the integral indicator in 2011–2018 years accepts values in the range of 0.46–0.53 2 times below the target), which reduces the integral index in general for the BSC. On the diagram of the political, economic and social component (*Fig. 4*) it is clearly traced deviation of indicators of development of market institutions, as well as per capita indicator of volume of GRP, general morbidity, unemployment rate from target values.

The integral indicator for the development component (0.47) has a minimum value in comparison with the rest of the BSC, which is due primarily to the decrease in the indicator of innovation potential. The diagram (*Fig. 5*) shows deviation from the target values of indicators that determine prospects of economic development of the Republic of Komi. Negative dynamics of rates of renewal of fixed assets and investment capacity is an indicator of decline in the perspective of investment activity.

The imbalance of investment policy is confirmed by the different direction of the dynamics and differentiation of values of BSC indicators: for the natural resource component, the integral indicator exceeded the integral indicator for the component of development by 2.3 times. At the same time, the implementation of investment potential is limited by the identified deviations from the target values of both private and integral indicators on components of development, political-economic and social.

The analysis of the results of the assessment using BCS revealed directions to increase the investment attractiveness of the Komi Republic: priority development of manufacturing industries, which belong

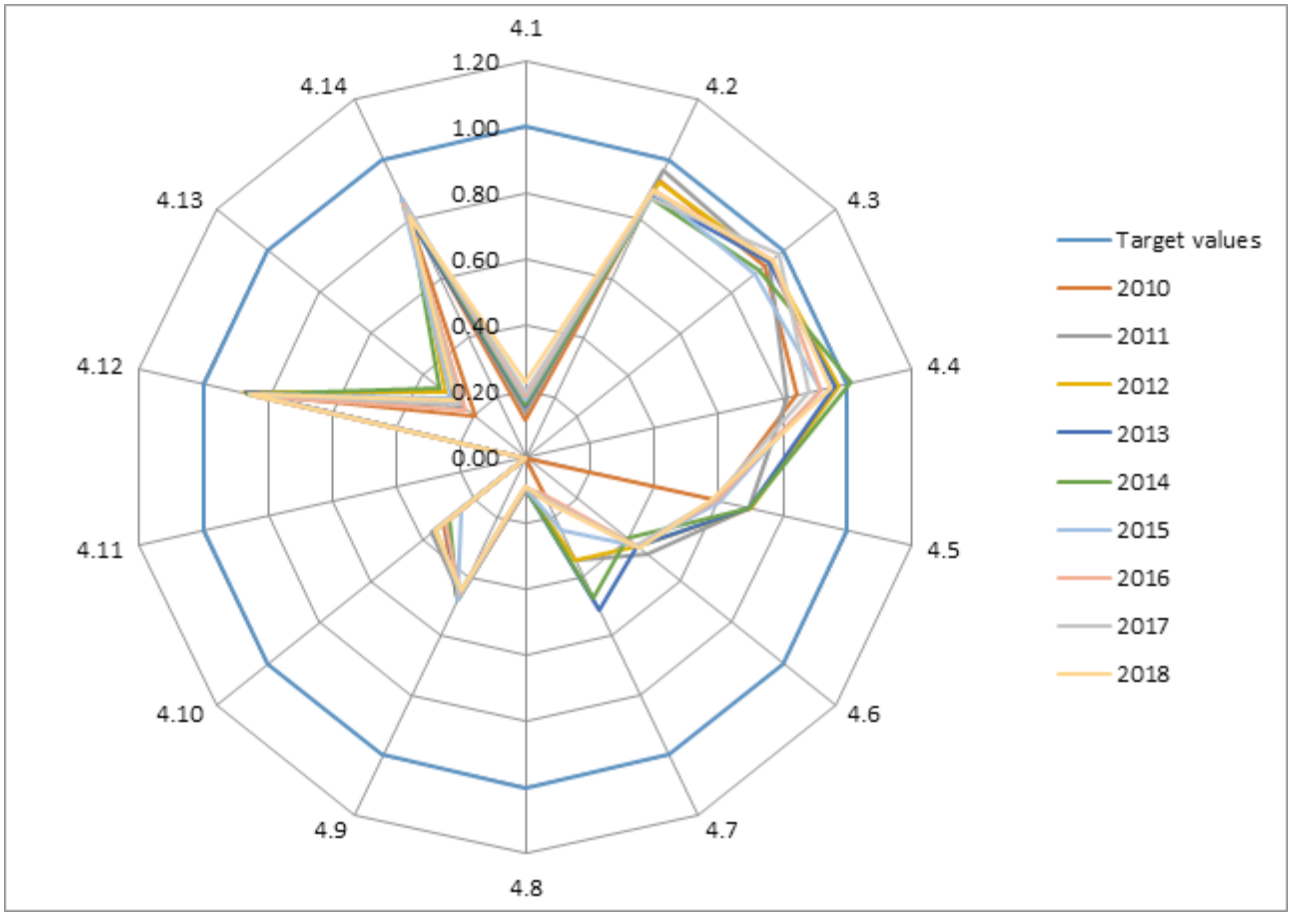

Fig. 4. **Diagram of the indicators of the political, economic and social components of the BSI investment policy of the Republic of Komi for 2011–2018**

Source: Compiled by the authors.

Note: the order of indicators corresponds to the BSI nomenclature for the political, economic and social component (*Fig. 1*).

to the long-term economic specialization; development of tourism, which has not only direct but also indirect (through multiplier effect in related industries) positive impact on the economy of the Republic of Komi; development of transport infrastructure and on this basis development of such industries as transportation and storage; implementation of a set of measures to support small business on the basis of the development of market economy institutions; introduction of innovations on this basis the development of export-oriented industries.

CONCLUSION

The use of the balanced scorecard model will make it possible to implement sustainable management of investment processes, increase the investment attractiveness of implemented projects. BCS can identify and present best regional practices to improve investment attractiveness.

The main result of the study is the development and scientific substantiation of the economic model of assessment of the balance of investment policies based on the BSC, which will give the opportunity to identify real measures to increase the investment attractiveness of the Russian subjects.

The novelty of the research consists in the proposed method of balanced assessment of the investment activities of regions of the Russian Federation, allowing to take into account the objectives of the investment process participants, developed an original balanced scorecard. Expediency of use of

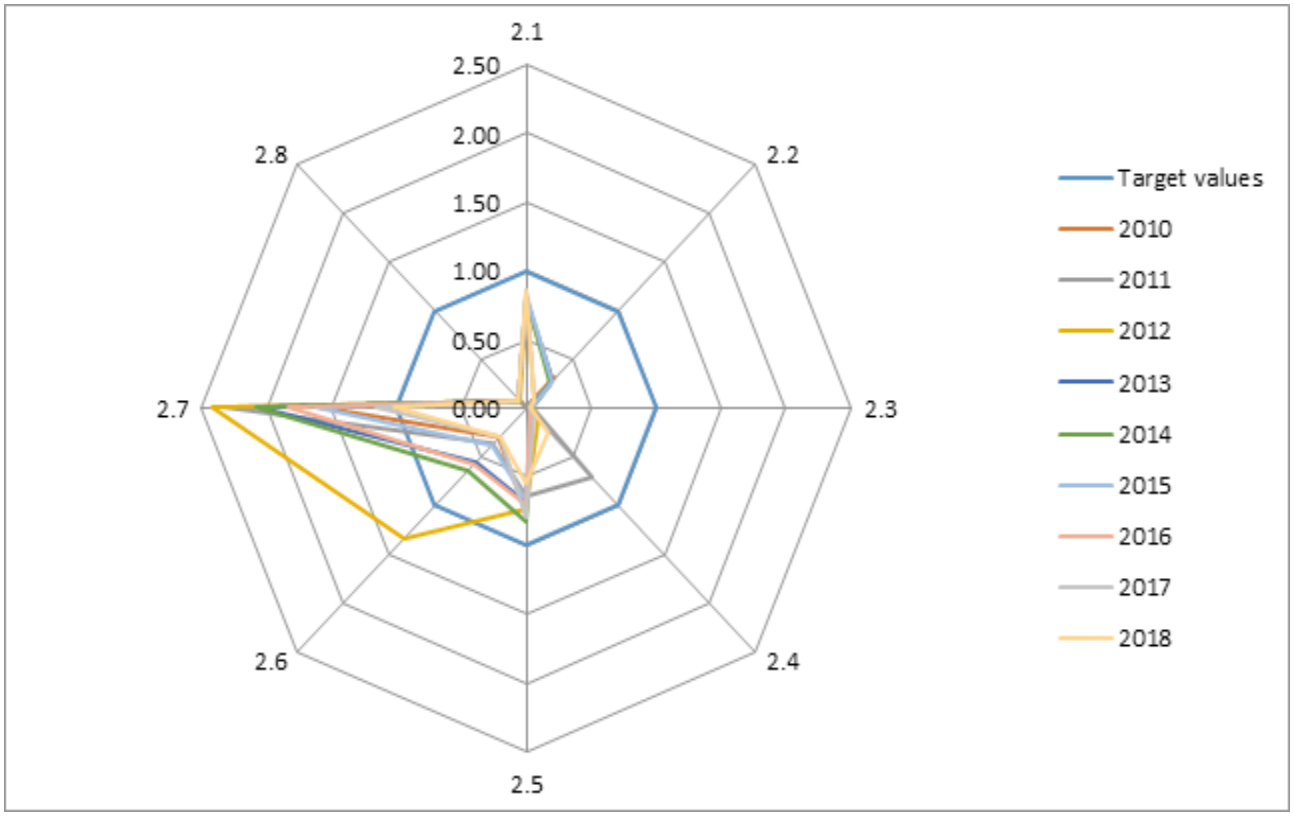

Fig. 5. **Diagram of the indicators of the BSI investment policy development of the Republic of Komi for 2011–2018**

Source: Compiled by the authors.

Note: The order of indicators corresponds to the BSI nomenclature for the development component (*Fig. 1*).

the proposed methodology for assessment of investment attractiveness and efficiency of investment policy by regional authorities of regions of the Russian Federation was substantiated. The obtained results confirm: implementation of the investment potential of AZ regions limits the imbalance of certain directions of regional investment policy, identified on the basis of the developed BSC.

Significantly increases the scope of application of the proposed methodology the possibility of its reproduction in different socio-economic conditions. The perspective direction of the research is the improvement of the BSC structure in the formation of the social market economy of Russia. The conducted research contributes to the theory of investment in the formation of new theoretical and methodological approaches to the management of regional investment processes on the basis of the concept of a balanced scorecard.

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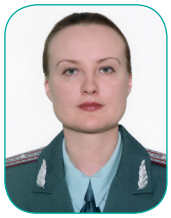
ABOUT THE AUTHORS

Vladimir N. Myakshin — Dr. Sci. (Econ.), Assoc. Prof., Professor of the Department of Financial Law and Jurisprudence, Northern (Arctic) Federal University. M.V. Lomonosov, Arkhangelsk, Russia
http://orcid.org/0000-0002-3989-7367
Corresponding author:
mcshin@yandex.ru

Vladimir N. Petrov — Dr. Sci. (Econ.), Prof., Head of the Department of Forest Policy, Economics and Management, St. Petersburg State Forest Engineering University named after Kirov, Arkhangelsk, Russia
http://orcid.org/0000-0003-4991-2249
wladimirpetrov@mail.ru



Tatiana N. Pesyakova — Deputy Head of the Department on Work with Taxpayers, Department of the Federal Tax Service of Russia for the Arkhangelsk Region and the Nenets Autonomous District, Arkhangelsk, Russia
http://orcid.org/0000-0002-5913-8042
safuecon@yandex.ru

Authors' declared contribution:
V.N. Myakshin — article development, data analysis, interpretation of the results.
V.N. Petrov — statement of the problem, conclusions and writing recommendations, abstract.
T.N. Pesyakova — literature review, interpretation of the results.

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ORIGINAL PAPER

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The Role of Infrastructure Investment in Economic Growth and Balanced Regional Development

N.V. Kapustina[a], A.I. Sadykov[b], J. Podhorský[c]
[a] Finance University, Moscow, Russia;
[b] Russian University of Transport (MIIT), Moscow, Russia;
[c] Institute of Expert Education and Research at University of Žilina, Žilina, Slovak Republic

ABSTRACT

The authors of the paper estimated infrastructure' impact to economic growth, which affects the regional balanced development. The **relevance** of the research is substantiated by the growing dynamics of investment of public funds in infrastructure development of regions. The **purpose** of the research is to determine the impact of infrastructure investments on economic growth and balanced regional development. The **objectives** of the research are: assessment of the impact of investment in infrastructure, assessment of GRP, price index in the regions, assessment of the ratio of population by regions of Russia with average per capita incomes, wages, investment in infrastructure, renewal of fixed assets and assessment of parameters for the balanced development of regions. The authors used statistical research **methods** (panel data, regression analysis) to identify cause-effect relationships in the process of growth and balance of the regional economy. The **scientific novelty** of this paper is the identification of disproportions in development of regions in comparison with the contribution of infrastructure to the regional economy. The **results** suggest that the volatility of infrastructure investment across regions remains high, with the contribution of infrastructure to economic growth and balanced development (p-values from 0.6363 to 0.9552). The authors **concluded** that the importance of infrastructure investments is one of the most important factors in achieving socio-economic development of the region. Infrastructure investment needs to be supported to reduce regional imbalances.

Keywords: balanced development; economic growth; infrastructure; infrastructure investment; regional development

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INTRODUCTION

Economic growth and balanced regional development are closely connected. In recent centuries, the world has been involved in a massive industrialization process with sustained quantitative economic growth of about 2% per year of real per capita income [1–4]. Russian economy was no exception in this process [5]. For many economists, such long-term economic growth has become illogical, for example, according to D. Ricardo [6] and J. Keynes [7] suggested that economic growth has to stop immediately. Most of these gloomy forecasts are based on assumptions about reducing returns to scale or increasing resource scarcity. In this regard, the study of regional development in Russia and its balance is relevant, as our country occupies a large geographical area, rich in resources and there are about 146 mln people.

Economic crises, especially caused by the recent COVID-19, media recession and popular political literature is associated with economic instability [8, 9]. Some economists, sociologists and political scientists argue that economic crises create unbridled capitalism, and markets need to be regulated and controlled economically [10].

Quantification — is the first stage in identifying causal relationships in the balanced economic development of regions. Any quantification requires measurement and identification of the most relevant influencing factors this or that indicator. Assessment the balance between regional development and the role of infrastructure in changing the domestic regional product (GRP) is important. The fact is that the infrastructure relates to the fixed assets that are needed for the daily functioning of the economy: it is equipment and facilities, including transport, roads, bridges, sewerage systems, water supply, power supply and communications, including facilities, needed to operate the Internet [11]. That is, infrastructure affects most of the socio-economic development of the region to some extent.

ECONOMIC GROWTH AND INFRASTRUCTURE IN BALANCED ECONOMIC DEVELOPMENT

In terms of balancing regional development, infrastructure spending is crucial to respond to its impact on the region's economy. The fact is that the money for infrastructure development is either for repair or construction, and the rate of return cost — is different. All this as a result affects the regional balance [12]. Different construction and repair times lead to different results [13]. Repairs give people jobs and speeds up regional growth in the short term [14]. Constructed buildings — are long-term economic objects. Both are important for the process of value addition, productivity and growth potential of the regions in both the short and long term [15, 16].

Another factor determining the rate of return on infrastructure costs is the intensity of future infrastructure use [17, 18]. Thus, the quantitative growth of regional economies is always the focus of economic analysis [19]. The primary problem focuses on the growth rate in equilibrium when modelling the economic growth of the region.

In economics, general equilibrium theory explains the behavior of demand [20, 21], supply and prices in general with several or many interacting markets and proves that the interaction of supply and demand will result to a general equilibrium [22–24].

It should also be taken into account that the theory of general equilibrium differs from the theory of partial equilibrium, which analyses only a certain part of the economy in order to study the balance of regional development. In a general equilibrium, permanent impacts are considered non-economic, so they go beyond economic analysis. Therefore, non-economic impacts may be volatile when economic variables change, and the accuracy of the forecast may

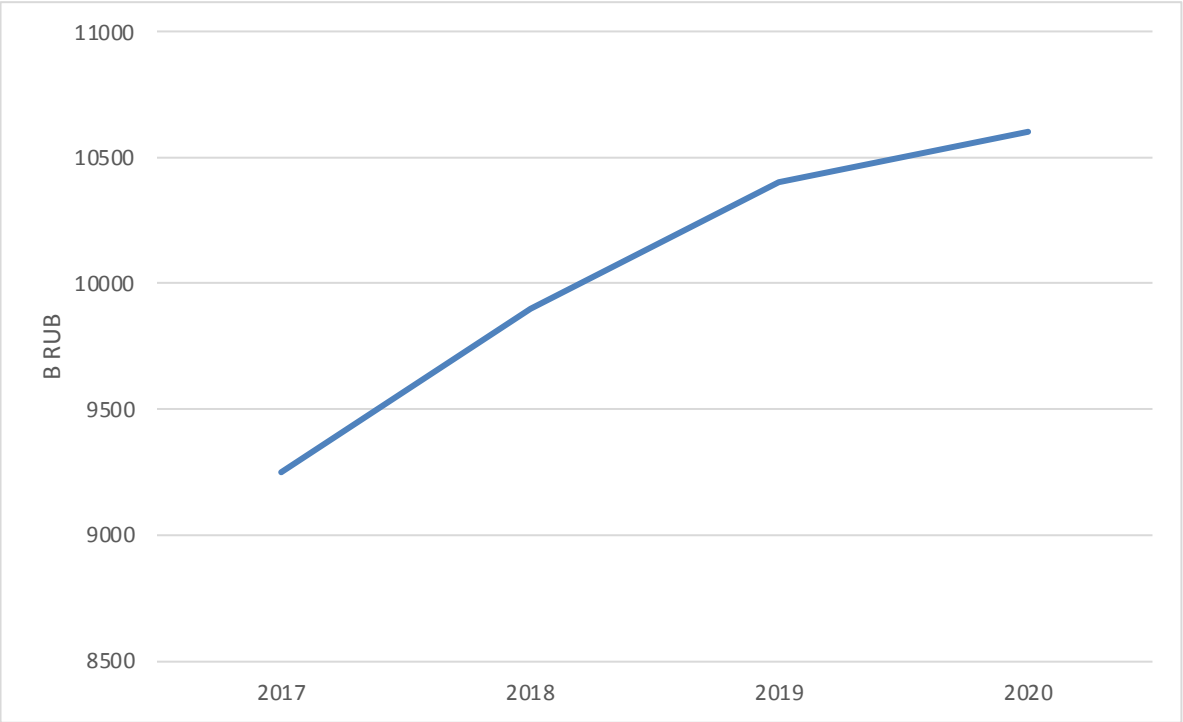

Fig. 1. **Investments in Infrastructure in 2017–2020**

Source: Compiled by the authors.

depend on the independence of economic factors.

In addition, in assessing the balanced development of the Russian regions, it is reasonable to apply the modern concept of general equilibrium, which is presented by the model developed jointly by K. Arrow, G. Debreu and W. Lionel, so-called Arrow-Debreu theory [25, 26]. The fundamentals of the theory, which must be considered in the regional vision of balanced regional economy, relate to three things.

First, it is assumed that goods differ in the place of production and delivery.

Second, it is assumed that the goods differ in their delivery times. This means that all markets are balanced at some initial point in time.

Third, delivery terms, i.e. equilibrium contracts, affect whether and how the goods are delivered.

That is, following the logic of Arrow-Debreu theory, economic theory focuses its equilibrium formulation on the combination of real interest rates (which affect contracts and supply terms) and prices that ensure the sustainable movement of goods, to which infrastructure contributes.

Also note that in recent decades the role of endogenous technological changes through research and development is becoming increasingly important [27]. These include investment in infrastructure, which uses new materials and technological developments of construction. If we take a look at this dynamic, investment in infrastructure has been steadily increasing in Russia for recent years (*Fig. 1*).

The fact is that long-term growth rates tend to increase over time as new waves of the economy come into industrialization and modernization. There have been various explanations for this tendency to increase the quantitative rate associated with infrastructure modernization.

First, there is a clear advantage of organizational and technological improvement, which increases over time as a consequence of the ongoing process in an increasing number of infrastructure enterprises.

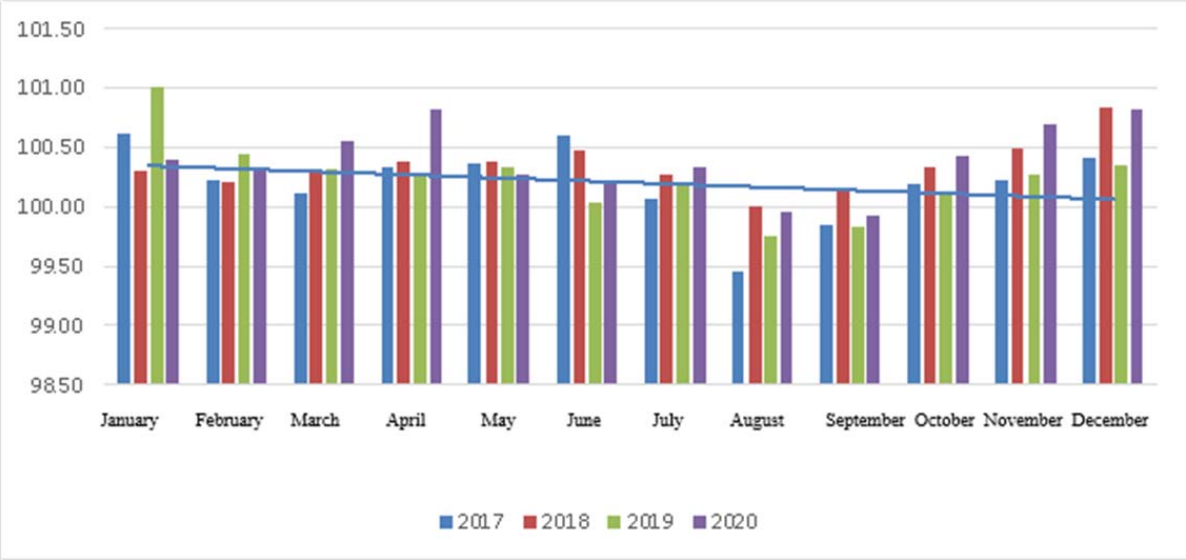

Fig. 2. **Change in the Price Index in the Regions for 2017–2020**

Source: Compiled by the authors.

Second, with expansion of industrialized regions, social capital in the form of hard and soft infrastructure is expanding and can be used at minimal cost in new regions.

However, economic growth through infrastructure modernization provides not only additional development benefits. One of the most significant impacts is the growing demand for free time following an increase in real per capita income. The steady increase in the number of workers in various industries is fully offset by a corresponding decline in the supply of labour per capita. It follows that the quantitative increase in infrastructure resources is primarily in terms of real capital growth. Thus, growth by the development of infrastructures in all directions is interesting to identify the balance of development of the regions.

METHODS OF RESEARCH

To evaluate the balance of regional economies and the role of infrastructure in this process, the authors selected the period 2017–2020. As the lower border we stopped for 2017, as it is new method of calculations, modified by the Federal Service of State Statistics, started working from this year. The study considered 85 regions of the Russian Federation, which ensures that the sample is representative.

Selection of parameters and assessment models

In order to evaluate the growth of Russian regional economies, according to the Arrow-Debreu theory, the focus should be on a combination of real interest rates and prices that ensure the sustainable movement of goods. But in the theory of Arrow-Debreu there is another important factor — the terms of delivery. It is infrastructure that provides the conditions of production and delivery, in connection with which prices are formed [28].

Since the interest rate of the Central Bank for the studied period in the regions is the same, let's consider the equilibrium of the price index change for 2017–2020 (*Fig. 2*).

As we can see, according to the graphics presented in the *Fig. 2*, the price deviations refer to seasonal changes (summer recession) and annual price changes are at 0.3%. Thus, when selecting the parameters of assessment, we can safely lower the terms of delivery and price in the assessment of balanced development of regions.

There is the following clarification. Economic growth creates capital investment

and a productive sector that turns these capital investments into goods. The production sector — is the real economic units that produce goods. Interaction of subjects of reproductive process, rhythm of work and supply of enterprises provides resources of enterprises: labor, material. Each region has a certain amount of labour and material resources, so each region is able to produce only a certain number of goods, the cost of which will be included in the cost of production.

In addition to investment and production in the regional economy, indicators of supply and demand will still play a role, which relate to both production and wages, average per capita incomes, i.e. the possibility of purchase of goods produced.

We will choose the following evaluation parameters for economic growth and balance of economic development:

Y (GRP) — dependent variable;

regressors:

X_1 — population by regions of Russia;

X_2 — average per capita income;

X_3 — wage;

X_4 — investment in infrastructure;

X_5 — renewal of fixed assets reflecting the industrialization of the region's economy.

Then the general formula of the model Y (GRP) from the factors Xi will have the following form:

$$Y = \beta_0 + \beta_1 \cdot X + \varepsilon, \quad (1)$$

where Y — value of the dependent variable; X — value of the predictor variable (regressors); β_0 — constant; β_1 — regression coefficient; ε — random model error.

Suppose that the set of parameters contains some heterogeneity due to factors that are not considered in the model (1), and unobserved factors may correlate with model regressors. Panel data for 2017–2020 and a sample of 85 regions allow this heterogeneity to be taken into account by considering individual effects (fixed) for panel objects that reflect the impact of all variables — both observed and unobserved, taking different values for sampling objects but not changing over time.

We assume that errors are distributed normally, then the coefficient vector will also be distributed normally around the real value, and its variance can be estimated. This might be testing the hypothesis on zero coefficient equality, and therefore check the importance of predictors, i.e. whether the value of Xi strongly affects the quality of the built Y model.

Gauss-Markov conditions are checked and fulfilled in model [29, 30]:

- there are not heteroskedasticity of random model errors;
- there are not autocorrelation of random errors.

The study was conducted in two stages:

Stage I — compared the dynamics of indicators.

Stage II — estimation of correlation and identification of the most significant regressors for Y (GRP).

RESULTS

Stage I

At the beginning, we will assess the development of all indicators. Data: GRP (Y), population by regions of Russia (X_1), average per capita income (X_2), wage (X_3), investment in infrastructure (X_4), rate of change in fixed assets (X_5) for 2017–2020 (*Fig. 3–8*).

As see (*Fig. 3*), the largest deviations in the GRP level by region were observed in 2018 (R^2 = 0.0362). The other years did not show such dynamics.

Changes in the population level for 2017–2020 can be observed in the Astrakhan, Chuvash, Kirov, Mordovian, Penza regions, the Altai region (*Fig. 4*).

With regard to the linear estimation of the correlation in the years under review, 2019 was noted. Whether this was due to the fall of GRP in 2018, according to the above graphics, but as a possible reason for the

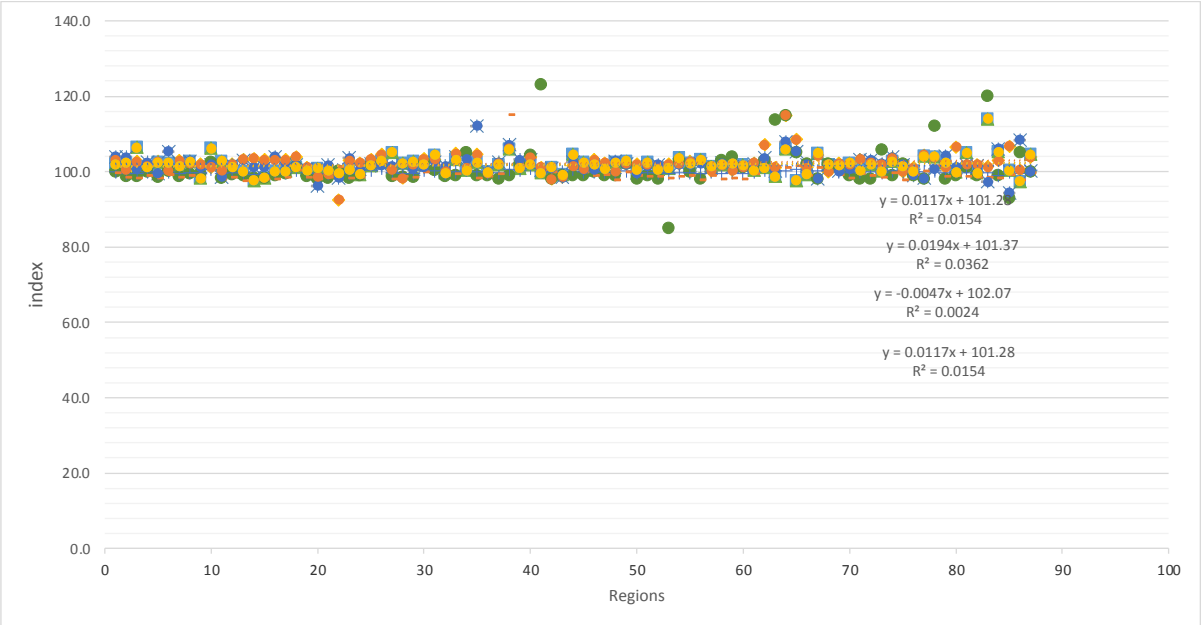

Fig. 3. **GRP of Russian regions (85 regions) for 2017–2020**

Source: Compiled by the authors.

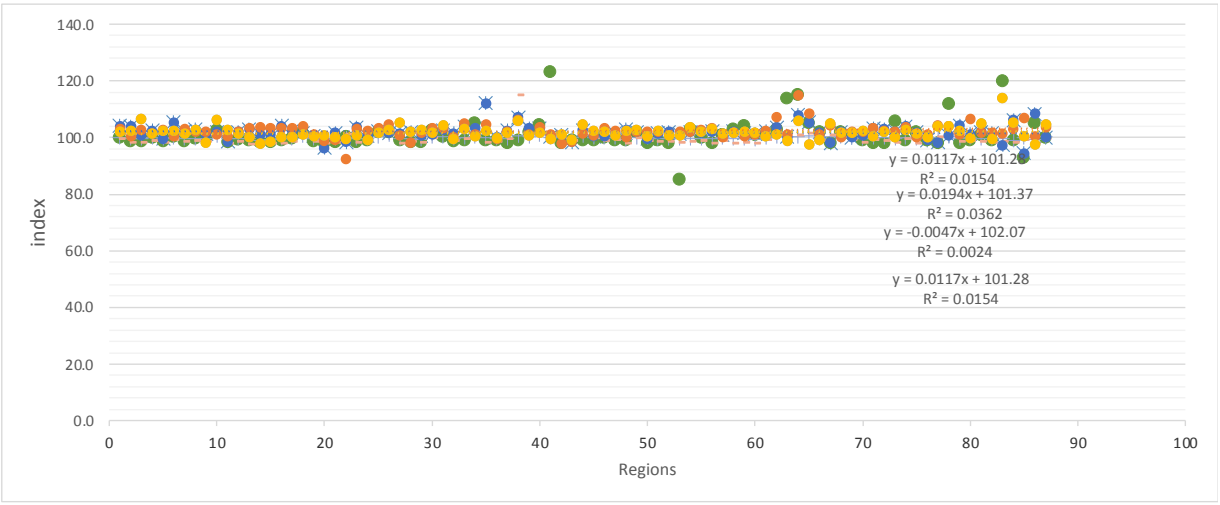

Fig. 4. **The population of Russia (85 regions) for 2017–2020**

Source: Compiled by the authors.

non-permanent migration of the population (work in other regions) can be noted.

Average per capita income (*Fig. 5*) varies significantly in 2017 R^2 = 0.064. The fall in average per capita income was observed in Kursk, Irkutsk, Buryat, Omsk regions, as well as in the Trans-Baikal region.

As for the average wage, as shown in *Fig. 6*, it varies considerably between regions. And in some regions, we see both a significant rise, especially in 2018 (Bryansk, Kostroma, Lipetsk, Arkhangelsk, Pskov, Ulyanovsk, Sverdlovsk regions), and a decrease in this indicator (Arkhangelsk, Bashkortostan, Khakassia, Kamchatka region, Chukotka). The principal changes occurred in 2020, R^2 = 0.0354.

The amount of investment in infrastructure (*Fig. 7*) varies greatly by region. Even excluding the Republic of Crimea (which

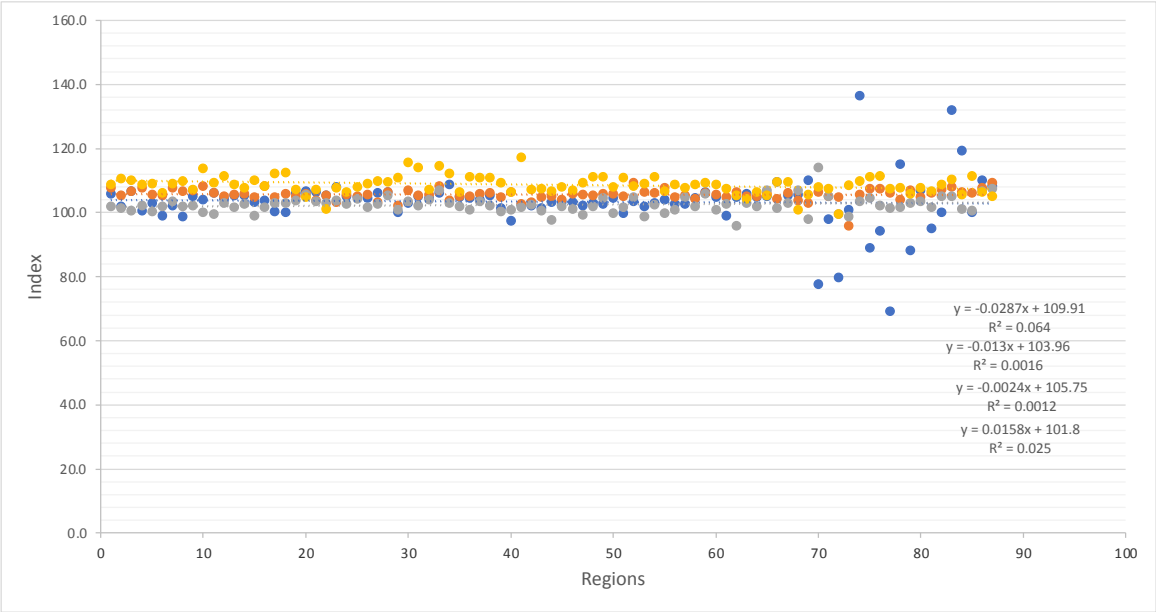

Fig. 5. **Average Per Capita Income of the Population of Russia (85 Regions) for 2017–2020**

Source: Compiled by the authors.

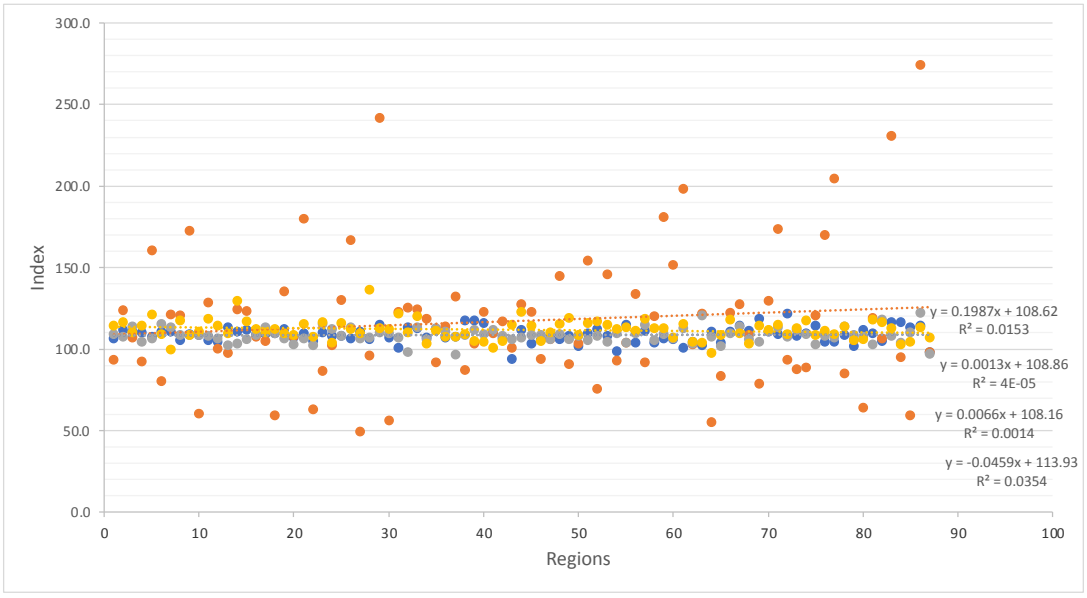

Fig. 6. **Average Salary in Russian Regions (85 Regions) for 2017–2020**

Source: Compiled by the authors.

in 2018 was invested by 400% more than in 2017), it is clear that the level of investment in infrastructure differs significantly by region.

The rate of renewal of fixed assets in the years under consideration ranges from 3% (Ivanovo region, Primorsky region) to 23% (Trans-Baikal region) (*Fig. 8*). Remember that quantitative growth through industrialization, which includes fixed assets, provides not only additional benefits of growth, but also long-term economic growth, which, following an increase in real per capita income, is a precursor to the growing demand for free time.

Thus, in Stage I we identified linear causal relationships for each parameter to assess the correlation (1).

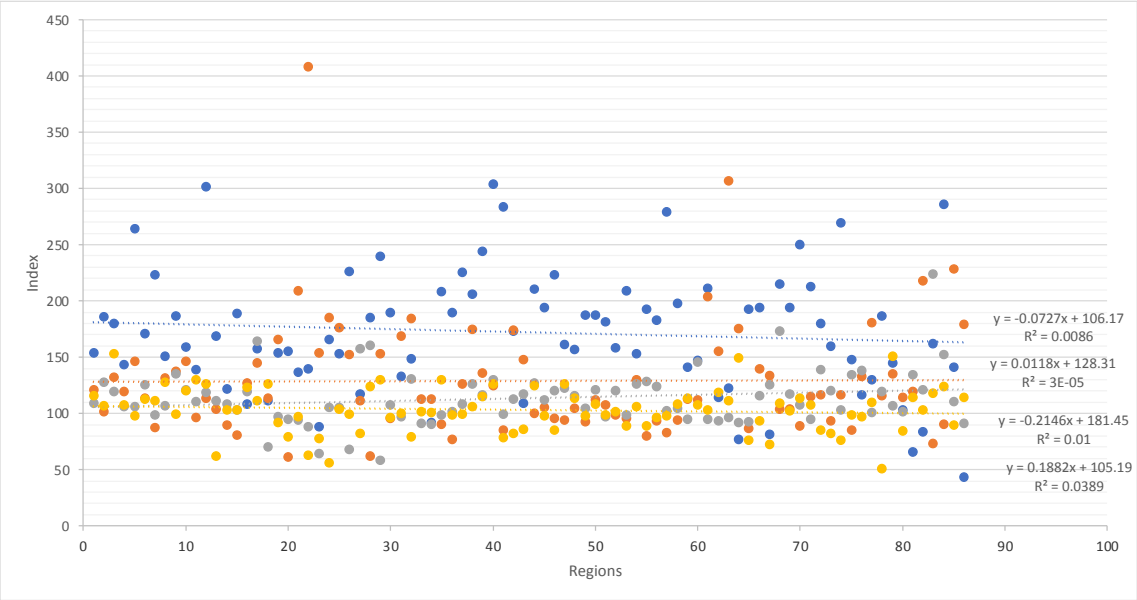

Fig. 7. **Investments in Infrastructure by Russian Regions (85 Regions) for 2017–2020**

Source: Compiled by the authors.

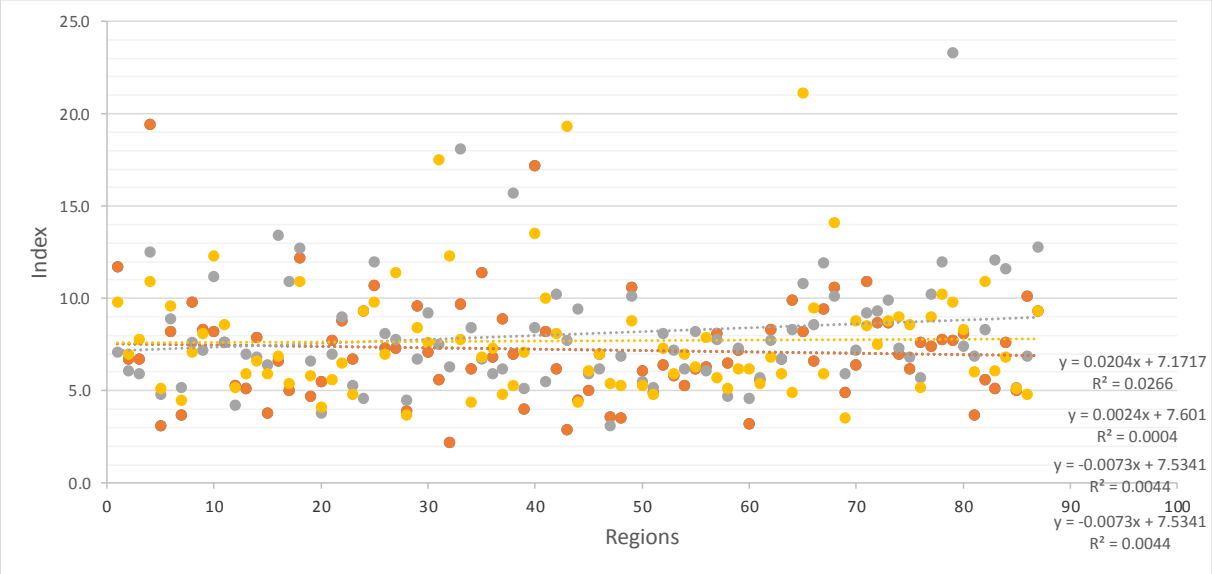

Fig. 8. **Coefficient of Renewal of Fixed Assets, by Russian Regions (85 Regions) for 2017–2020**

Source: Compiled by the authors.

Stage II

In the second stage of the study, we performed regression analysis based on the MLS for panel data 2017–2020 across 85 regions. The obtained results are presented in *Table 1*.

In 2017, the largest *p*- value of 0.9542 was obtained for X_4 — infrastructure investment. That is, the more investment — the more GRP.

So, as we can observe (*Table 2*), in 2018 the largest *p*-value of 0.9552 was also obtained for variable X_4 — infrastructure.

In 2019 (*Table 3*) the largest *p*-value of 0.8344 was obtained for variable X_2 — average per capita income of the population.

In 2020, the largest *p*-value of 0.6363 was obtained for variableX_4 — infrastructure investment.

Table 1

Regression Analysis of the Dependence of GRP on Indices of Changes in Indicators: Population, Average Per Capita Income, Wages, Investments in Infrastructure, Renewal of Fixed Assets in 2017

Regressors	Coefficient	Statistical error	*t*-statistic	*P*-value
X_1	–0.0158310	0.0173060	–0.9148	0.3630
X_2	0.217461***	0.0530676***	4.098***	< 0.0001***
X_3	0.721287***	0.0564953***	12.77***	< 0.0001***
X_4	0.000516632	0.00897457	0.05757	0.9542
X_5	0.268601	0.171884	1.563	0.1220

Source: Compiled by the authors.

Note: All tests confirmed the homoscedasticity of the residue (p > 0.05). The residue has a normal distribution (p > 0.05). *, ** and *** denote statistical significance at levels of 10, 5 and 1% respectively (Dickey and Fuller [30, p. 1057]).

Table 2

Regression Analysis of the Dependence of GRP on Indices of Changes in Indicators: Population, Average Per Capita Income, Wages, Investments in Infrastructure, Renewal of Fixed Assets in 2018

Regressors	Coefficient	Statistical error	*t*-statistic	*P*-value
X_1	0.0137956	0.0152299	0.9058	0.3677
X_2	0.954956***	0.0197554***	48.34***	<0.0001***
X_3	–0.00969721	0.00784437	–1.236	0.2199
X_4	–3.77876e-05	0.000670042	–0.05640	0.9552
X_5	0.150269	0.114950	1.307	0.1948

Source: Compiled by the authors.

Note: All tests confirmed the homoscedasticityof the residue (p > 0.05). The residue has a normal distribution (p > 0.05). *, ** and *** denote statistical significance at levels of 10, 5 and 1% respectively (Dickey and Fuller [30, p. 1057]).

We shall reduce the received data (*Table 5*).

Infrastructure investments show strong correlation with GRP. In this case, GRP is a significant parameter in assessing the balanced development of regions, as we quickly get the result on the produced infrastructure. If road construction efficiency has a long lag in GRP evaluation, then residential, office, storage construction, we can track already in the results of GRP change in a year.

Table 3

Regression Analysis of the Dependence of GRP on Indices of Changes in Indicators: Population, Average Per Capita Income, Wages, Investments in Infrastructure, Renewal of Fixed Assets in 2019

Regressors	Coefficient	Statistical error	*t*-statistic	*P*-value
X_1	1.05775***	0.112863***	9.372***	<0.0001***
X_2	−0.0205850	0.0981689	−0.2097	0.8344
X_3	−0.0447308	0.0561826	−0.7962	0.4282
X_4	0.0150266	0.0104515	1.438	0.1543
X_5	0.176674**	0.0793981**	2.225**	0.0288**

Source: Compiled by the authors.

Note: All tests confirmed the homoscedasticityof the residue (p > 0.05). The residue has a normal distribution (p > 0.05). *, ** and *** denote statistical significance at levels of 10, 5 and 1% respectively (Dickey and Fuller [30, p. 1057]).

Table 4

Regression Analysis of the Dependence of GRP on Indices of Changes in Indicators: Population, Average Per Capita Income, Wages, Investments in Infrastructure, Renewal of Fixed Assets in 2020

Regressors	Coefficient	Statistical error	*t*-statistic	*P*-value
X_1	0.192121*	0.112093*	1.714*	0.0903*
X_2	0.583255***	0.114930***	5.075***	< 0.0001***
X_3	0.145133**	0.0589802**	2.461**	0.0160**
X_4	−0.00923272	0.0194538	−0.4746	0.6363
X_5	0.0973739	0.117952	0.8255	0.4115

Source: Compiled by the authors.

Note: All tests confirmed the homoscedasticityof the residue (p > 0.05). The residue has a normal distribution (p > 0.05). *, ** and *** denote statistical significance at levels of 10, 5 and 1% respectively (Dickey and Fuller [30, p. 1057]).

CONCLUSION

The authors determined the degree of influence of infrastructure on the balance of economic development through economic growth and GRP.

The theory study showed that endogenous factors, which include investment in infrastructure, play a significant role in the economic growth of each region.

Selected quantitative characteristics of the balance of regional development for 2017–2020 showed very ambiguous dynamics of GRP, average per capita incomes, wages,

Table 5

Final Data on Testing Based on the Regression Model for 2017–2020

Years	*p*-value	Evaluation parameters
2017	0.9542	Infrastructure investment
2018	0.9552	Infrastructure investment
2019	0.8344	Per capita income of the population
2020	0.6363	Infrastructure investment

Source: Compiled by the authors.

investments in infrastructure, as well as the rate of renewal of fixed assets. There was a high regional volatility in infrastructure investments and the rate of renewal of fixed assets.

From this it follows that investment in infrastructure and the rate of asset renewal — are factors that significantly affect the economic growth of the region and GRP. These factors are the main source of regional imbalances.

The correlation between the GRP index and the indices was studied according to the presented regression model: X_1 — population by regions of Russia; X_2 — average per capita income; X_3 — wage; X_4 — infrastructure investment; X_5 — fixed assets renewal. The evaluation found that the correlation between GRP and infrastructure had *p*-values from 0.6363 to 0.9552. And only in one study year, which was used in the panel data for the estimate, 2019, there was a large dependence of GRP on average per capita income, *p*-value — 0.8344

Thus, infrastructure investment has the leading role in changing the region's economic growth and balanced development.

Indeed, in order to meet the growth and development needs of any region, special attention must be paid to its viability. Standard development arguments for a particular region simply do not apply or are not used in time. This is shown by the statistics given in the article.

The potential to address these imbalances is provided by infrastructure development that increases productivity and creates new resources for the entire region. And in an underdeveloped region, both the supply side and the demand side are rebalancing, affecting the productivity of enterprises. Economic growth in one region is not always balanced development of a country. This fact should be taken into account in the development strategy of Russia. The authors will also continue to work in this direction, assessing the development of regions, the disproportion of their development, and identifying the necessary balance of economic growth of regions.

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ABOUT THE AUTHORS

Nadezhda V. Kapustina — Dr. Sci. (Econ.), Prof., Department of Economic Security and Risk Management, Faculty of Economics and Business, Financial University, Moscow, Russia
https://orcid.org/0000-0002-5991-5200
Corresponding author:
nvkapustina@fa.ru

Albert I. Sadykov — postgraduate student, Russian University of Transport (MIIT), Moscow, Russia
https://orcid.org/0000-0002-4740-5414
albsadykov001@gmail.com

Ján Podhorský — Assoc. Prof. of the Institute of Expert Education and Research at University of Žilina, Žilina, Slovak Republic
https://orcid.org/0000-0002-4588-4028
podhorsky.jan@gmail.com

Authors' declared contribution:
N.V. Kapustina — problem statement, article concept development, statistical data analysis, description of results.
A.I. Sadykov — literature analysis, formation of research conclusions, collection of statistical data, description of calculation methods, econometric calculations.
J. Podhorský — tabular and graphical representation of the results of the study, introduction.

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Credit Risks of Russian Commercial Banks: New Approaches to Management

M.F. Gumerov[a], I.A. Rizvanova[b]
[a] Moscow Technical University of Communications and Informatics, Moscow, Russia;
[b] Financial University, Moscow, Russia

ANNOTATION

In the realities of the modern domestic economy, the process of risk management of commercial banks associated to credit corporate customers, acquires new content. The assessment of what place in the company's activity has a work that contributes to solving the most pressing problems of our time: environment, social and general corporate governance comes to the fore. As a result, the focus is on a group of lending risks known as ESG. Since the areas of work of clients — legal entities, with which these risks are associated, and described mainly by qualitative, non-formalized characteristics, a difficult task for modern bank risk-management becomes normalizing the process of their evaluation when making specific decisions on the loan. This explains the interest and **relevance** of this research, the **object** of which is the risk management subsystem for lending to corporate clients by commercial banks, the **subject** is the consideration of ESG factors in this process. The **purpose** of the paper is to develop the basics of decision-making tools in the management of bank credit risks, with this group of factors. The authors apply **methods** of both general scientific (induction, deduction, analysis, synthesis) and special: system and retrospective analysis of existing developments in the field of justification of decisions of bank risk management. The theoretical significance of the research **results** consists in a complex analysis of the role and place of ESG-risks in the overall risk landscape and the integration of environmental, social and managerial factors into credit risk assessment. Basic principles of construction of phenomenological model, used to support credit decisions by banks of corporate clients taking into account ESG-factors that influence their activity, have been developed.
Keywords: bank lending; credit risks; ESG risks; phenomenological modeling; management decision-making

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INTRODUCTION

According to the Global Progress Report of the Sustainable Banking Network (SBN)[1] [1] in the coming years one of the priority directions of development of "green" financing will be identification and management of ESG-risks. Note that the share of loans provided by the global banking community in 2016 for the purpose of "green" financing was 7% (22 trillion USD) of the total volume of issued loans. By 2030, however, this figure could rise to 30% (44.5 trillion USD)[1], indicating an investment potential in the transition to sustainable development policies. In the Russian market, experts predict a volume of 1.3 trillion rubles of "green" and SDG-oriented credits to 2030, while maintaining current trends [1]. One of the challenges for Russian banks is the development of methodology for ESG-risk management. In order for domestic banks to be able to take into account the ESG risks associated with their business when making decisions on lending to corporate clients, they must have tools, which allows you to model economic systems with a lot of complex and poorly formalized relationships. Phenomenological models that have long proven themselves in natural science and technical sciences are a promising basis for such tools. Their essence consists in describing the reactions of the simulated system to external control effects, but without the task of identifying the underlying mechanisms of these reactions. The end result of this is a short-term solution that should result in either a new phenomenological model for use in the next short-term interval, or a model that explains in detail the work of the system under study and provides a basis for longer-term solutions [2]. At present, the experience of applying phenomenological models for substantiation of managerial decisions in economic spheres, including financial and banking, has an eclectic character, and there is a need to systematize it, which determined the structure of this paper. Its purpose is — to develop the basic principles of construction of phenomenological models used to substantiate decisions on lending to corporate clients by banks, taking into account ESG-indicators that affect their activities.

To achieve to this goal set specific goals:

1) summarize the role and place of ESG-risks in the overall risk landscape, which are taken into account when making decisions on lending to corporate clients by modern Russian banks and present ESG-risk indicators when assessing the creditworthiness of a client — legal person;

2) to develop an algorithm of building a phenomenological model of the situation related to the provision of credit by the domestic bank to a corporate client whose activity is under the influence of ESG-indicators.

The object of the study are the decision-making processes on lending corporate clients by domestic banks with consideration of ESG-risks; subject — application of phenomenological models of relationships between the state of corporate clients-borrowers with ESG-indicators when making such decisions. The theoretical and methodological basis of the study are the works of domestic and foreign specialists in the field of banking, lending, credit risk management, enterprise economy, application of mathematical and phenomenological modeling in the economy.

METHOD

The methodological basis of the study has two components. Research related to credit risk management by modern banks of corporate clients on the basis of the ESG-approach, which are based on the work of foreign scientists on this topic, presented in libraries and scientific

[1] Accelerating sustainable finance together: Global progress report of the Sustainable Banking and Finance Network. Evidence of policy innovations and market actions across 43 emerging markets. Washington, DC: International Finance Corporation; 2021. 117 p. URL: https://sbfnetwork.org/wp-content/uploads/pdfs/2021_Global_Progress_Report_Downloads/SBFN_D 003_GLOBAL_Progress_Report_02_Nov_2021.pdf (accessed on 18.04.2022).

databases Scopus and Wo S. Research related to the application of phenomenological models in bank lending and risk management to account for factors of volatile and non-standard factors (due to Russian specificity) based on developments in the application of systems analysis and modelling in the economy. These developments have been created by scientific schools of the Financial University under the Government of the Russian Federation, the Central Institute of Economics and Mathematics of the Russian Academy of Sciences, the Saint Petersburg HSE and Management, the Volga Federal University to date. The central part of the approach developed in the study to substantiation of decisions on lending by banks of corporate clients with consideration of influence of ESG-indicators on their business is the method of construction of phenomenological models of these situations. The problem is that existing methods of constructing phenomenological models have developed within the framework of the natural sciences and their particular, subject area, so it is necessary to adapt them to the specifics of the description of the subject area of bank lending.

RESULTS

Result 1

ESG risk assessment becomes an important element of strategic planning, decision-making and risk management especially in the banking sector when assessing the creditworthiness of corporate clients. This is evidenced by the approaches of the European Banking Authority to lending, the purpose of which is to provide reliable and reasonable standards of lending, covering factors and ESG-indicators both when issuing a loan and assessing creditworthiness, and when monitoring loans issued. A lot of research has been done on the impact of ESG-risks on various aspects of operations. The authors of [3] prove that the inclusion of ESG-risk assessment indicators increases the effectiveness of forecasting the volatility of traditional financial risk measures. The study [4] confirms that the implementation of ESG-principles reduces the risk of financial default. The paper [5] concludes that socially responsible human resource management has a positive impact on the level of corporate environmental responsibility, which in turn affects the financial performance of the company. A similar study was conducted by the authors [6]: implementation of ESG-principles in the company's activities ensures improvement of the company's business reputation in the society and trust of investors; results in efficient use of resources and preservation of competitiveness [7]. The study [8] proves that a higher commitment of the company to ESG-principles is closely related to the reduction of credit risk of the corporate customer. ESG-risks — a concept primarily socio-economic, it cannot be considered in isolation from the national economy and the features of its development. These risks should be seen as a system consisting of three blocks: environmental, social, corporate governance.

Environmental block. ESG-principles are based on knowledge about ecological problems of society, responsible behavior of market participants in making investment decisions, conscious investment in the segment of "green" sustainable development and environmental risk reduction. Environmental risk[2] — the probability of events with adverse effects on the natural environment and caused by negative impacts of economic and other activities, natural emergencies and technogenic character. Unfortunately, the share of Russian investors does not have to be a formal ESG-principles, despite the active promotion of this direction, is not yet enough: for 2020, out of 66 Russian public joint stock companies analyzed, 44 disclosed non-financial information in the annual report (total of about 1000). Obviously,

[2] Russian Federation. Laws. On environmental protection: No. 7: text with amendments and additions as of 26 March 2022: [adopted on 10 January 2022]. Legal reference system "Consultant Plus". URL: Федеральный закон «Об охране окружающей среды» от 10.01.2002 № 7-ФЗ (последняя редакция). КонсультантПлюс (consultant.ru) (accessed on 08.07.2022).

it is necessary to cultivate among national investors and consumers of financial services responsible behavior that creates the basis for the sustainable development of the country for future generations, including actively using tax and other incentives.

Social block is characterized by social risk — the risk that creates, produces, provokes society itself. According to research [9, 10], companies with high ESG-ratings have a high future return on shares. An important component of ESG-indicators is the social aspect: the higher the index of social norms, the higher the level of investment of institutional investors in ESG-companies, which leads to their higher financial performance in the stock market and increase in the market value of the company. In turn, the authors of the paper [11] in the analysis of 65 socially responsible banks from 18 countries came to the conclusion that socially responsible banks have significantly higher financial performance than "socially not responsible banks".

Corporate governance block covers the system of relationships in the company between all stakeholders. However, in both Russian and international practice, most issues related directly to corporate governance are not legal but ethical. For example, rules of civil legislation establish the possibility to rely on the requirements of reasonableness, integrity and fairness in some cases. Therefore, it seems important to base corporate governance on the principle of sustainable development of society, definition of the company's mission and the introduction of corporate values, which will become a tool for all stakeholders of the company to achieve strategic goals.

Based on the analysis and summarize of the literature, it can be concluded that when assessing the creditworthiness of the client — legal entity, it is necessary to take into account the indicators of ESG-risks indicated in the *Table 1*.[3]

Of course, quality ESG-policy risk management is an important aspect of ESG-banking. Accordingly, it seems necessary to integrate ESG factors into the risk management process as *seamlessly* as possible and to consider ESG-risks in the overall risk system. From this point of view, our article contributes to the development of ESG-practice in the banking sector, offering a theoretical and methodological framework for the effective integration of ESG-factors in the analysis of creditworthiness of clients — legal entities.

Result 2

The complexity of the mechanisms by which ESG-factors operate, makes the discussion about the development of special tools to take them into account in the development of decisions on lending to corporate clients by banks.

For Russian banks accounting for ESG-risks when lending customers is complicated by factors that are caused by the overlap of two large bifurcation processes in the national economy (*Fig. 1*).

Thus, the mechanisms of functioning of the Russian economy as macrosystems at present are extremely difficult to understand and deepen in their essence, including the mechanisms of influence of ESG-factors on the development of business of domestic enterprises, borrowing banks.

In this regard, for Russian banks, tools based on phenomenological models appear to be very effective in taking these factors into account when lending enterprises. This type of model came into economic management science and practice from technical disciplines [12, 13].

The main question remains the creation of a unified approach to the construction of phenomenological models, applicable specifically to economic systems, taking into account their specificity compared to technical. The paper [15] suggests the primary principles of such an approach, based on the provisions of

[3] Methodology of assigning credit ratings to financial and non-financial companies. Expert RA. URL: https://raexpert.ru/ratings/methods/current/ (accessed on 18.04.2022). ESG assessment methodology. URL: https://www.acra-ratings.ru/criteria/2072/ (accessed on 18.04.2022).

Table 1

Index and Indicators of EGS-Risks

Index	Indicator	Positive/negative adjustment of indexes in assessing the creditworthiness of the client
Direction: Environment		
Water and energy management	Used water from all sources (million cubic meters) Volume of turnaround and repeatedly-consecutive water supply from all sources (million cubic meters). Consumption of fuel and energy resources, including heat, fuel, electricity (toe) Share of renewable energy (RES) in total energy consumption (%)	Existence of programmes to improve energy and water efficiency, adaptation to climate change Availability of ISO 50001 certificate Integration agenda into the global climate change business model An industrial accident resulting in the freezing of the company's assets and compensation for damage Impacts with socio-economic and economic damage, caused the public resonance Non-compliance with environmental legislation was identified Presence of repetitive requirements by public authorities Existence of a disputed environmental situation involving a company or its contractors Insufficient information transparency: the company does not provide up-to-date information on the disputed environmental situation
Waste management and environmental	Discharge of contaminated wastewater into surface water bodies, including transfer for treatment (million cubic meters) Generated waste I–IV hazard classes (total and separately by classes) (thous. tons) Waste management I–IV classes of hazard, including disposed of, defused of, buried, given to other persons/ received from others (thous. tons) Emission of pollutants in atmospheric air from stationary sources (thous. tons) Greenhouse gas emissions (thous. tons of CO2 equivalent)	High quality environmental management Availability of ISO 14001certificate Unit gross emissions of pollutants, greenhouse gases to the atmosphere, carbon footprint show a decreasing trend over the last year/two/three years Availability of programs on rubbish and waste removal An industrial accident resulting in the freezing of the company's assets and compensation for damage Repeated prescriptions by public authorities Existence of a disputed environmental situation involving a company or its contractors Insufficient information transparency: the company does not provide relevant information on the disputed environmental situation

Table 1 (continued)

Index	Indicator	Positive/negative adjustment of indexes in assessing the creditworthiness of the client
Finance environmental projects	Environmental costs, including: air protection and mitigation; collection and treatment of wastewater; waste management; conservation of biodiversity and protection of natural areas (thous. rub.)	Existence of a programme and policies on land reclamation, biodiversity conservation, atmospheric air protection and mitigation, wastewater collection and treatment Incident, that caused a public outcry related to the financing of environmental projects Availability of supporting documents for financing environmental projects
Direction: Social		
Conditions of work	Social costs per staff Higher pay (%) Annual additional paid leave (calendar days) Reduced working time (hours) Personnel development costs per staff Number of courses offered and advanced training Number of recreation centers, clinics, etc. Workers: men, women, persons under the age of 18, persons with disabilities, older workers, refugees Structure and gender distribution of posts Results of current activities of the employee, unit (KPI) Number of employee proposals and initiatives (un.) Positive evaluation of eNPS measurement, engagement, project activity, motivational climate	Availability of employee social support Availability of feedback mechanisms for staff Availability of social investments in the development of the regions of the company's presence Existence of human rights policies and standards Failure to comply with labour legislation Existence of a contentious situation with a public impact on the observance of human rights The company participates in court proceedings related to workers' conditions Insufficient information transparency
Local communities	Investments in local communities (thous. rub.) Consumer Satisfaction Index (CSI) Customer Acquisition Costs (CAC) Customer Retention Rate (CRR) Customer Lifetime Value (CLTV) Customer loyalty index Responsible marketing Share of defective goods Percentage of orders delivered on time Order completion (%) Responsible products/services Responsible supply chain Percentage of complaints (refunds) by quality	Availability of investment in local communities Existence of supporting documents that show that the company imposes requirements on the counterparties in the field of responsible business; respect for human rights

Table 1 (continued)

Index	Indicator	Positive/negative adjustment of indexes in assessing the creditworthiness of the client
Health and safety	Number of accidents per 1000 employees Number of workplaces at which the factors of production environment and labor process have been assessed: light environment, gravity of labor process, tension of labor process, etc.	Existence of health and safety policies and standards/ Incident resulted in loss of life Incident resulted significant damage and public outcry. High industrial injuries
Direction: Governance		
Business ethics	Number of offences (by sector and industry)	It was found that the company did not comply with the constituent and internal documents The company participates in court proceedings, has claims from the state authorities High level of disclosure and quality of non-financial information Risk identification and risk management framework for sustainable development in place Presence of a unit or staff responsible for sustainable development Integration of ESG-factors into long-term strategy Implementing Disclosure Recommendations (in the TCFD)
Corruption and theft	Share of independent board members; Share of open market shares; Top management reward	The facts of participation of top management/ beneficial owners of the company in illegal activities were revealed Revealed evidence of excessively risky activity, leading to the possibility of damage to customers, contractors, and hence the business reputation of the company High level of disclosure and quality of financial information

Source: Compiled by the authors according to [1]; Accelerating sustainable finance together: Global progress report of the Sustainable Banking and Finance Network. Evidence of policy innovations and market actions across 43 emerging markets. Washington, DC: International Finance Corporation; 2021. 117 p. URL: https://sbfnetwork.org/wp-content/uploads/pdfs/2021_Global_Progress_Report_Downloads/SBFN_D 003_GLOBAL_Progress_Report_02_Nov_2021.pdf (accessed on 18.04.2022).

classical and modern management theories, in which the problem area of modeling during the development of the solution is characterized by 16 indicators of resource exchange — 4 of their kind in 4 subsystems (*Fig. 2*).

Management decision is considered as an act, as a result of which in a managed system all 16 indicators of resource exchange are transferred from old values to new, and the decision itself is characterized by 4 parameters of changes introduced into the system by the decision maker (on the scheme they are marked beech "*d*" (*decision*) with the symbols of resource exchanges. All three groups of indicators of resource exchanges: before and after a management decision and the changes it introduces are linked by a system of equations:

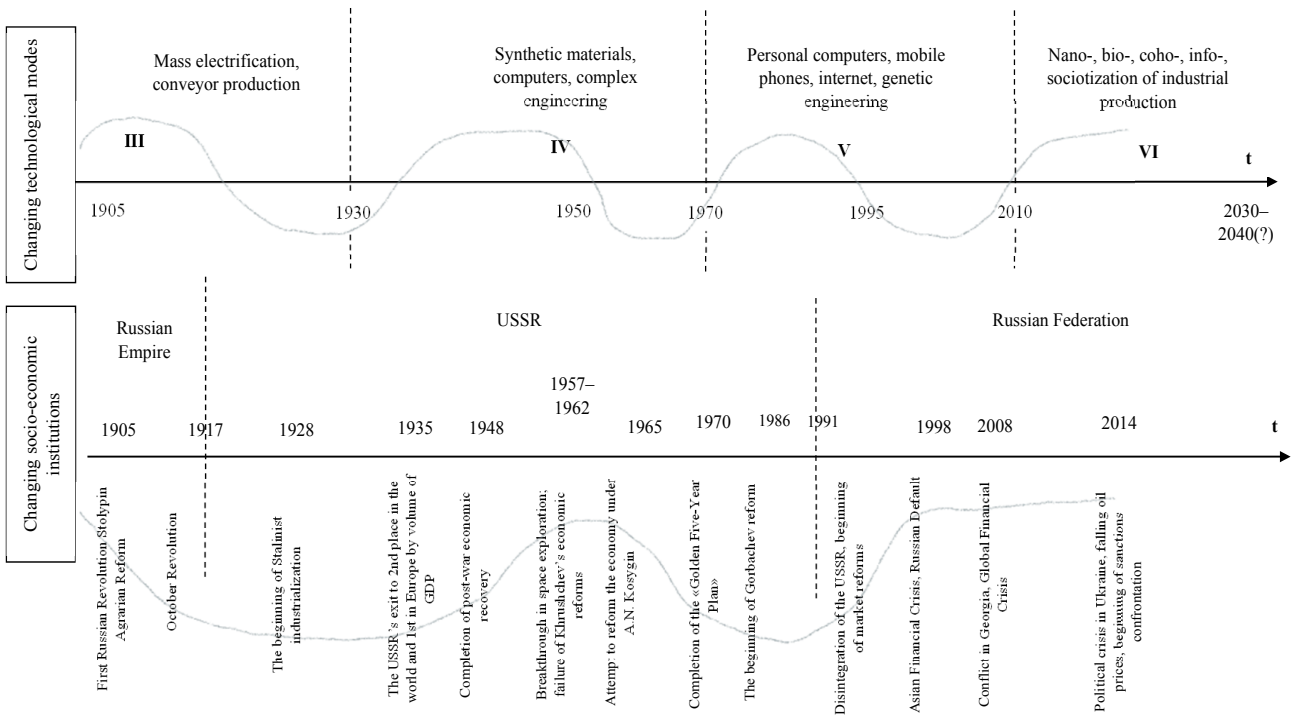

Fig. 1. **Synergy of Bifurcations Provided with Changing Technological Modes and Social-Economic Institutions in Russia of the Early XXI Century**

Source: Compiled by the authors.

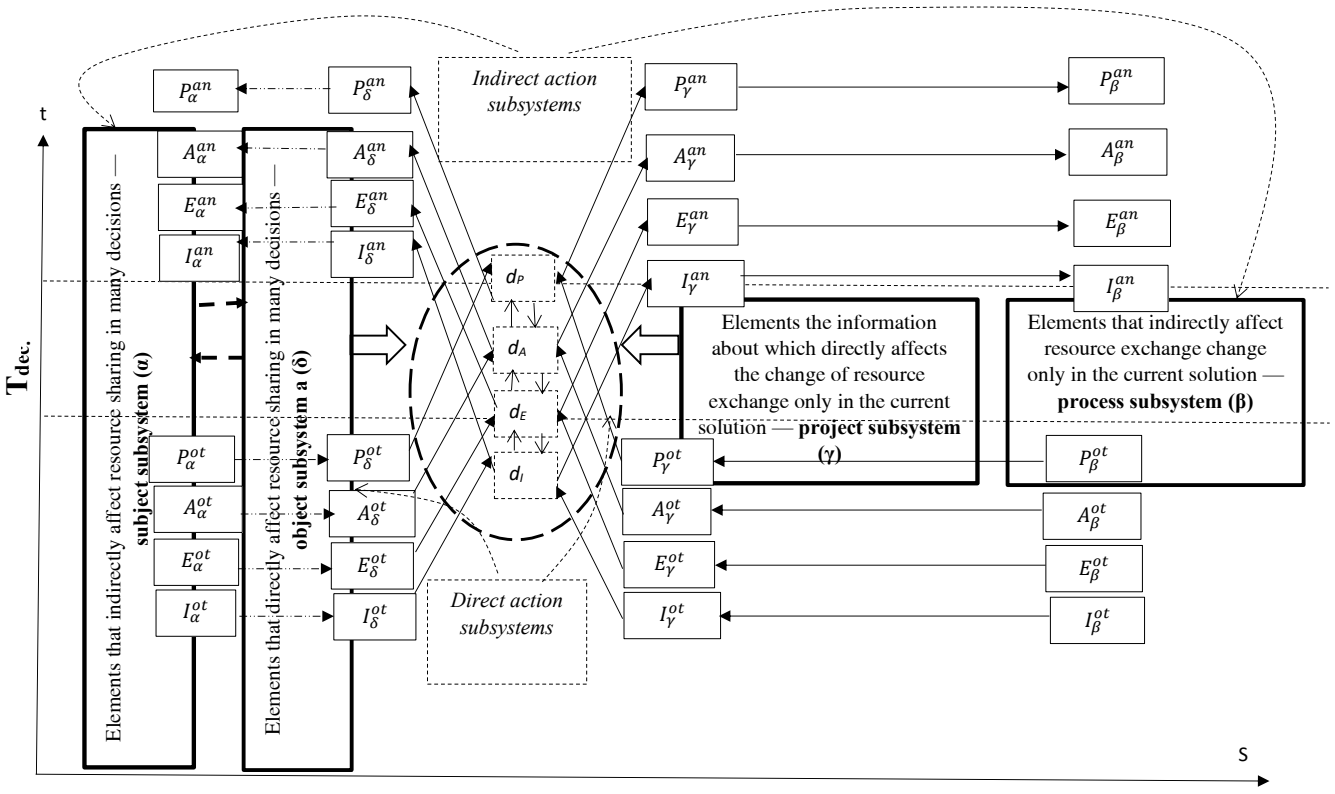

Fig. 2. **Area of Creating Phenomenological Model During Managerial Decision-Making in the Economic Systems**

Source: Compiled by the authors.

$$\begin{cases} \dfrac{\Delta P_{\delta}^{an} + g_P\left(d_A, d_E, d_I\right)}{\Delta P_{\alpha}^{an}} + \dfrac{\Delta P_{\gamma}^{an} + g_P\left(d_A, d_E, d_I\right)}{\Delta P_{\beta}^{an}} = \dfrac{\sum_{i=2}^{n}\left(\dfrac{\Delta P_{\delta}^{ot.i}}{\Delta P_{\alpha}^{\partial p.ii}} + \dfrac{\Delta P_{\gamma}^{ot.i}}{\Delta P_{\beta}^{\cdot}}\right)}{n-1} \\ \dfrac{\Delta A_{\delta}^{an} + g_A\left(d_P, d_E, d_I\right)}{\Delta A_{\alpha}^{an}} + \dfrac{\Delta A_{\gamma}^{np} + g_A\left(d_P, d_E, d_I\right)}{\Delta A_{\beta}^{an}} = \dfrac{\sum_{i=2}^{n}\left(\dfrac{\Delta A_{\delta}^{ot.i}}{\Delta A_{\alpha}^{ot.i}} + \dfrac{\Delta A_{\gamma}^{ot.i}}{\Delta A_{\beta}^{ot.i}}\right)}{n-1} \\ \dfrac{\Delta E_{\delta}^{an} + g_E\left(d_P, d_A, d_I\right)}{\Delta E_{\alpha}^{an}} + \dfrac{\Delta E_{\gamma}^{an} + g_E\left(d_P, d_A, d_I\right)}{\Delta E_{\beta}^{an}} = \dfrac{\sum_{i=2}^{n}\left(\dfrac{\Delta E_{\delta}^{ot.i}}{\Delta E_{\alpha}^{ot.i}} + \dfrac{\Delta E_{\gamma}^{ot.i}}{\Delta E_{\beta}^{ot.i}}\right)}{n-1} \\ \dfrac{\Delta I_{\delta}^{an} + g_I\left(d_P, d_A, d_E\right)}{\Delta I_{\alpha}^{an}} + \dfrac{\Delta I_{\gamma}^{an} + g_I\left(d_P, d_A, d_E\right)}{\Delta I_{\beta}^{an}} = \dfrac{\sum_{i=2}^{n}\left(\dfrac{\Delta I_{\delta}^{ot.i}}{\Delta I_{\alpha}^{ot.i}} + \dfrac{\Delta I_{\gamma}^{ot.i}}{\Delta I_{\beta}^{ot.i}}\right)}{n-1} \end{cases}$$

Details of the conclusion of this formula are contained in the paper [15]. Further considered questions of its practical application. The main point of the phenomenological model is that in the absence of full knowledge of the factors influencing the problem to be solved, the controlling subject must make the parameters of the system such that they are not very different from those what was before the solution, and the system as a whole retained the existing trajectory of development and did not come to collapse. This approach has shown its effectiveness in making decisions in Russian commercial banks about crediting enterprises in situations where it is difficult to identify the mechanisms of influence of all factors (including ESG) on the state of their business.

Example. In 2014–2017, the branch of the Investment Trade Bank in Kazan credited the work on the refinery complex "Tatneft" to create and implement a new progressive technology — heavy residue conversion (HRC) of refined oil. At the end of the planned period, it became apparent that further R&D was required. The enterprise appealed to the lending bank for additional cash resources, and the management of the bank faced a non-trivial task of developing a decision on the parameters for issuing a new loan. Because there is insufficient information to understand in depth how all environmental, social and management factors affect the outcome of R&D credits. To develop a solution, a phenomenological model of a solvable problem situation was applied, where indicators of resource exchange acquire economic meaning, presented in the *Table 2*.

Based on the model, the following banking solution parameters were calculated: to issue a loan to "Tatneft" enterprise in the amount of 500 million rubles for 20% of annual interest for 12 months, as a pledge the enterprise should provide fixed assets worth 200 million rubles. Throughout the year there was debt service, and at the beginning of 2019 "Tatneft" completely repaid it. Both the bank and the enterprise the issuance of this loan allowed to increase the performance of their activity.

CONCLUSION

Factors related to the environmental, social and managerial components of enterprises' business play an increasingly important role, but there is currently no formalized and unified tools for their accounting during the lending of enterprises by banks. This is particularly difficult for domestic commercial

Table 2

Indicators of Phenomenological Model Used in Making-Decision on Crediting the Activities of "Tatnefteproduct" Provided with Creating Deep Processing of Heavy Residues

Resource exchange type Subsystem	*P*	*A*	*E*	*I*
Subject (α)	*P*α: total loan portfolio of the banking system (TLP_{bs})	*A*α: base interest rate (BIR)	*E*α: average weighted loan period in the banking system (AWL_{bs})	*I*α: level of collateral coverage in the banking system (LCV_{bs})
Object (δ)	*P*δ: loan portfolio of the bank- creditor (LP_{bc})	*A*δ: profitability of bank- creditor loans $(Pr_{bc} = \frac{IL_b}{LP_{bs}})$, where IL_b – loan bank interest money	*E*δ: weighted average period of bank-lender loans $(\frac{\sum_{i=1}^{k} AmCr_i * AvCr_i}{LP_{bs}})$, k – number of loans in the bank's portfolio	*I*δ: loan bank collateral level $(\frac{Db}{LP_{bs}})$, where D_b – value of all loan bank deposits
Project (γ)	*P*γ: enterprise borrower output (E_{bo})	*A*γ: gross profit of the borrowing enterprise (GP_{be})	*E*γ: contract duration remaining with the counterparties (CDM_0)	*I*γ: value of all fixed assets of the borrower enterprise (FA_b)
Process (β)	*P*β: enterprise debt to banks (ED_b)	*A*β: interest paid by the borrowing enterprise (IP_{be})	*E*β: weighted average duration of use of loans by the borrowing enterprise $(\frac{\sum_{i=1}^{m} AmL_i * AvL_i}{ED_b})$, m – enterprise credit number	*I*β: Value of the borrower's fixed assets (VFA_b)
Rate of change in resource exchange	P_{ch}: credit amount (Am_{cr})	*A*ch: loan interest rate (L_{ir})	E_{ch}: loan term (L_t)	*I*ch: loan collateral value (C)

Source: Compiled by the authors.

banks and their corporate borrowers due to many historical backgrounds.

Thus, the study conducted a formalized complex analysis of the role and place of ESG-risks in the overall risk landscape and integration of ESG-risk factors into credit risk assessment. Adaptation of the general methodology of construction of phenomenological models to the description of crediting processes by commercial banks

of enterprises under the conditions of ESG-factors was carried out and basic principles of phenomenological modeling of bank-enterprise interaction were formulated the borrower under the conditions of ESG-factors. As a result, an algorithm of substantiation of decisions on lending by banks of corporate clients with consideration of ESG-factors influencing their activity was developed.

Phenomenological modeling has demonstrated its effectiveness in substantiating the decisions of domestic banks to credit enterprises under the conditions of complex and poorly formalized factors. From this point of view, our paper contributes to the development of ESG-practice in the banking sector, offering a theoretical and methodological basis for the effective integration of ESG-factors in the analysis of creditworthiness of customers under the conditions of growth of turbulence of the domestic economy.

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ABOUT THE AUTHORS

Marat F. Gumerov — Dr. Sci. (Econ.), Prof., Department of Digital Economy, Management and Business Technologies, Moscow Technical University of Communications and Informatics, Moscow, Russia
https://orcid.org/0000-0002-6886-0192
m.f.gumerov.kki@mail.ru

Irina A. Rizvanova — Cand. Sci. (Econ.), Senior Lecturer, Department of Banking and Monetary Regulation, Faculty of Finance, Financial University, Moscow, Russia
https://orcid.org/0000-0001-9238-0247
Corresponding author:
iarizvanova@ya.ru

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Assessment of the Characteristics, Scopes and Limits of the Application of Digital Innovations in the Financial Sector

E.S. Zeleneva
Financial University, Moscow, Russia

ABSTRACT

The overall degree of financial development of the State depends on innovative development of the financial sector. In this regard, it is important to conduct a comprehensive assessment of the characteristics, scopes and limits of the application of digital financial innovations both at the State level and at the global level, which determines **the relevance** of the research topic. **The aim** of the research is to develop an approach to assessment of the characteristics, scopes and limits of digital innovations in the financial sector and its approbation of the approach by the example of Russia. At the theoretical level, **the method** of literature analysis, abstraction and aggregation are used in the research. At the empirical level, **methods** of statistical, structural and coefficient analysis are applied. **The results** of the research in terms of the development of the theory of innovation in the financial sector are development of an approach to assessment of the characteristics and scope of digital innovation in the financial sector, to allow a comprehensive assessment of the development of financial innovation at the State level and comparison of the assessment results by country or with the world average values of the indicators proposed for assessment. The paper also proposes classifications of scopes and limits for the use of digital financial technologies, which allow for a qualitative analysis of the integrated development of financial innovations. Empirical research has allowed us to make **conclusions** about the accelerated development of the Russian financial technology market compared to the world average values based on the developed theoretical approach. At the same time, the problems of further development of financial innovations have been identified, namely, the low level of trust of the Russian population in small businesses in the field of financial technologies, limiting the inflow of foreign investment and narrowing the external market for the dissemination of Russian financial innovations in conditions of political instability. The following measures are proposed to solve these problems: improving the quality of education and improving the working conditions of specialists in the field of innovations, developing programs for concessional lending to small businesses in the field of financial technologies, and improving the financial literacy of the population as a consumer of innovative financial services.

Keywords: digital innovations; financial sector; financial technology risks; financial technology frontiers; financial literacy

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INTRODUCTION

Government financial development depends on the scale of the penetration of digital innovations into the financial sector. The authors use a variety of methods that consider the availability of financial services to the public and businesses when assessing the level of financial development in countries. [1–3]. This level of financial services availability is strongly influenced by the digitalization process [4]. Availability of financial services using the fintech-index is already assessed in the scientific literature [5]. In this regard, the role of digital innovation in the financial sector is significant.

However, the impact of digital technologies on the financial sector can be both positive and negative due to the formation of a number of risks and uneven development of financial industries. Moreover, the positive impact of digitization on the financial sector may be limited by external and domestic factors. All this indicates about the need to systematize and assess the characteristics, scope and limits of the application of digital technologies in the financial sector and determines the relevance of the research.

LITERATURE REVIEW

A unified approach to assessing the characteristics, scope and boundaries of digital innovation in the financial sector is not currently developed. However, the researchers dedicate

their paper to digital and financial innovation. These papers can be divided into three groups.

The first group focuses on the impact of digital financial innovation on macro and microeconomic indicators. J. Li and etc. [6] cite evidence that digital inclusive finance can stimulate household consumption. S.N.M. Daud and etc. [7] come to the conclusion that financial technology contributes to financial stability through artificial intelligence. P.K. Ozili [8] pays attention to the impact of the digitalization of the financial sector on the economic development of the government in its work. At the micro level, the impact of digitalization on the financial results of organizations studied by V.A. Cherkasova and G.A. Slepushenko [9]. Researchers provide evidence of the positive impact of digitalization on the operational companies' efficiency. A number of studies [10–12] prove that digitalization of financing has a significant impact on sustainable employment.

Summarizing the results of the analysis of the literature of the first group, it can be concluded that there is no unified understanding of the process of digitalization of the financial sector, market [6–8], digital availability of financial services [10], and digitalizing the economy as a whole [9, 11, 12] is analyzed to assess the impact of digital finance on economic performance. Need to develop a general approach to assessing the performance of digital innovation in the financial sector.

The second group includes research of digital development in various financial spheres.

Digitalization in the banking sector described by M. Jünger and M. Mietzner [13]. The authors prove that digital development of banking services is based on consumer confidence, their level of financial literacy, as well as transparency of fintech banking. V. Murinde and etc. [14] explore the possibility of replacing classic banks with fintech-startups. A. Boot and etc. [15] analyze possible directions of transformation of banking activity as digital technologies are implemented.

The evolution of the payment system in terms of digitalization is described by R.H. Salazar [16]. The author points to the need for proper regulation of the digital payment system from the government. A.L. Prete [17] has dedicated to research the relationship of digital payments with the financial and digital literacy of the population.

Q. Wang [18] analyses the impact of digital technologies on the insurance industry in its research and concludes that digitalization provides a solid basis for insurance industry supervision and development. S. Kaffash and etc. [19] are investigated the efficiency factors of insurance companies, which include innovative technologies.

The review of the second group shows that the authors analyze the degree of impact of innovative technologies on the development of the financial industry, but we do not find any papers on the question of the uneven digitalization of financial industries. Digital development of one financial industry makes it impossible to understand the general innovative financial development of government. Hence the need to develop an approach to assessing digital innovation in the financial sector.

The third group discusses the risks of introducing innovative technologies in the financial sector.

P. Yue and etc. [20] prove that digitalization of the financial sector multiplies the risks of households falling into the debt trap. About the security risks of digital payments wrote N. Shaw and etc. [21]. Country analysis conducted by researchers showed that privacy concerns and payment security risks vary as innovations develop depending on country. O. Akanfe and etc. [22] come to similar conclusions and provide recommendations for assessing privacy risks at the national level. The systemic risk of fintech-companies is investigated by S.M. Chaudhry and etc. [23]. The authors argue that the activities of fintech-companies are riskier than the activities of classical financial organizations, therefore, require strict regulation in order to minimize systemic risk.

The analysis of the third group of paper also shows a lack of a general approach to the

identification of financial technology risks. In addition, the authors do not pay attention to the limits of innovative technologies in the financial sector. Hence the importance and necessity of systematizing the risks of financial technology development, and defining the limits of innovation in the financial sector at both the macro and micro levels

Thus, a review of the literature shows that there is no general approach to the analysis of the characteristics, scope and limits of financial innovation at the macro level. These studies are aimed at analyzing the scope of application of innovative technologies in the financial industry, studying the characteristics and risks in the selected sphere. So, there is the problem of understanding the overall structure of digital technologies in the financial sector, its characteristics at the level of countries and limits of development. This allows us to conclude the need to systematize the characteristics, scope and limits of digital innovation in the financial sector, as well as the development of an approach to their evaluation.

ASSESSMENT OF APPLICATION THE FINANCIAL TECHNOLOGY

Digital innovation in the financial sector have led to a new fintech industry in the financial system of governments. Bank of Russia hold this position and describes the use of digital financial innovations by the term "Financial technologies" or "Fintech".[1] Analysts assess the financial technology market based on the total assets of fintech-companies. Thus, according to the forecast of Pichbuk,[2] by 2024 the global market of financial technologies will grow to 221 mln USD. It follows that volume of assets of the fintech market is a significant characteristic of its development.

The financial technology market is fast growing and innovative, and is developing through the inflow of foreign and domestic investment in the industry. Correlation analysis shows a direct, strong correlation of indicators of the volume of the Russian fintech-market and investments in it: correlation coefficient is 0.96. Consequently, the dynamics of investment in the fintech-market is also a characteristic of the general development of innovation in the financial sector on a government level.

In this regard, there are two main quantitative characteristics of the general development of the financial technologies' market on a government level: the volume of fintech-market, measured by the assets of the sector, and the volume of investment in the sector of financial technologies. These characteristics show the dynamics of the industry at the country level, but do not allow a comparison of the level of financial development of governments. Thus, we can calculate the relative indicators of the development of the fintech market, on the basis of which it is possible to measure the development of financial technologies of various countries, as well as to assess the level of development of the fintech market of government in comparison with the average world values, based on quantitative characteristics. We propose an approach to assess the characteristics of financial technology development based on the relative indicators given in the *Table*.

We propose a system of indicators that assess the volume markets of the financial technology and investment in the fintech-industry as% of GDP, which is the main indicator of economic growth on the government. Calculation of indicators relative to GDP allows to get economic coverage of the market of financial technologies. Comparison of the obtained indicators by countries and/or with world averages allows to assess the conformity of the level of development of financial technologies to the general economic development of the country.

To illustrate, let's make a calculation of proposed indicators for Russia and at the world level. Comparison of indicators for Russia with world indicators will allow to assess the characteristics of the Russian fintech-market

[1] Development of financial technologies. Bank of Russia: official website. URL: https://cbr.ru/fintech/ (accessed on 20.04.2022).

[2] Pitchbook. Analytics: official website. URL: https://pitchbook.com/news/reports/2021-annual-fintech-report (accessed on 20.04.2022).

Table

Relative Indicators for Assessing the Characteristics of the Development of the Financial Technology Market

The name of the indicator	Calculation formula
Economic coverage of the fintech-market, % of GDP	Fintech-market volume / GDP
Economic coverage of investment in the fintech-industry, % of GDP	Fintech- industry volume / GDP
Market share of government' financial technology in the world market	Government fintech-market volume / World fintech-market volume

Source: Compiled by the author.

in comparison with the world average in the dynamics (*Fig. 1, 2*).

As seen in *Fig. 1* and *Fig. 2*, the Russian market of financial technologies is growing faster than the global fintech market. In addition, the volume of investment in the sector of financial technologies in Russia is developing with more growth than the volume of the fintech-market. Thus, the economic coverage of the fintech market in Russia exceeded the economic coverage of the global market of financial technologies in 2016 by 7.8 times, and in 2020 — by 10.6 times. At the same time, the growth rate of the global fintech-market for five years remains at about 20%, while the growth rate of the Russian financial technology market more than doubled in five years, namely from 13 to 28%. Due to the high growth rate of the market of financial technologies in Russia, the Russian market share in the global fintech market is growing, which increased from 13.29 to 18.51% in 2016–2020.

Higher growth rates of the Russian fintech-market and increase in its share in the world can be associated with accelerated investment in the industry. Thus, the volume of investment in innovative financial technologies in Russia as a% of GDP in 2016 corresponded to the global average. At the same time, investments in the sector of financial technologies in Russia have been increasing annually and since 2017 are ahead of global investments, characterized by mixed dynamics. This helped accelerate the development of the Russian financial innovation sector.

However, despite the accelerated development of the fintech-industry, the Russian market share in the world as of 2020 is only 18.51%. Russia's fintech-market is not the largest, second to China (more than 40%) and the US (more than 47%).[3] To increase the share of the Russian market of financial technologies should contribute to investment in the fintech industry, as well as to improving the quality of IT-education, improving the working conditions of specialists in IT, increasing public confidence in financial technologies, improving the welfare of the population and the profitability of fintech services consumers.

Thus, indicators of the characteristics of the development of innovative technologies in the financial sector in Russia are increasing at an accelerated rate compared to the global average and significantly exceed them from 2017, which suggests a significant level of economic coverage of Russian financial technologies.

ASSESSMENT OF APPLICATION AREAS OF THE FINANCIAL TECHNOLOGY

Assessment of the characteristics of the development of the market of financial technologies allows to compare the overall level of development of this market with the values in other governments and global averages. A comparison of innovative financial development

[3] Market of innovative financial technologies and services — 2019. HSE. URL: https://dcenter.hse.ru/data/2019/12/09/1523584041/Рынок%20финансовых%20технологий-2019.pdf (accessed on 20.04.2022).

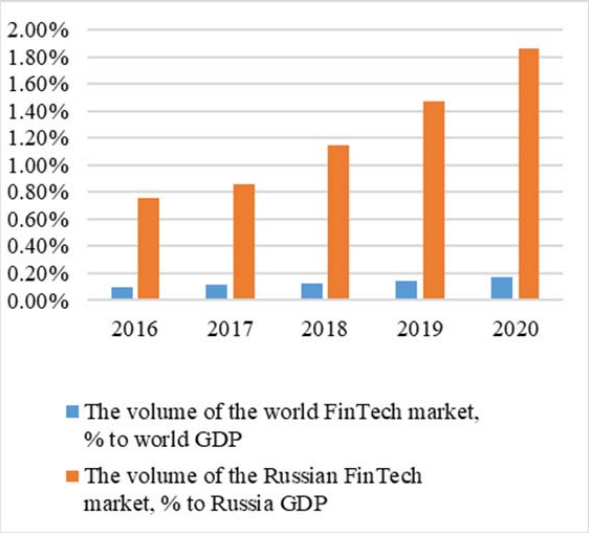

Fig. 1. **Economic Coverage of the Financial Technology Market in 2016–2020**

Source: Compiled by the author based on Pitchbook data. URL: https://pitchbook.com/news/reports/2021-annual-fintech-report (accessed on 20.04.2022).

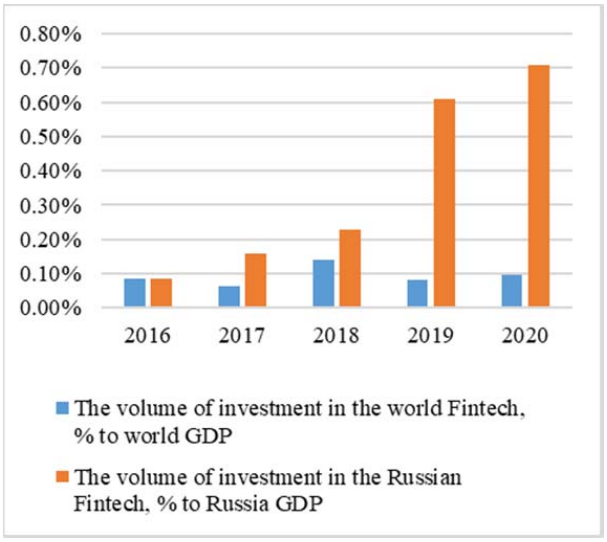

Fig. 2. **Economic Coverage of Investments in Financial Technologies in 2016–2020**

Source: Compiled by the author based on Pitchbook data. URL: https://pitchbook.com/news/reports/2021-annual-fintech-report (accessed on 20.04.2022).

of countries is possible not only on the basis of indicators of market characteristics, but also on the basis of an assessment of the development of innovative technologies in the financial sector.

Financial technologies are introduced in all sectors of the financial system of the state, so we provide a classification of the scope of innovation in the financial sector (*Fig. 3*).

Assessment of financial technology applications is possible using structural analysis of the fintech-market at the country and world level. Assessment of the application of innovative technologies in the financial sector will be carried out in order to compare the shares of the government from the share of the world and to identify the causes and factors of identified deviations.

Here is a structural analysis of existing fintech-services companies in Russia and the world, using statistics on the number of fintech-companies providing services in each area (*Fig. 4, 5*).

Figures 7 and *8* show that in Russia, as in the world, about 50% of fintech companies offer services for lending, asset management, payments and transfers. While the share of innovative lending in Russia is almost half less than in the world. Similarly, the share of banking in Russia is significantly lower than the global value. This is due to the high barriers to entry into the banking industry that have developed in Russia: more than 90% of assets of the banking sector are concentrated in the ten largest credit organizations, which have the highest level of public confidence.[4] The further development of small fintech business in the areas of credit and banking should be accompanied by an increase in the level of digital and financial literacy of the population of Russia, the development of legal regulation of the market of financial technologies, which helps to increase the level of trust of the public and business to Russian fintech-companies in the sphere of lending and banking.

In addition, it is necessary to develop the introduction of innovative technologies in the activities of Russian commercial banks, which have a high level of public and business confidence, and which are characterized by a large volume of assets for investment in the sector of financial technology. According to 2022 data, 60 fintech-companies provide high-

[4] Imaeva G.R., Aimaletdinov T.A., Sharova O.A. Russian financial services market // Sociologiya. Statistika.Publikatsii. Otrasleviye obzory. Vol. 8(12). NAFI Analytical center. Moscow: Publishers NAFI; 2017. 45 p.

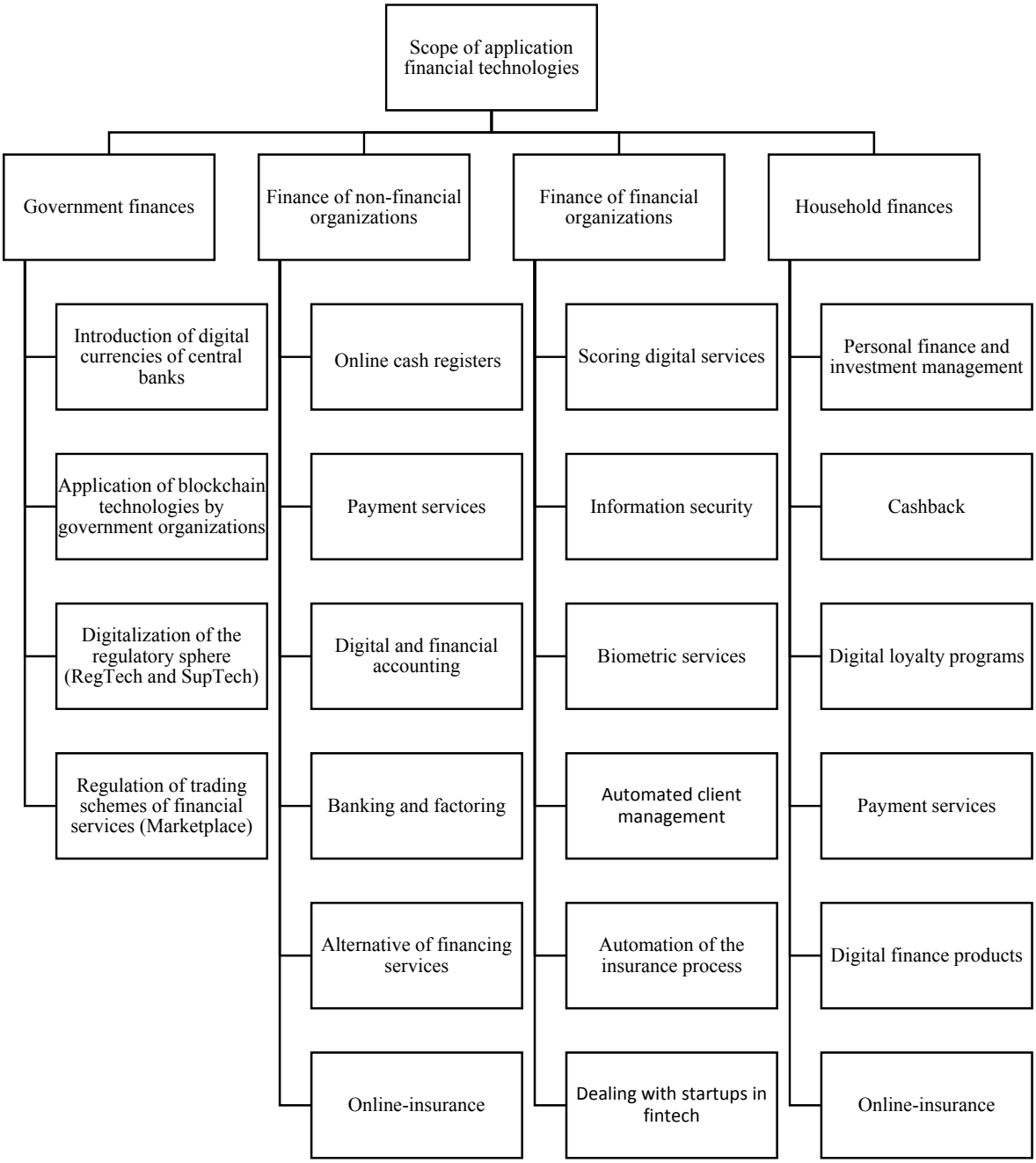

Fig. 3. **Scopes of Application of Digital Innovations in the Financial Sector**

Source: Compiled by the author based on data from the Bank of Russia and Rusbase. URL: https://cbr.ru/fintech/; URL: https://rb.ru/fintech-otkrytye-innovacii-v-bankah/#startlogo (accessed on 20.04.2022).

tech services for credit organizations in Russia, and 15 commercial banks actively cooperate with fintech-startups, providing them with additional financing, pilot site, sales channels and access to infrastructure.[5] Increase in the number of Russian banks interacting with fintech-companies may contribute to complete transition to digital banking model in Russia.

Application of high-tech services in the public finance sector can also have a positive impact on the overall financial development of the government. An important direction of innovative development of public finance is the

[5] Map of the Russian market FinTech. Rusbase: official website. URL: https://rb.ru/fintech-otkrytye-innovacii-v-bankah/#startlogo (accessed on 20.04.2022).

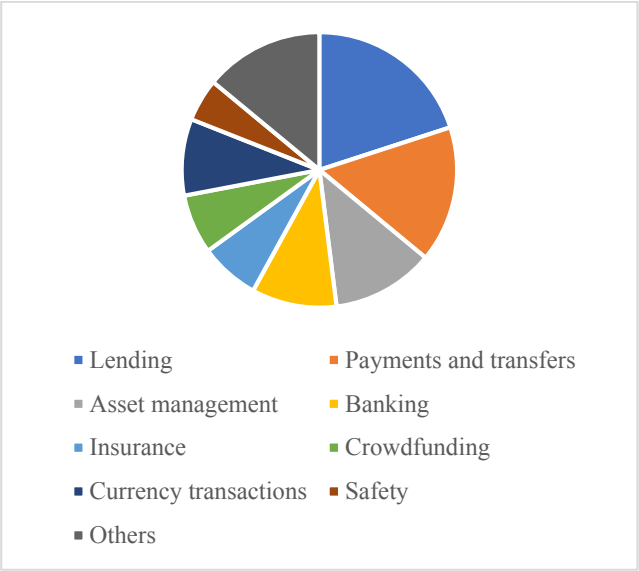

Fig. 4. **Distribution of Fintech Companies by Scopes of Innovative Services in the World**

Source: Compiled by the author based on data from the Higher School of Economics. URL: https://dcenter.hse.ru/data/2019/12/09/1523584041/Рынок%20финансовых%20технологий-2019.pdf (accessed on 20.04.2022).

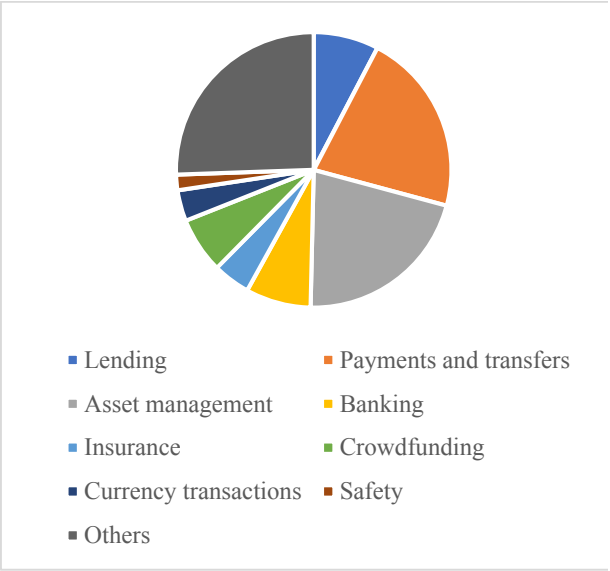

Fig. 5. **Distribution of fintech companies by Scopes of innovative services in Russia**

Source: Compiled by the author based on data from the Rusbase. URL: https://rb.ru/fintech-otkrytye-innovacii-v-bankah/#startlogo (accessed on 20.04.2022).

introduction of the digital currency of the central bank based on blockchain technology as a new form of money for the development of payment services and the emergence of new digital financial services. This will lead to increased competition in the financial technology industry and a significant improvement in the quality and cost of fintech services, as well as to overall digital development of the financial sector.

Blockchain technologies are used at the national level not only to create and use digital currencies of central banks, but also to automate the collection, storage and processing of big data in the field of government and municipal government. Automation of these processes allows to optimize the expenditures of the federal, regional and municipal budget on the government and municipal administration, that is, has a positive impact on the development of public finance.

In order to improve the quality of supervision and control over financial organizations, regulators use SupTech-solutions, which allow to automate and accelerate the process of analysis of compliance with regulatory requirements by financial market participants. At the same time, RegTech-solutions are used to simplify and automate the implementation of regulatory requirements by financial institutions. 6 SupTech- and RegTech-projects are already under implementation in Russia, and 7 projects are under development.[6]

Innovative technologies in the public finance sector are also used in the creation of marketplaces — platforms that unite retailers and consumers of financial services. Russian "Market Place" can contribute to the growth of competition in banking, credit, insurance, pension, investment markets, to reduce the costs of financial service providers, increase the benefits of their consumers, as well as automation and simplification of regulation of the financial system by the Bank of Russia.

THE LIMITS OF DIGITAL INNOVATION IN THE FINANCIAL SECTOR

The limits of innovative financial sector development are difficult to quantify, but it

[6] Development of financial technologies. Bank of Russia: official website. URL: https://cbr.ru/fintech/ (accessed on 20.04.2022).

is possible to make qualitative assessments by identifying trends in the expansion or narrowing of these limits. On the basis of the described trends, it is possible to emphasize further directions of development of financial technologies. While financial technology boundaries are not described or classified in the literature, we propose author's classification of microeconomic and macroeconomic limits (*Fig. 6*).

The microeconomic limits of innovation in the financial sector exist at the level of fintech companies and financial institutions implementing innovative technologies. Macroeconomic boundaries may arise from insufficient regulation of innovation by financial companies, with limited domestic investment in the financial technology industry.

Ehe development of the Russian fintech industry in 2022 faced political and economic sanctions from unfriendly governments, which limit the external market for the spread of Russian financial technologies, and reduce the flow of foreign investment in innovation to the Russian financial sector. External limits also hinder the general economic development of Russia, with a narrowing impact on the internal limits of the development of financial technologies. Thus, according to Bank of Russia forecasts in 2022, as a result of the sanctions, the decline in GDP may be 8–10%.[7] This, in turn, can lead to reduced consumer welfare for fintech-services. On the other hand, as a result of the economic sanctions, there is an outflow of foreign competitors from the Russian market of financial innovations, which leads to an increase in domestic demand for fintech-services of domestic companies and can contribute to the expansion of internal limits of Russian financial technologies in the long-term, provided that further investment in the industry.

It is important to note the expansion of the macroeconomic boundaries of financial innovations represented by the level of training of fintech-specialists. Since 2017, Russian universities develop and implement educational programs for the training of fintech-specialists. In addition, professional standards "Specialist in information (cyber) security" and "Specialist in the field of financial technologies",[8] are developed, which are necessary for the expanded launch of university fintech-programs.

Thus, despite the foreign policy and foreign economic constraints, in Russia there is an expansion of the macro- and microeconomic limits of the development of innovative technologies in the financial sector. This positive trend will continue in the future provided that further investment in the fintech-industry and the development of the education system of fintech-specialists.

CONCLUSION

Development of innovative technologies in the financial sector is a significant factor of financial development of the government. In order to identify the directions of further development of the fintech market, it is important to assess the characteristics, scope and limits of financial technologies. In the result of the study provides quantitative indicators of the characteristics of the application of financial innovations, taking into account the volume of fintech market in the government and the volume of investments in the development of financial technologies. Based on the proposed indicators, an assessment of the development of the Russian fintech market in comparison with the global average. The results of the analysis showed the accelerated development of financial technologies in Russia and the existence of prospects for development through increased investment in financial technology, improving the quality of education of fintech specialists and improving working conditions, as well as improving the welfare of the population and the profitability of industries — consumers of fintech services.

[7] Statement by the Chairman of the Bank of Russia E. Nabiullina on the results of the meeting of the Board of Directors of the Bank of Russia on 29 April 2022. Bank of Russia. URL: https://cbr.ru/press/event/?id=12857 (accessed on 20.04.2022).

[8] Market of innovative financial technologies and services — 2019. HSE. URL: https://dcenter.hse.ru/data/2019/12/09/1523584041/Рынок%20финансовых%20технологий-2019.pdf (accessed on 20.04.2022).

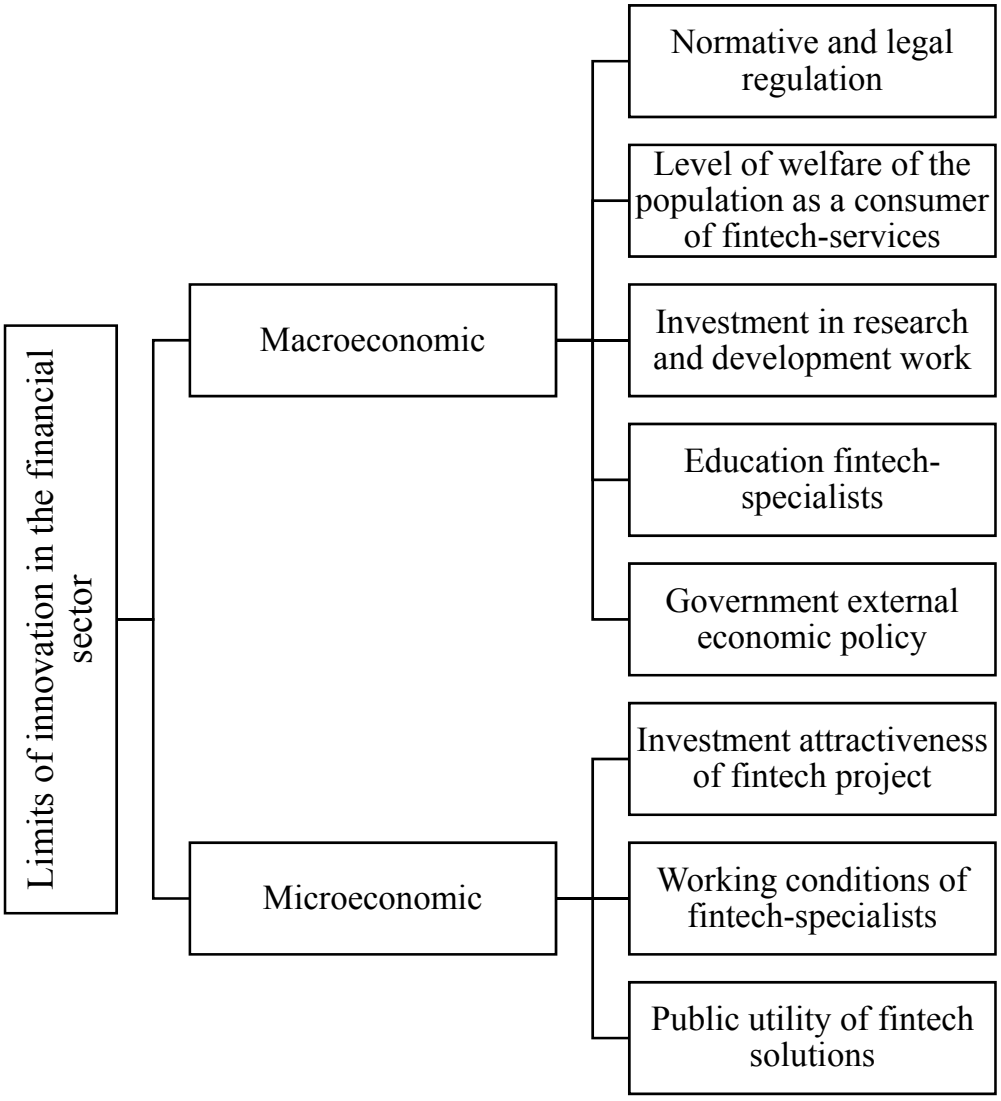

Fig. 6. **Classification of the Limits of Innovation in the Financial Sector**

Source: Compiled by the author.

The paper also systematizes the scope of application of innovative technologies based on the sectors of the financial system of the state, which represents the theoretical importance. It is proposed to conduct structural analysis of the industry and identify significant deviations from the structure of the global market of financial technologies to assess the selected areas of innovation in the financial sector. This analysis allows assessing the causes of structural deviations in the development of financial technologies in the government from global trends. Approbation of the approach on the data for Russia has revealed the problem of insufficient development of competition in the field of banking and credit financial technologies. As a solution to this problem is considered the need to further increase the financial literacy of the population of Russia and the development of legal regulation of the sector of financial technologies in order to increase confidence in fintech-startups.

As a result of researches, the limits of financial innovation are classified, which can only be assessed at a qualitative level by identifying the trends of narrowing or expanding the limits considered in the classification. Qualitative analysis of the limits of financial technologies in Russia showed prospects of expanding the limits of financial innovations, despite political

instability. This expansion will be facilitated by the inflow of domestic investment and an increase in the level of education of fintech-specialists.

In the framework of development of the flow of investment in financial technologies, the Bank of Russia should continue to develop programmes of preferential lending of innovative financial projects together with the Ministry of Economic Development and the Small and Medium-Sized Enterprise Corporation. It is also recommended to expand the list of fintech-services whose projects can be implemented in regulatory "sandboxes", in order to increase the confidence of potential investors to these projects.

To implement the direction of improving the quality of training of fintech-specialists it is necessary to increase the number of target places in the leading universities of the country in training programs related to financial technologies and data analysis. In order to retrain skilled IT-specialists and financiers, it is recommended to develop additional professional education programs in terms of increasing their accessibility to potential listeners and practical applicability. It is recommended to create a unified Russian platform of courses on financial technologies, similar to the platform "Marketplace", which will unite courses of universities and organizations of additional professional education. Use of this platform will simplify the search for the required course, will allow comparing the cost of programs and learning conditions. It will also contribute to competition in the market of financial technology courses, which should improve their quality.

Thus, the study is of theoretical and practical significance in assessing the characteristics, scope and limits of innovation in the financial sector and identifying problems and solutions regarding the further development of financial technologies at the national level.

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ABOUT THE AUTHOR

Elena S. Zeleneva — Assistant of the Department of Banking and Monetary Regulation, Financial University, Moscow, Russia
https://orcid.org/0000-0003-0892-6070
eszeleneva@fa.ru

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ORIGINAL PAPER

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JEL G15, F21, C58

Volatility of Returns in Stock Market Investments: A Study of BRICS Nations

Natasha Pankunni[a], **S. Rajitha Kumar**[b]
[a] University of Calicut, Malappuram, Kerala, India;
[b] Cochin University of Science and Technology, Kochi, Kerala, India

ABSTRACT

Fluctuations in returns from investment in stocks make these risky. This factor should be kept in mind in stock investment decisions, which determines the relevance of this research. Through the study, the volatility in the stock returns of BRICS nations is analysed for inferring on the riskiness associated with investing in the respective nations, which is the **aim** of the research. For this study, the daily returns of five indexes representing each of the nation namely Ibovespa (Brazil), Moex (Russia), Nifty 50 (India), Hang Seng Index (HSI, China), and FTSE/JSE All Share Index (JALSH, South Africa) for a period of 14 years are collected and analysed. Both unconditional and conditional volatility in returns is analysed for each of the nations for imparting clearer and more comprehensive picture of the volatility in returns. Such an in-depth and long period analysis of volatility of the returns of the emerging BRICS economies is a **novelty** of the research that determined that no volatility model can be said as perfect for all economies for all time. The GARCH (1, 1) model was used to study for the returns of all the five indexes. The **results** of the study point out that the daily returns of all these indexes are heteroscedastic, implying presence of varying variance. Accordingly, the study **concludes** that the BRICS nations' index returns are more volatile and riskier, and authors are **recommended** to invest in those indexes with lesser conditional volatility.

Keywords: BRICS; risk; stock return; volatility forecasting; volatility of stock

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INTRODUCTION

Investment in stock market is one of the decisions that one takes with at most diligence. It is because of the inherent nature of risk in investing in equity. Among the investment avenues, equity investment can be considered as the riskiest as there is higher uncertainty in its returns. The return expected from equity and the actual return may vary, since the future is uncertain. If the actual return is same as the expected return, then the investor is satisfied. In other case, if the actual return is greater than what is expected, then the investor is overwhelmed with gain. However, if the actual return is less than the expected return, the investor faces loss. Thus, the uncertainty that the actual return can be less than the expected return is called the risk in investment.

One significant factor that contributes to this risk is the volatility in the returns. Volatility is usually termed as the degree of variation in the stock prices. The volatility may be positive/negative, normal/abnormal or conditional/unconditional. When volatility leads to rise in returns, then it is positive volatility. On the other hand, if volatility leads to fall in returns, it is negative volatility. Abnormal volatility happens as a consequence of any abnormal events that can affect the stock market.

Unconditional volatility refers to the fluctuations in the returns that are not dependent or conditional upon any other factors and it can be measured through the standard deviation and variance. Conditional volatility means that the variance of the returns is conditional to its past residuals or its own past variance. In that case, the variance calculated assuming unconditional volatility would not suffice to measure the actual volatility. This conditional variance is what the investors are more concerned about. Hence, it is the aspect of conditional variance that should be addressed and studied.

SIGNIFICANCE OF THE RESEARCH

In the present research an attempt is made to analyse the volatility patterns of the returns on investments in stock markets in the BRICS nations. The BRICS are the association of the five emerging economies of the Federative Republic of Brazil, the Russian Federation, the Republic of India, the People's

Republic of China and the Republic of South Africa. The first BRICS summit held in 2009 laid down the goals of the BRIC as "to promote dialogue and cooperation among our countries in an incremental, proactive, pragmatic, open and transparent way. The dialogue and cooperation of the BRIC countries is conducive not only to serving common interests of emerging market economies and developing countries, but also to build a harmonious world of lasting peace and common prosperity"[1]. The rationale for selecting BRICS nations is because of the fact that, they contribute considerably to the global economy. While considering Gross Domestic Product (GDP) in 2013, BRICS contributed about 27% of the global GDP.[2] The five BRICS nations together constitute a major part of the world population. It is 42% of the world population in 2013. Thus, deciding upon a stock investment in BRICS nations based on the risk involved in it, which in turn can be inferred through volatility analysis constitutes both the significance and scope of this research. The volatility analysis of stock returns involves the analysis of both conditional and unconditional variance of the daily returns of the selected stock indexes.

Stock indexes representing BRICS nations for a period of fourteen years were collected and used for analysis in this research. The indexes representing BRICS nations selected for the study include Ibovespa (Brazil), Moex (Russia), Nifty 50 (India), Hang Seng Index [HSI (China)], and FTSE/JSE All Share Index (JALSH, South Africa).

REVIEW OF LITERATURE

Various academicians all over the world have contributed to the literature related to volatility of returns. R.F. Officer studied the 1930s high volatility stressing on leverage effect along with the volatility of industrial production [1]. R. Merton introduced an inter-temporal Capital Asset Pricing Model (CAPM) giving due consideration to the volatility in the assets [2]. However, traditional volatility measures assumed constant variance and various econometric methods were developed based on it.

It was then that R.F. Engle introduced a new set of stochastic processes, namely Autoregressive Conditional Heteroscedasticity (ARCH) processes. These processes have an expected mean of zero, serially uncorrelated, but variances are non-constant and conditional upon the past. He also developed a regression model for measuring such processes [3]. The ARCH model of Engle assumed the variance to be conditional upon the past error squares only. T. Bollerslev introduced a more generalized ARCH model (GARCH) where the variance is conditional upon not only the past errors, but also its own past variances. The number of lags to be taken for errors and variance depends on the series to which the model is applied. However, pursuing to the principle of parsimony, GARCH (1, 1) model can fit almost all symmetrical distributions [4].

A symmetric ARCH model assumes that volatility is higher in a falling market than in rising market, which is mentioned as the leverage effect. But sometimes, responses can be viewed as in the work of R.F. Engle and V.K. Ng, where they provided a news impact curve in asymmetric response to good and bad news [5]. Engle (1990) had developed an Asymmetric GARCH (AGARCH) model [6].[1] The significant asymmetric models are Threshold ARCH (TARCH) developed by J-M. Zakoian and Exponential GARCH (EGARCH) model developed by D.B. Nelson [7, 8]. D.B. Nelson also developed GARCH-M and IGARCH. L. Glosten et al. developed the Threshold GARCH (TGARCH) model [9]. S. Taylor and G.W. Schwert developed Power GARCH (PGARCH) [10, 11]. All these models were developed in order to capture the volatility in all the varying possibilities.

Academicians and researchers have employed several of these models in their studies worldwide. G. Ogum analysed the volatility in the Kenyan and Nigerian market using EGARCH model [12]. E. Balaban and A. Bayar used both symmetric and asymmetric ARCH models to capture the volatility in fourteen countries [13]. J.Y. Uppal and I.U. Mangla made an effort to compare the Bombay Stock Exchange (BSE) and Karachi stock exchange (KSE) in terms of market volatility using GARCH-M [14]. P. Dennis et al. examined both implied volatility innovations and asymmetric volatility phenomenon for the S&P 100 index and 50 large U.S. firms [15].

[1] History of BRICS. BRICS Information Portal. 2015. URL: https://infobrics.org/page/history-of-brics/ (accessed on 20.06.2020); Joint Statement of the BRIC Countries' Leaders (Yekaterinburg, Russia, June 16, 2009). BRICS Information Portal. 2015. URL: https://infobrics.org/document/3/ (accessed on 20.06.2020).

H. Guo and R. Savideas studied the idiosyncratic volatility in G7 countries [16], while D. Alberg, H. Shalit and R. Yosef estimated the volatility in Tel Aviv stock exchange [17]. C. Tudor studied the Romanian market volatility and found that EGARCH fitted well for the market [18]. S.M. Bartram et al. observed that the volatility of U.S. firms was higher mostly because of good volatility [19]. Y. Wang and C. Wu forecasted the energy market volatility using univariate and multivariate GARCH models [20]. C.M. Lim and S.K. Sek employed both symmetric and asymmetric GARCH to analyse the volatility of the Malaysian market [21].

The research thesis of K.B. Nalina was an exploratory to analyse the Indian stock market volatility [22] using the methodology suggested by J.Y. Campbell et al. [23]. Q. Zhang and S. Jeffry studied the volatility spill over between Mainland China and Hong Kong stock market [24]. M. Tamilselvan and S.M. Vali forecasted volatility [25] while P. Sharma and Vipul forecasted the stock market volatility based on international evidence using realized GARCH models [26].

A. Moriera and T. Muir claim that the volatility-managed portfolios increases Sharpe ratio, and provide many gains to the investors [27]. Equity volatility has been analysed with various possibilities by several authors like D. Carvahlo [28]. H.N.D. Seoane found a positive correlation between the sovereign income and the volatility after studying several European economies during debt crisis [29]. In the latest study of T. Bollerslev et al., a new factor-based estimator for high dimensional and multivariate volatility is introduced [30]. In a study of R. Selmi et al., it was noted that globalisation and trade openness amplify the international transmission of the volatility [31].

There were several attempts to capture the volatility in the BRICS nations by the academicians including that of N. Kishor and R.P. Singh [32] and C.B. Hunzinger et al. [33]. An investigation into the relation between the BRICS stock market and commodity futures market was made by S.H. Kang et al. using the Fractionally Integrated Asymmetric Power ARCH (FIAPARCH) model [34]. A wavelet analysis of mean and volatility spill overs between the oil and the BRICS stock market was conducted by H. Boubaker and S.A. Raza [35].

Thus, volatility has been studied and predicted to arrive at various investment decisions and to arrive at conclusions on economies. Various volatility models were fitted by the academicians all over the world to determine the most apt one for volatility analysis. However, there is no single model that can be said as apt for all stock markets or all economies. It depends on the market on which the study is being conducted. This fact itself points out the need for studying the volatility of the various economies to contribute to the investors and the literature alike. Hence, the present study intends to analyse the volatility patterns of BRICS, an emerging nations' association and to fit an appropriate volatility model for those nations under the current scenario.

STATEMENT OF THE PROBLEM

Volatility, especially conditional volatility poses a significant problem for investors in taking investment decisions. Predicting returns from investment can be done using varying models, but how far the predictions will stand in future depends on the volatility in the returns. Even if, volatility is predicted, how long it will persist depends on the volatility persistence of the returns. Thus, it is imperative to study the volatility of stock returns and especially that of the emerging economies association like BRICS. In this backdrop, the present study has been undertaken.

OBJECTIVE OF THE STUDY

The objective of the present study is to empirically analyse the volatility features of the daily returns of investments in stock markets of the BRICS nations.

METHODOLOGY

The study was conducted with secondary data collected from the selected stock market indexes representing BRICS nations. The selected indexes for the study include indexes representing BRICS nations: Ibovespa, Moex, Nifty 50, HIS, and JALSH index respectively. The data used for analysis cover the daily price index of the selected stock indexes which were collected from the official websites of the respective stock exchanges. The data were collected for a period of fourteen years with 3441 observations.

EMPIRICAL TESTS

The data analysis was made on the basis of daily returns of the BRICS indexes. Daily returns were calculated using the following formula:

$$Return = \frac{P_1 - P_0}{P_0},$$

where P_1 is the current price and P_0 is the previous or past price. Since daily returns are to be calculated, the price of the latest day is taken as P_1 and its immediately previous price is taken as P_0.

Jarque-Bera (JB) normality test was applied to analyse the normality in the returns. The JB test statistic is worked out by using the following formula:

$$\text{Jarque-Bera test statistic} = n\left[\frac{S^2}{6} + \frac{(K-3)^2)}{24}\right],$$

where n is size of the sample, S is the skewness value and K is the Kurtosis value. The null hypothesis (H_0) of the JB test statistic is that the distribution is normal.

Augmented Dickey Fuller (ADF) Unit root test was also done for the returns of all indexes to ensure stationarity in returns. The null hypothesis (H_0) of ADF test is that there is a unit root (i.e. the series is non-stationary).

Both unconditional and conditional volatility analyses were done for the BRICS indexes. The unconditional volatility was measured through standard deviation and variance of the returns. The variance is calculated using the following formula:

$$\sigma^2 = \frac{\sum (X - \overline{X})^2}{N},$$

where σ^2 is variance, X represents the stock return, $\overline{X}$ is the mean of the stock returns and N is the number of observations. It will be constant for all observations. Hence may be called homoscedastic. The variance is said to be unconditional as it is purely independent and are uncorrelated with any of the explanatory variables or its own past values. The variances of the BRICS indexes were computed and compared to state the homoscedasticity of these nations in the research.

Conditional variance is at variance which is conditional upon its own past variances or conditional upon any of the explanatory variables. Conditional variance occurs when there is heteroscedasticity in the returns. So, heteroscedasticity test (Breusch-Pagan-Godfrey Test) is carried out by obtaining residual squares from the regression of the daily returns with its own lagged returns. ARCH model was applied to measure the conditional variance in the returns. ARCH method implies the use of squared residuals obtained out of the ARCH equation which is given as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2,$$

where σ_t^2 is the conditional variance, α_0 is the constant, α_1 is the ARCH coefficient and e_{t-1}^2 is the first lag of the squared residuals. The null hypothesis of the test is that there is no heteroscedasticity.

For those indexes that were found ARCH effect were put to misspecification test. Misspecification in model refers to the situation of bias in the model out of either omission of significant independent variables or adding insignificant variables into the model. The heteroscedasticity found in a series may be due to the misspecification in some cases and that heteroscedasticity cannot be considered as true conditional variance. Thus, the misspecification test is done on the residuals, that are put to Correlogram Q-Statistic test for testing whether the series is white noise or not. White noise refers to the stationary series with a zero mean, constant variance and insignificant autocorrelation. If the series is white noise, then the heteroscedasticity is pure and not out of misspecification in the model.

If there is ARCH effect, it is possible that there could be Generalized ARCH (GARCH) effected. While ARCH measures the variance conditional upon its past errors, GARCH measures the variance that is conditional upon both past errors and its own past variance. Therefore, GARCH model was applied to the returns of the indexes to measure the conditional variance. It was T. Bollerslev [4] who developed the GARCH model as an extension of the ARCH model. The GARCH (1, 1) model that is fitted to the index returns is shown below:

$$\sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \beta_1 \sigma_{t-1}^2,$$

where σ_t^2 is the conditional variance, α_0 is the constant, α_1 is the ARCH coefficient, e_{t-1}^2 is the one lag squared residuals, β is the GARCH coefficient (γ_1 can also be used) and σ_{t-1}^2 is the lag of variance (past variance).

Table 1

Descriptive Statistics of Daily Index Returns for 14 Years

Descriptive Statistics	Ibovespa	Moex	Nifty 50	HIS	JALSH
Mean	0.00035	0.00037	0.000366	0.00022	0.000296
Median	0.0006	0.0004	0.0006	0.0006	0.0006
Standard Deviation	0.0180	0.0194	0.0144	0.0151	0.0125
Kurtosis	9.3150	28.5965	13.2224	9.3446	5.7013
Skewness	−0.1590	0.5885	−0.0256	0.2344	−0.2881
Range	0.2943	0.4735	0.3072	0.2704	0.1725
Minimum	−0.1478	−0.1866	−0.1298	−0.1270	−0.0972
Maximum	0.1465	0.2869	0.1774	0.1434	0.0753
Jarque-bera	12 454.18	119 377.50	25 184.2	12 510.2	4768.16
Probability	0.00	0.00	0.00	0.00	0.00

Source: Calculated based on the stock price data from 1/4/2006 to 31/3/2020 collected from the official website of the stock exchanges.

From the GARCH (1, 1) model fitted for the indexes, the coefficients were analysed to measure the volatility persistence. Volatility persistence is duration that the variances take to revert to the mean. Symmetric GARCH model restricts the sum of the ARCH (α_1) and GARCH (β_1) coefficients to be less than one. If the sum of the ARCH and GARCH coefficients are greater than 0.5, then there is high volatility persistence. That means it will take more time to mean reversion. On the contrary, if the sum is lower than 0.5, then the mean reversion will be faster showing low volatility persistence. Low volatility persistence is preferred to high volatility persistence as far as the investors are concerned. The Statistical Packages used for processing the data were EViews 9 and SPSS 23.

DATA ANALYSIS AND DISCUSSION

The empirical analysis of the volatility of the returns of the selected indexes are done in three phases. The first phase constitutes the analysis of summary statistics, the second phase is the analysis of unconditional variance in the returns and the analysis of conditional variance in the returns is made in the third phase.

ANALYSIS OF SUMMARY STATISTICS

The empirical study of the daily stock market returns of BRICS nations were calculated on the indexes representing each nation namely Ibovespa (Brazil), Moex (Russia), Nifty 50 (India), HSI (China) and JALSH (South Africa). The summary statistics of the daily returns of the five indexes are given in *Table 1*.

As shown in *Table 1*, Moex has the highest mean daily return with 0.00037 while HSI has the lowest (0.00022). Similarly, the standard deviation is also high for the Moex index (0.0194) while JALSH has the lowest dispersion (0.0125). The minimum and maximum return marked in the whole return series for each of the indexes are also shown in the *Table*, from which the range within the returns are lying can be inferred. In that case, it can be noted that Moex has the widest range of 0.4735 and JALSH has the least range (0.1725). This confirms their respective measure of dispersion shown by the standard deviation.

When analysing the Kurtosis, it can be seen that the daily return distribution of all indices is leptokurtic with Kurtosis greater than 3 (*Table 1*). Also, from the *Table 1*, it can be observed that all the indexes have the presence of asymmetry. Thus, it can be rightly concluded that the daily return distributions of the selected indexes are not normal. Moreover, the JB Statistic and its probability confirm that the series are non-normal. Normality is usually expected from data in order to make sure that the conclusions drawn based on such data are valid and can be generalised. However, in case of time series data, especially stock return data, normality need not

Table 2

Augmented Dickey Fuller Unit Root Test of the Indices for 14 Years

Stock Market Indexes	Augmented Dickey-Fuller test statistic		
	Constant	Constant, Linear Trend	None
Ibovespa: t-statistic	–62.21	–62.20	–62.19
Prob.	0.00	0.00	0.00
Moex: t-statistic	–59.01	–58.99	–58.99
Prob.	0.00	0.00	0.00
Nifty 50: t-statistic	–56.56	–56.57	–56.54
Prob.	0.00	0.00	0.00
HSI: t-statistic	–59.88	–56.57	–56.54
Prob.	0.00	0.00	0.00
JALSH: t-statistic	–58.81	–58.82	–58.78
Prob.	0.00	0.00	0.00

Source: Calculated based on the stock price data collected from the official website of the stock exchanges.

be ensured. Thus, it is quite usual that the returns of the selected indices are not normal.

Table 2 shows the ADF Unit root test results of the daily returns of the indexes under three cases, wherein the first case assumes a constant, the second case assumes a constant with linear trend and the third case with none of these.

From the statistical results presented in *Table 2*, it is seen that the probability is near to zero. The null hypothesis of the ADF Unit root test is that there is a unit root, meaning the series is non-stationary. Since all the probabilities are less than 0.05, the null hypothesis is rejected and thus, the series are stationary. A series is stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed [36]. For a stationary series, the parameters will not change despite changes in time. This validates the generalisation of the inferences drawn based on the stationary series. Here, in case of all the indices representing BRICS nations, the returns are found stationary.

UNCONDITIONAL VARIANCE ANALYSIS

The foremost step in the volatility analysis constitutes the unconditional variance analysis. It is the overall and simple testing of the return series for volatility using standard deviation and variance.

The daily returns of the indexes are regressed with its own previous lag (one) for finding the unconditional variance. Then the residuals are plotted in order to view how far the returns are scattered and dispersed. The *Fig. 1* shows the residual plot of the daily returns regressed with its one lag of all the indices. From the *Fig. 1*, the overall picture of the volatility in the returns of indexes is drawn. The residuals of all the indices are highly fluctuating and deviating from their means. Moreover, it seems that there is volatility clustering in its returns. Volatility clustering, as defined by B.B. Mandelbrot is that "large changes tend to be followed by large changes, of either sign, and small changes tend to be followed by small changes" [37]. Such kind of clustering can be viewed in the residual plot of the indices.

Volatility analysis of BRICS nations can be primarily done through unconditional variance analysis. *Table 3* shows the unconditional variance of the residuals/errors of the daily returns of the indexes, assuming the volatility is unconditional.

As shown in the *Table 3*, the residuals of the Moex index have the highest variance of 0.00038. It means that the Moex index returns are more volatile. Similarly, JALSH index returns are less volatile with a variance

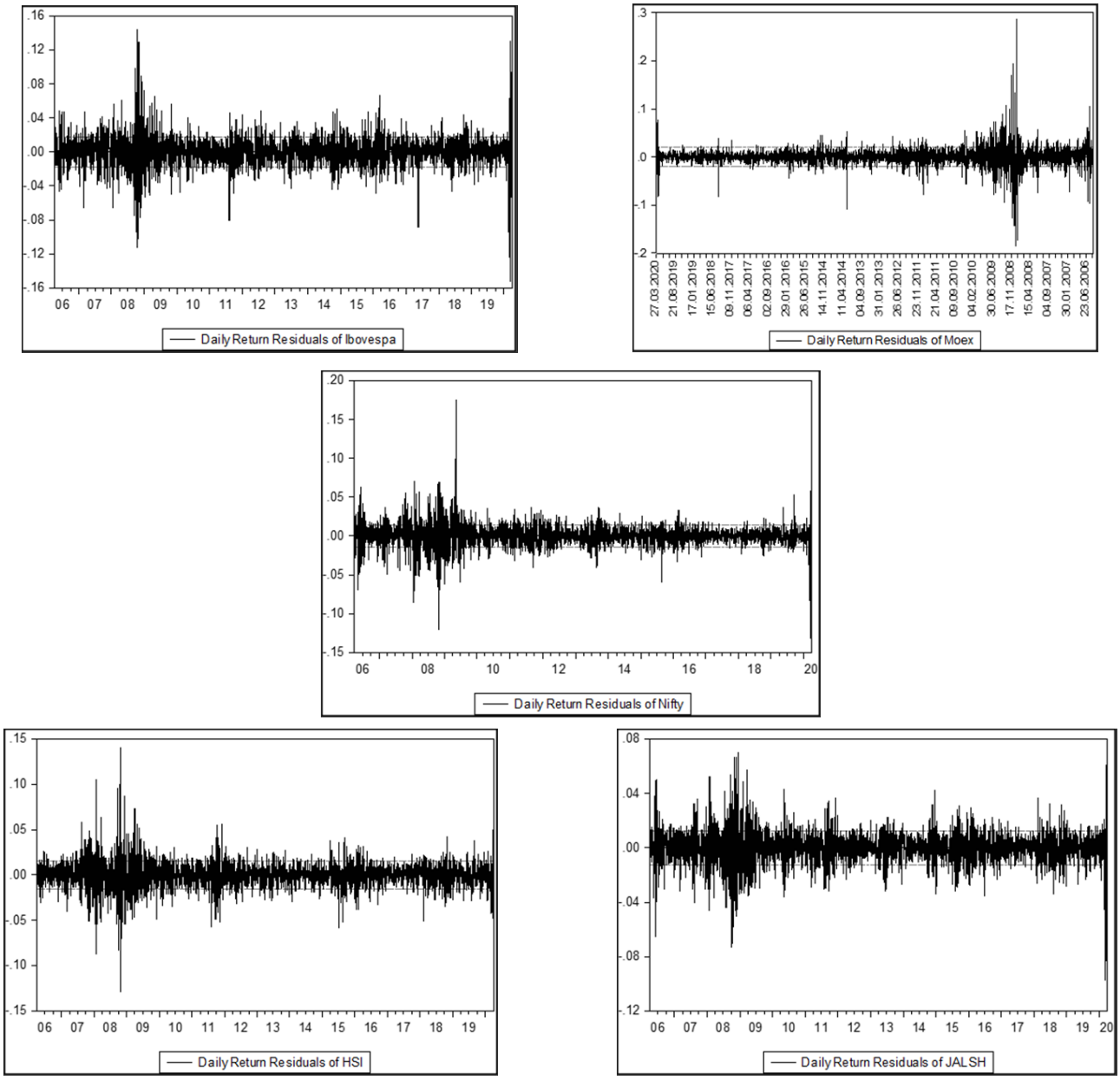

Fig. **Daily Return Residual Plot of the Indices for 14 Years**

Source: Plot generated using daily returns in EViews software.

of 0.00016. Ibovespa has a low variance compared to Moex, and greater than Nifty 50 and HSI. HSI is less volatile than Moex (0.00038) with a variance of 0.00023, but more volatile than Nifty 50.

CONDITIONAL VARIANCE ANALYSIS

The residual plot as shown in the *Figure* pointed out the volatility clustering in the returns of certain indexes. In that case, it is necessary to analyse the conditional variance of returns. Thus, heteroscedasticity needs to be tested for the returns of all indexes. Heteroscedasticity means different (hetero) dispersion (scedasticity). It implies the varying variance. Thus, there is a need to test the ARCH effect in the returns of the index to capture the whole volatility in the returns. If there is no ARCH effect, it means that there is no conditional variance and hence the unconditional variance is strong enough to measure the volatility in returns.

The ARCH variance is calculated by considering the first lag of the squared residuals obtained out of regression of the returns with its own lag. The *Table 4* shows the result of the ARCH test conducted on the daily returns of the selected indexes.

From the *Table 4*, it can be seen that the ARCH coefficient of Ibovespa is 0.3594. The t-statistic value is 22.61 and as the probability to get that value is 0.00, the null hypothesis that there is no heteroscedasticity is rejected and thus, the test is significant. It means that there exists conditional volatility in the returns of the index. It adds to the complexity in assessing the risk of the index and further, it contributes to the riskiness of investing in the Brazilian market. Similarly, in case of Moex, Nifty 50, HSI and JALSH also, the null hypothesis is rejected and there is heteroscedasticity in returns.

As shown in *Table 4*, all the five indices have significant heteroscedasticity. That is, the market is highly volatile and thus risky to invest. Only the magnitude of it varies between the indices. However, in order to ensure that the heteroscedasticity is not due to misspecification, the residuals of ARCH equation are put to the white noise test. Thus, Autocorrelation Test and the Q-Statistic along with its Chi-square probability are employed to the residuals to test whether they fit into white noise. The *Table 5* shows the result of the misspecification test done on the residuals of the ARCH regression.

The results of the residuals subjected to misspecification, as in *Table 5*, clearly point out that the residuals are purely white noise in all the cases. Thus, the heteroscedasticity found in the daily returns of the indices is pure and not out of any misspecification in the model.

Similarly, the conditional variance itself should also depend on its own, previous or past conditional variance (GARCH effect). Therefore, that variance should be integrated with the ARCH variance. Thus, GARCH (1, 1) model is applied here to find the gross conditional variance that arises due to the ARCH and GARCH effects, for the five indexes. The *Table 6* shows the result of GARCH (1, 1) model fitted to the indexes.

Table 3

Unconditional Variance of the Daily Returns of the Indices for 14 Years

Stock Market Indexes	Variance
Ibovespa	0.00032
Moex	0.00038
Nifty 50	0.00021
HIS	0.00023
JALSH	0.00016

Source: Calculated based on the stock price data collected from the official website of the stock exchanges.

The *Table 6* shows the GARCH (1, 1) model fitted. A significant inference that can be made from the model is regarding the volatility persistence. If the sum of ARCH (α_1) and GARCH (β_1) coefficients is greater than 0.5, then there is greater volatility persistence. From the *Table 6*, it can be seen that the sum of the coefficients of Ibovespa is 0.9757, which is less than 1 but close to 1. It means that there is high volatility persistence. For Moex, the sum is 0.9975, which is nearly 1, for Nifty 50, the

Table 4

ARCH Test of the Daily Returns for 14 Years

Sl. No.	Stock Market Indexes	α_1			
		Coefficient	t-Statistic	Probability	Significant/ Insignificant
1	Ibovespa	0.36	22.61	0.00	Sig.
2	Moex	0.16	6.88	0.00	Sig.
3	Nifty 50	0.14	8.48	0.00	Sig.
4	HSI	0.36	23.02	0.00	Sig.
5	JSE	0.21	12.89	0.00	Sig.

Source: Calculated based on the stock price data collected from the official website of the stock exchanges.
Note: α_1 is the ARCH coefficient. P value is the probability value of the t-statistic.

Table 5

Misspecification Test on the Residuals of ARCH Equation of the Indices for 14 Years

Sl. No.	Stock Market Indexes	Autocorrelation	Q-Statistic	Probability	White Noise (WN)/ Non random (NR)
1	Ibovespa	–0.008	0.218	0.640	WN
2	Moex	–0.014	0.674	0.411	WN
3	Nifty 50	–0.026	2.423	0.119	WN
4	HSI	0.001	0.003	0.954	WN
5	JALSH	0.011	0.407	0.523	WN

Source: Calculated based on the stock price data collected from the official website of the stock exchanges.

Table 6

GARCH (1, 1) Model Fitted for Indicesa for 14 Years

Index	Coefficient	Z-Statistic	Probability
Ibovespa: α_0	0.0000	6.0738	0.00
α_1	0.0852	11.4086	0.00
β_1	0.8905	90.1768	0.00
Moex: α_0	0.0000	5.0721	0.00
α_1	0.1192	15.4769	0.00
β_1	0.8783	130.8408	0.00
Nifty: α_0	0.0000	5.7627	0.00
α_1	0.1022	15.2566	0.00
β_1	0.8945	134.1795	0.00
HSI: α_0	0.0000	5.2843	0.00
α_1	0.0686	11.7288	0.00
β_1	0.9205	130.9760	0.00
JALSH: α_0	0.0000	5.0932	0.00
α_1	0.1017	11.4507	0.00
β_1	0.8849	87.0968	0.00

Source: Calculated based on the stock price data collected from the official website of the stock exchanges.
Note: α_0 is the Constant; α_1 is the ARCH Coefficient, and β_1 is the GARCH Coefficient.

sum is 0.9967, for HSI it is 0.9891 and for JALSH the sum is 0.9866, that is also high. Thus, Moex has the highest volatility persistence while Ibovespa has the lowest. In general, all the five indices have high volatility persistence. The fact intensifies the riskiness of the indices. Moreover, the GARCH (1, 1) model fitted for the daily returns of the indexes as per Maximum Likelihood Estimation (MLE) shows no asymmetry, as the sum of the ARCH and GARCH coefficients are less than 1.

Table 7 shows the total conditional variance of the indexes. It is the weighted sum of the past squared errors and the past variance obtained by applying the GARCH (1, 1) model. The aggregate conditional variance for the GARCH equations is calculated for each index and given in *Table 7*.

From the statistical results presented in *Table 7*, it can be seen that Moex has the highest total conditional variance and JALSH has the lowest conditional variance. It means that Moex is the most volatile and thus risky when compared to other indices, while JALSH is the least volatile. HSI is the second least volatile index with a total variance of 0.0645. Nifty 50 comes next with variance of 0.0816. Ibovespa (0.1224) has a variance less than Moex but greater than JALSH, HSI and Nifty 50.

After taking into consideration both conditional volatility and unconditional volatility of the daily return of indices representing BRICS nations, it can be inferred that Moex is having the highest volatility measuring 0.1681 (*Table 7*). At the same time, as per the analysis, JALSH has the lowest volatility.

Table 7

Total GARCH Variance of the Daily Returns of Indices for 14 Years

Stock Market Indexes	Total GARCH (Conditional) Variance
Ibovespa	0.1224
Moex	0.1681
Nifty 50	0.0816
HSI	0.0645
JALSH	0.0643

Source: Calculated based on the stock price data collected from the official website of the stock exchanges.

CONCLUSION

The daily returns of BRICS nations' indexes were analysed for studying the volatility patterns in it. The indexes selected representing the BRICS nations were Ibovespa, Moex, NIFTY 50, HIS, and JALSH. Upon unconditional variance analysis, among the indexes, the returns of Moex showed highest volatility while JALSH was the least volatile. Heteroscedasticity was detected for the returns of all the five indices. Therefore, conditional volatility analysis was called for. Accordingly, for each index, GARCH (1, 1) model was fitted after conducting misspecification test.

As per the GARCH (1, 1) model revelation, returns of Moex index has shown the highest volatility persistence level. The volatility persistence of the Ibovespa index was the lowest when compared with the others. However, all the five indexes had high persistence of volatility in their returns, implying they are very risky. When quantified the GARCH variance, returns of Moex index had the highest conditional variance. Thus, among the BRICS nations' indexes, it can be generalised that Moex is the most volatile while JALSH is less volatile. Thus, investment in the South African stock market can be said as less risky when compared to the other BRICS nations. It is a Russian stock market that is most risky among the other stock markets. When Indian stock market is considered, it can be said that it is among the less risky stocks along with South African, and China stock market. Brazilian stock market is less risky than Russian, but riskier than South African, China and Indian stock market.

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ABOUT THE AUTHORS

Natasha Pankunni — Assis. Prof., Department of Commerce and Management Studies, School of Business Studies, University of Calicut, Malappuram, Kerala, India
https://orcid.org/0000-0002-9854-8175
Corresponding author:
natashapankunni@gmail.com

S. Rajitha Kumar — PhD, Prof., School of Management Studies, Cochin University of Science and Technology, Kochi, Kerala, India
https://orcid.org/0000-0003-0348-3207
rajithakumar@cusat.ac.in

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The Impact of Loan Portfolio Returns on Stock Returns: The Moderating Role of Solvency in Jordanian Commercial Banks

Z. Al-Slehat
Tafila Technical University, Tafila, Jordan

ABSTRACT

The current research **aims** is to test the impact of loan portfolio returns on stock returns in the Jordanian commercial banking sector in the presence of solvency as a conditional variable (moderator). **Set** in the research represents all Jordan's local commercial banks listed on the Amman Stock Exchange for the period of 2013–2020. The **SPSS** program was used to achieve the study's objective and test its hypotheses. The **results** showed significant impact of loan portfolio return on stock returns in the Jordanian banking sector. It means that loan portfolio return growth has an impact on shareholder stock returns as it depends on the bank's financial performance. Solvency is a conditional variable to improve the impact of loan portfolio return on stock returns. Accordingly, the research presents a set of **recommendations**, Bank managers should focus on loan portfolio management and financial solvency in order to have greater profitability and follow the decisions which are passed by the Basel Committee.

Keywords: loan portfolio returns; stock returns; solvency; financial markets; Jordanian commercial banks; SPSS program

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INTRODUCTION

The financial markets are critical means enabling investors to invest in the securities offered or traded for many joint-stock companies for the purpose of gaining profits. In the contrast, the rational investors prefer a high return on their investments with taking into account the balancing between the risks and returns and thus maximizing the profits, more specifically companies, including banks, seek to manage their financial statements and control the capital structure efficiently to announce appropriate returns for each share [1, 2]. Thus, investors seek investment opportunities, the returns of which are greater than the cost of investing in them, including stock investments. Given that the banking sector is the link between the state's monetary and financial policies, attention must be paid to this sector. Furthermore, it should be managed effectively, because this sector has a vital role in providing banking services to various economic activities. J. Afrino and E. Masdupi [3], along with I. Jodeh [4], stated that banks' objectives are divided into general and functional objectives. The general objectives are related to the general policies of the bank, such as achieving profit growth and focusing on other objectives, such as liquidity, profitability, safety, and firm growth. As for the functional objectives, they are represented in providing effective mechanisms and means of payment in economic activities, as well as creating and collecting funds, and then directing them to the community, apart from other financial services.

As the banking sector operates in a competitive environment at the local and international levels, in anticipation of this competition, it is necessary to strengthen the role of the banking administration in maintaining its performance, because this dramatically affects the value of shares in the market. Furthermore, the performance of the loan portfolio returns should be improved, as it is the primary source in achieving high annual net financial returns for the banking sector with a low level of risk through granting loans to several sectors [5, 6].

Solvency, which refers to the relationship between borrowed money and owner's money in the bank's

capital structure, is one of the basic principles that guide banking operations and an essential aspect of banking management [7, 8].

Therefore, the impact of the loan portfolio's return on stock returns in the presence of solvency as a moderating variable is one of the important issues facing the banking sector. On the one hand, solvency has attracted the attention of shareholders and stakeholders. On the other hand, it is one of the important indicators that reflect the robustness and efficiency of banking management. Therefore, the study aims to address the following research questions:

Do loan portfolio returns have an impact on the stock returns of local Jordanian commercial banks?

Does solvency have a moderating role in the impact of loan portfolio returns on the stock returns of local Jordanian commercial banks?

The Importance of the Research

The importance of the study is evident in that it deals with three essential variables of banking: loan portfolio returns, stock returns, and solvency. These are important variables, especially given that the banking sector operates in an environment characterized by intense competition in providing banking services.

Furthermore, banking is a critical economic sector through a cycle of directing liquidity towards investments that, in turn, drives economic development. Thus, the importance of the study can be clarified by the following points:

1. It highlights the value of providing optimal returns for loan portfolios in a way that achieves financial stability for banks.

2. It emphasizes the value of achieving high returns on shares, thus increasing banks' market share, and attracting more customers.

3. It presents findings and recommendations that would benefit decision-makers in the banking sector.

Objectives of the Research

The current study aims to test the impact of the loan portfolio returns on the stock returns of the Jordanian commercial banking sector for the period of 2013–2020 in the presence of solvency as a moderating variable.

THEORETICAL FRAMEWORK

Loan Portfolio Returns

The loan portfolio depends on several factors, such as the interest rates earned on the loans, the nature of the loans, and the probability of repayment. It is therefore considered to be one of the main assets owned by the banks. This also refers to loans that are made or purchased and held for repayment. Therefore, banking departments must effectively manage these to achieve the maximum possible profits. This can be achieved by focusing on diversification in bank loan portfolios to avoid future banking crises and expansion of strategies based on the modern portfolio theory of H. Markowitz [9–12].

According to V. Acharya and I. Hasan [13] and P. Howells and K. Bain [14], a loan portfolio indicates the amount of the increase in the capital value of assets that comprise it or the return on investment an investor is expected to obtain from it. Thus, the loan portfolio is the most prominent source of revenue in banks while also posing the greatest risks affecting bank security. Therefore, it is necessary to effectively manage loan portfolios to identify and control those risks to achieve success in the banking industry [15].

Notably, the loan portfolio returns can be measured through one of the accounting profitability indicators, which is the loan portfolio's rate of return. This determines a bank's ability to generate profits from the most profitable areas of investment, as represented by loans and banking facilities. It is calculated using the following equation [16, 17]:

Return on the loan portfolio and credit facilities = = commissions and interest on loans / total loans.

Stock Returns

Stock returns are the profits or losses in the value of shares during a specific period, during which investors choose investments that can generate returns that are greater than the costs involved. Moreover, the investors who buy shares expect cash profits or capital gains represented by the rise in share prices [18]. The fluctuations in share prices, which is reflected in the level of demand and supply of shares, represent a state of uncertainty for investors [19]. Therefore, the optimistic expectations of banking management

with an increase in the shares' rate of return can positively affect the future returns of the shares, while the pessimistic expectations with a decrease in the shares' rate of return can negatively affect the returns on the shares [20].

Consequently, the rise in stock returns will lead to an increase in the market value of assets and a decrease in the debt ratio, which in turn, will negatively affect stock returns. At the same time, if the debt ratio increases, the investors will demand a higher return due to the higher risk of bankruptcy, thereby indicating the positive effect of financial leverage on stock returns [21, 22].

J. Afrino and E. Masdupi [3] insisted on the need to have basic and technical information to analyse stock returns. "Fundamental analysis" refers to the information published by issuers and stock exchange managers, while "technical analysis" relies on historical data of stock prices to estimate prices in the future. The factors that affect stock returns in the event of future uncertainties are macroeconomic factors and internal standards for public companies [23].

Solvency

"Solvency" refers to the ability of a financial institution to meet its short-, medium-, and long-term financial obligations. It is also defined as the ability to meet obligations, including interest and main debts, in the event of liquidation or cessation of activity. In other words, it represents a company's financial structure [24, 25]. K. Devarajan [26] explained that solvency refers to (1) a company's ability to own sufficient assets to cover its obligations, (2) its current condition that enables it to meet its debt obligations, and (3) its ability to meet its long-term expenses and achieve expansion and growth in the long term, considering the notion that the higher the solvency, the better the financial state of the company.

According to past studies [27, 28], following the financial turmoil of 2007, interest in the performance of banks increased. At the same time, there has been an increased focus on solvency and liquidity to ensure the proper functioning of the global financial system, as banks are considered solvent if total assets exceed total liabilities and vice versa. Meanwhile, a bank is technically insolvent if it is unable to meet its long-term financial obligations or pay the depositors. Furthermore, the solvency of commercial banks can be measured through the cash flow and capital adequacy indexes, which expresses the short-term and long-term solvency, respectively.

The research [27] reported that there are two ways for banks to enhance financial solvency and meet capital requirements. The first method is by increasing a bank's owned capital, which is achieved by issuing new shares or retained earnings. The second method is to change the uses of funds from risky assets to less risky ones. The debt-to-equity ratio is one of the leading financial ratios used to measure a bank's solvency, as it indicates the degree of financial leverage used by the bank, including short- and long-term debts [28–31].

PREVIOUS STUDIES

The current research seeks to test the impact of loan portfolio returns on stock returns in the presence of solvency as a moderating variable. However, many studies linking these variables have been conducted differently from the current research.

For example, Huynh and Dang [32] found that increasing the loan portfolio diversification reduces bank returns, but not to the same extent for all banks. They also reported that banks relying on non-interest activities are affected to a lesser degree by diversifying their loan portfolios, and that the strength of the banking market can mitigate the harmful effects of diversifying the loan portfolio on banks' returns. B. Abu Khalaf and S. Alajlani [33] concluded that the diversification of loans affects the performance of Jordanian commercial banks. In particular, individual lending, corporate lending, and mortgage loans positively affect banks' performance. In contrast, there is a negative impact on performance in the case of loans to small- and medium-sized enterprises and government loans. H.K. Anaya and H.N. Otinga [34] similarly found a significant impact of loan portfolios on the financial performance of companies.

Q.M. Hammod [35] also found a negative impact relationship between loan portfolio concentration and one bank's return indicators (with statistically significant return indicators) as well as a positive

relationship between loan portfolio concentration and the return indicators for another bank in the same study sample. They also found that there is a positive influence between focusing on loan portfolios and risk indicators in the research community. Meanwhile, H. Al-Khalidi [6] reported positive relationships between loan portfolio returns and banking facilities, on the one hand, and bank size, capital adequacy rate, current cash flow, advertising spending rate, and the age of the bank, on the other hand. They also found a negative relationship between return loan portfolio and banking facilities and deposit employment rate. T. Siudek [36] similarly reported a positive effect of net loans to total assets on the solvency ratio of Polish banks.

One of the most important findings presented by N. Chasanah and A. Sucipto [5] is that liquidity ratios negatively impact stock returns, while profitability and solvency ratios do not affect stock returns. J. Afrino and E. Masdupi [3] reported that the return on assets (ROA), capital adequacy ratio, and debt to equity ratio do not affect stock returns in the sample banks, while the ratio of share price to profit has a positive effect on the stock returns in banks. Meanwhile, D.B. Yousouf [37] concluded that a positive relationship exists between interest rates and corporate capital with stock returns. M. Halaaq [38] found direct and statistically significant relationships between the degree of capital adequacy in banks, on the one hand, and interest rate risk, liquidity risk, capital risk, rate of revenue strength, and ROA, on the other hand. Moreover, A.A. Mohammad [39] noted a relationship between solvency variables and earnings per share, with the exception of equity to deposits and equity to assets.

Contributions of the Study

Although this work is based on previous efforts, to the best of the researcher's knowledge, this is the first study that links three variables, namely, loan portfolio return, stock returns, and solvency, and examines them simultaneously. At the outset, these variables seem separate, but they are actually interrelated in their content. Therefore, they can be used to guide administrative leaders to make sound decisions that would maximize stock returns. This research also examined the Jordanian commercial banking sector, which is subject to the decisions of the Basel Committee and the Banks and Companies Law simultaneously.

RESEARCH METHODS

The researcher used the descriptive-analytical method to study the impact of the loan portfolio returns on stock returns in the presence of solvency as a moderating variable for the period 2013–2020. Several data sources were used. From the primary sources, we extracted financial data and indicators from the Company Directory found on the Amman Stock Exchange website. For the secondary sources, we used books, periodicals, and previous studies related to the subject of research.

Population

The study population consists of all 13 local Jordanian commercial banks (2013–2020) listed on the Amman Stock Exchange.

Measuring study variables

The study variables were measured according to several variables, listed below.

The independent variable [6]:

- Loan portfolio returns = commissions and interest on loans / total loans.

The dependent variable is the stock return [18]:

- Stock Return = (Pt – Pt – 1) / (Pt – 1) × 100%

The moderate variable is solvency [28, 30]:

- Solvency = Debt ratio / Equity Ratio.

Study Model and Hypotheses

The following model reflects the perceptions of the current study related to the impact of the loan portfolio returns on stock returns in the presence of solvency as a moderating variable in the context of the Jordanian commercial banking sector for the period 2014–2020 (*Fig.*).

Hypotheses

H_1: Loan portfolio returns have no statistically significant effect on the stock returns of local Jordanian commercial banks.

H_2: Solvency has no statistically significant effect in moderating the impact of loan portfolio returns on the stock returns of local Jordanian commercial banks.

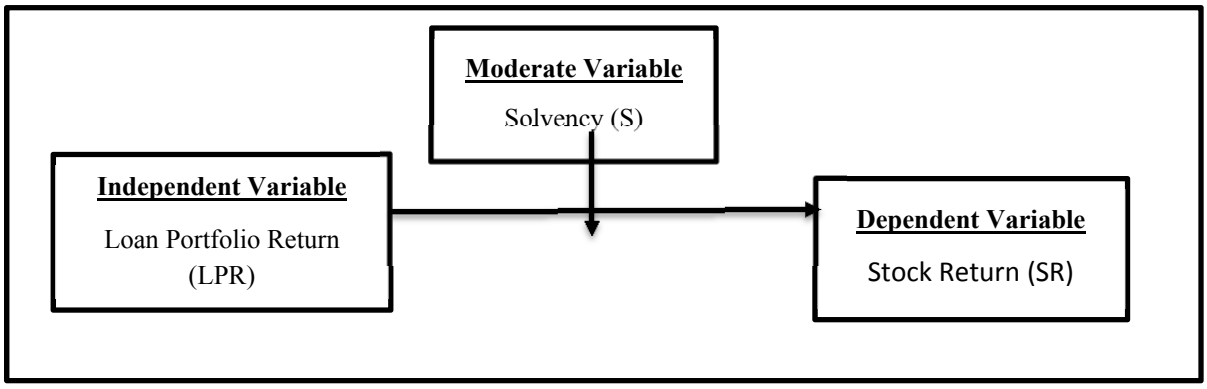

Fig. **Study Model**

Source: Compiled by the author.

RESULTS AND HYPOTHESIS TESTING

Pearson's Correlation

Table 1 shows the Pearson's correlation coefficients between the study variables (loan portfolio returns, stock returns, and solvency). As can be seen, there is no problem of multiple linear correlations between the variables, given that the values of the correlation coefficients between all variables reached less than 80%, with positive relationships and statistical significance at the 0.01 level.

Table 1

Correlation

	LPR	SR	S
LPR	1	.690**	.375**
SR	.690**	1	.469**
S	.375**	.469**	1
N	117	117	117

Source: Compiled by the author.

Note: ** Correlation is significant at the 0.01 level (2-tailed).

Hypothesis Test

H_1: Loan portfolio returns have no statistically significant effect on the stock returns of local Jordanian commercial banks.

The results in *Tables 2 and 3* refer to simple linear regression analysis to test the first hypothesis, in which we set the value of R^2 to 0.476, and therefore the loan portfolio returns explained 47.6% of the change in stock returns. Moreover, the value of R was 0.690, indicating a positive correlation between the loan portfolio returns and stock returns.

The results also revealed that the Durbin-Watson value was within the acceptable test limits, indicating the absence of an autocorrelation problem between the errors in the regression equation. Based on the F value of 104.361 and the t-value of 10.216 at a significant level less than 0.05, the first main hypothesis is rejected, and the alternative hypothesis is accepted, which states that loan portfolio returns have a statistically significant effect on the stock returns of Jordanian local commercial banks for the period under examination and analysis.

H_2: Solvency has no statistically significant effect in moderating the impact of loan portfolio returns on the stock returns of local Jordanian commercial banks.

The results presented in *Tables 4 and 5* refer to a hierarchical multiple linear regression test to validate the hypothesis of the second study. The value of R^2 in the second model was 0.527. This indicated that the portfolio returns explained 52.7% of the changes in stock returns in the presence of solvency as a moderating variable. By introducing the moderator variable represented by solvency in the regression equation, the interpretation of the independent variable on the dependent increased by 5.1% over the first model.

In addition, we noticed an increase in the value of R by 0.036, indicating the absence of an autocorrelation problem between the errors involved in the regression equation according to the Durbin-Watson value. Based on the value of F (12.440), with a level of significance less than 0.05, we accept the

Table 2

Model Summery

Model	Model Summery					
	R	R^2	Adjusted R square	F Change	Sig. F Change	Durbin-Watson
1	0.690	0.476	0.471	104.361	0.000	1.832

Source: Compiled by the author.

Table 3

Coefficients

Independent Variable: Loan Portfolio Return (LPR)	Model	Coefficients				
		B	Std. Error	Beta	t	Sig
	1	0.698	0.068	0.690	10.216	0.000
	Dependent Variable: Stock Returns (SR)					

Source: Compiled by the author.

Table 4

Model Summery

Model	Model Summery					
	R	R^2	Adjusted R square	F Change	Sig. F Change	Durbin-Watson
1	0.690	0.476	0.471	104.361	0.000	1.832
2	0.726	0.527	0.519	12.440	0.001	1.681
Change ($^{+}\Delta$)	0.036	0.051				

Source: Compiled by the author.

Table 5

Coefficients

Model	Variable	Coefficients				
		B	Std. Error	Beta	t	Sig
1	Independent Variable: Loan Portfolio Return (LPR)	0.698	0.068	0.960	10.216	0.000
2	Independent Variable: Loan Portfolio Return (LPR)	0.605	0.070	0.598	8.609	0.000
	Moderate Variable: Solvency (S)	0.287	0.081	0.245	3.527	0.001
Dependent Variable: Stock Returns (SR)						

Source: Compiled by the author.

alternative hypothesis that solvency has a statistically significant effect in improving the impact of loan portfolio returns on the stock returns of Jordanian commercial banks for the period under examination and analysis.

DISCUSSION

The results of the first hypothesis test revealed a significant effect of the loan portfolio returns on the stock returns in the Jordanian commercial banking sector. This means that when loan

portfolio returns increase, this will be reflected in the returns on the shares owned by the shareholders, because existing stock returns reflect the bank's financial performance ability. Although no study has been able to directly link these two variables, to the researcher's knowledge, this result is partially consistent with past studies [6, 8, 36].

The second hypothesis revealed the role of solvency as a moderating variable in improving the impact of loan portfolio returns on stock returns. Notably, when solvency was included in the regression equation, the effect on the value of R^2 increased by 5.1%. This indicates the role of solvency in improving the performance of banks, especially in their loan portfolios, which is reflected in their ability to pay short-term financial obligations. In turn, this increases the confidence of stakeholders, especially investors, thus creating more demand for investments in bank shares that achieve positive returns — something that all investors seek to do. As no study has combined the three variables, according to the researcher's knowledge, this result is partially consistent with [37, 39] and inconsistent with [3, 5].

RECOMMENDATIONS

1. Banks should focus on diversifying their loan portfolios, especially long-term lending, to achieve more profits and enhance their financial solvency.
2. Loan portfolios and bank solvency should be optimally managed through a specialized department that achieves more profitability while following the decisions of the Basel Committee.
3. Future researches must be conducted and other variables must be introduced, such as the structure of bank deposits, banking risks, and the size of the bank.

LIMITATIONS

1. This research was limited to the Jordanian commercial banking sector. Therefore, generalizing the results to other sectors, such as the foreign banking sector inside Jordan or foreign branches of Jordanian banks, is not recommended.
2. The research period was limited to the years 2013–2020. Therefore, it is difficult to adapt it to other periods due to the significant changes that occur at the economic level.
3. Finally, the study was limited to three variables represented by the loan portfolio returns as an independent variable, stock returns as a dependent variable, and solvency as a moderating variable. Therefore, the results can change, especially when other variables are considered.

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ABOUT THE AUTHOR

Zaher Al-Slehat — PhD, Business Faculty, Department of Business Economic, Tafila Technical University, Tafila, Jordan
https://orcid.org/0000-0003-4544-4097
Zalabadi@yahoo.com

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Relationship Between Business Models of Banks and Stability of Economic Development

G.G. Gospodarchuk[a], A.V. Aistov[b], E.O. Suchkova[c]
[a] N.I. Lobachevsky National Research University of Nizhny Novgorod, Nizhny Novgorod, Russia;
[b, c] HSE University, Nizhny Novgorod, Russia

ABSTRACT

Depending on the chosen business model, banks can act as both shock absorbers and crisis catalysts. In this regard, the analysis of the relationship between banks' business models and financial cycles becomes a useful tool for diagnosing and predicting crisis phenomena. The **purpose** of the research is to identify the relationship between the volume of debt of the banking and the debt burden of the economy. The research uses econometric methods. The key result of the research is two new econometric models, which were calibrated for the Russian economy. The models differ from each other by the types of bank liabilities used in the calculation of independent variables. The models also differ from the existing models by the calculation algorithm of independent variables. The source of information is the official statistics of the Bank of Russia for the period 2008–2019. The tests of the models confirmed the presence of a statistically significant cointegration relationship between the debt burden of the banking sector and the debt burden of the economy. Coupling coefficients in the models are identified as debt multipliers of the banking sector and characterize the multiplier effect of changes in the debt burden of banks. For the model containing banks' balance sheet liabilities, the debt multiplier for the Russian economy was 6.7; and for the model using banks' total liabilities was 3.1. The developed models are easy-to-use for forecasting financial cycles.

Keywords: economic stability; banks; business models; credit burden; credit cycles

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INTRODUCTION

The financial crisis and the new regulatory requirements proposed by the Basel Committee on Banking Supervision have had a profound impact on the international banking sector. R. Roengpitya et al. [1] indicate that many banks responded to economic challenges by attempting to transform their business models. According to C. Kok, C. More, M. Petrescu [2], D.V. Tran, K. Hoang, C. Nguyen [3] such restructuring of banks has led to a transformation of their business strategies and balance sheet business models.

However, as P. Cavelaars et al. [4] have rightly pointed out, wrong business models could lead to financial problems in the future. P.M. Tanzi, E. Aruanno, and M. Suardi, M. [5], R. Karkowska [6], M. Farnè M. and A.T. Vouldis [7] come to a similar conclusion.

In general, studies show that the analysis of the relationship between business models of banks and financial cycles serves as a useful tool for a better understanding of the nature of risk inherent in each business model of banks and its contribution to systemic risks. At the same time, an analysis of the scientific literature and regulatory documents shows that research on the relationship between the business models of banks and the financial stability (cyclicality) of the economy is based primarily on the indicators of assets and equity, as well as leverage (in this case, this indicator is seen as the ratio of debt to bank assets), and liquidity indicators.

Our study consists of several sections. The first section is an overview of current research on the transformation of banks' business models and their impact on the financial stability of the economy. The second section includes a description of a sample of data, indicators, methods, and models. The third section is model-based testing and interpretation of results. The next section is devoted to discussion. The last section contains the principal findings.

LITERATURE REVIEW

The term "business model" is interpreted quite broadly, but in most cases, a business model is described as a "list of ways to make a profit" R. Roengpitya et al [1], A. Blundell-Wignall, P. Atkinson, and C. Roulet [8], G. Abuselidze [9]. The experts of the Bank of International Settlements point out that banks dependent on short-term interbank financing are more exposed to risk than banks involved in traditional lending [1].

The expert review of the European banking sector states that it is still the large banks that follow a business model focused on short-term financing in the interbank and stock markets [10, 11]. At the same time, M. Brunnermeier and L. Pedersen [12], note that such banks can experience serious liquidity problems even if there is little financial turbulence.

A large amount of research is devoted to analysing the relationship between banks' equity capital and the cyclical nature of the economy. For example, studies by M. Olszak, S. Roszkowska and I. Kowalska [13] confirmed the pro-cyclical effect of bank capital on lending. U. Noreen, F. Alamdar, and T. Tariq [14], C. Bui, H. Scheule and E. Wu [15] concluded that a moderate increase in the banks' capital buffers is sufficient to sustain the stability of the financial system, as credit supply may be impeded if the banks' capital level is too high. A. Hodbod, S.J. Huber and K. Vasilev [16] identified the extent to which different models of bank capital requirements influence the business cycle. F. Dong and Z. Xu [17] proved that excessive credit creation by the frictional banking sector can lead to overinvestment and, consequently, to endogenous boom and bust cycles.

Several authors note the importance of the impact of bank debts on financial stability. For instance, T. Virtanen et al. [18] analysed the economic stability and concluded that a financial crisis is usually preceded by bubbles of borrowed funds. S.G. Gadzo, H.K. Kportorgbi and J.G. Gatsi [19] and S. Bressan [20] argue that excessive debt in the banking sector can lead to unstable dynamics. Its regulation has a more profound impact on risk than capital regulation [21]. M. King [22] stresses the need to limit bank debt to ensure sustainable economic development. They point out that banks should be funded much more through own equity rather than debt. Furthermore, in an environment of underdeveloped capital markets, especially risk capital markets such as venture capital and private equity, limits on bank borrowing may allow these alternative forms of financing to thrive. This idea underpins the EU Commission's proposals for building a European Union capital markets union.[1]

Another area of research on the impact of balance sheet business models of banks on financial stability is the analysis of the relationship between the leverage of banks and the cyclical nature of the economy. J. Mankart, A. Michaelides and S. Pagratis [23] analysed the impact of regulatory leverage requirements on bank lending. The authors concluded that stricter leverage requirements lead to increased lending and lower bankruptcy rates. J. de Haan, Y. Fang and Z. Jing [24] examined the predictive power of these balance sheet variables for future banking crises. As a result, the authors concluded that a low level of liquid assets and domestic financial liabilities, a high level of external liabilities, and rapid growth of financial leverage are the main indicators of banking crises. Similar conclusions were reached by M. Jarmuzek and R. Rozenov [25] and D. Schoenmaker and P. Wierts [26]. In their publications, they note that leverage can be used as an indicator of the cyclical nature of the economy. In doing so, the predictive power of leverage is approximately comparable to the predictive power of financial predictors commonly used for forecasting. E. Kaya and Y. Koksal [27] concluded that leverage is procyclical. Leverage procyclicality can trigger financial cycles and credit cycles during periods of bank asset growth. Similar conclusions were reached by M. Gross, J. Henry and W. Semmler [28]. In their research, they proved that a banking system with high leverage can lead to volatile dynamics.

Overall, the research and professional literature analyses the transformation of the business models of banks primarily in terms of changes in assets, equity, debt, and leverage of banks, as well as the impact of these changes on the size of banking risks and the sustainability of the economy. The ratio of borrowed funds to equity reflects the level of relative debt burden in the banking sector and serves as a convenient tool for identifying the relationship between banks' debt and the debt cycles of the economy.

[1] EU Commission, 2015. Building a capital markets union. EU Commission Green Paper, Brussels. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52015DC 0063 (accessed on 14.01.2022).

All this predetermines the need to study the potential of financial leverage (as a ratio between borrowed and own funds) in analyzing the debt burden of the banking sector and its relationship with the debt burden of the economy.

This research aims to identify the relationship between the debt burden of the banking sector in the form of a ratio between borrowed and own funds of banks and the debt burden of the economy, which makes it possible to assess the debt multiplier of banks (the multiplier effect from changes in their business models).

MATERIALS AND METHODS

Sampling and Data

Since the economies and banking systems of the countries differ in the level of development and mechanisms of state regulation, one country — Russia — was chosen as the subject of the research. The research used a 100% sample of banks with different types of ownership (banks with state participation, banks with foreign capital participation, other banks). This allowed considering the Russian banking system as a natural experimental platform for studying the debt burden of the banking sector and its multiplier effect.

The source of information is the official statistical data of the Bank of Russia for the period 2008–2019 (from April 1, 2008, through July 1, 2019). The limitation of the period is due to the lack of available data on financial stability, which began to be published by the Bank of Russia in 2008.

The database includes quarterly data on the Russian economy and monthly data on the entire Russian banking sector. Quarterly data on financial stability were converted to monthly values. The conversion assumed that these data would change evenly within one quarter.

Measurement of Financial Indicators

This section describes the key variables used in building regression models. It should be noted in advance that the dependent variable measured the credit cycle, while the independent variable was used to measure the debt burden of banks.

Dependent Variable

Currently, the main measure of the credit cycle phase is the Credit Gap, Credit-to-GDP, debt service ratio, and credit cycle indicators (main and auxiliary) [BCBS, 2010 and Bank of Russia 2016].

Each of the above indicators has its advantages and disadvantages. They consist of the following.

1. The Credit Gap indicator was recommended by the Basel Committee on Banking Supervision[2] to assess the credit cycle phase of countercyclical macroprudential regulation. It is calculated as a deviation of the actual Credit-to-GDP ratio from its long-term trend. The credit gap indicators are practically applicable both to the credit market as a whole and to its segments. In addition, these indicators are quite informative. At the same time, they do not predict crisis periods equally well in all the domains. For example, the European Systemic Risk Board[3] notes that the credit gap is not always a reliable benchmark for determining the level of countercyclical mark-ups and recommends that European countries use different approaches to calculating credit gaps.

Also, scientific publications regularly criticize this indicator [28, 29]. However, the main drawback is that the indicator does not apply to countries with emerging markets, which are characterized by structural shifts in the development of the economy and financial sector. Thus, the analytical papers by the Bank of Russia[4] note that in emerging markets the GDP gap does not perform better than the usual indicators of the credit cycle.

2. The "Credit-to-GDP" indicator is a standard indicator of the credit burden of the economy. It is defined as the ratio of loans and other placed funds provided to non-financial organizations and individuals to the gross domestic product. Most countries use this indicator as an alternative measure of the credit cycle

[2] Basel Committee on Banking Supervision (BCBS), 2010. Guidance for national authorities operating the countercyclical capital buffer. URL: https://www.bis.org/publ/bcbs187.htm (accessed on 16.01.2022).

[3] European Systemic Risk Board (ESRB), 2018. The ESRB handbook on operationalising macro-prudential policy in the banking sector. URL: https://www.esrb.europa.eu/pub/pdf/reports/esrb.report180115_handbook~c9160ed5b1.en.pdf (accessed on 16.01.2022).

[4] Bank of Russia, 2016. Report on the national countercyclical capital buffer requirement. Bank of Russia. URL: http://www.cbr.ru/Content/Document/File/50246/Report_1612.pdf. (accessed on 20.01.2022).

phase.4 The ECB also uses this indicator due to its good predictive power.

3. The debt service coverage ratio (DSC) is defined as the ratio of the principal and interest payments flow of current income.[5] The DSC is calculated for the aggregate liabilities of individuals and non-financial organizations. However, due to the lack of regularly updated statistics on the value of the debt service coverage ratio, its use in scientific research is very limited.

4. The credit cycle indicators, as well as the credit gap indicators, belong to the class of early warning indicators, which indicate the possibility of future crisis events in advance. The main indicator of the credit cycle is a binary variable, which is calculated based on five indicators[6]: annual GDP growth rate; debt service coverage ratio; banks' liabilities to non-residents (in % of domestic credit); the share of value-added produced by the financial sector of GDP; deviation of domestic credit to GDP ratio from the trend (based on the HP filter, $\lambda = 400{,}000$). In terms of its content, this indicator is a combination of previous indicators, so it aggregates not only their strengths but also their weaknesses.

A summary of the results of the analysis shows that the best measure for the credit cycle phase is the Credit-to-GDP indicator. An additional advantage of this indicator is that the debt of financial organizations is not taken into account when calculating the amount of debt. This avoids double-counting when identifying the relationship between the debt burden of the banking sector and the debt burden of the economy.

Independent Variable

The relative debt ratio of banks was used as an independent variable as the ratio of the banks' liabilities to equity. The banks' liabilities are known to be reflected in both on and off-balance sheet items. Therefore, to better account for the debts of banks, two measures of debt were considered: balance sheet (includes only balance sheet liabilities) and total (includes both on-balance sheet and off-balance sheet liabilities).

The off-balance sheet liabilities were included in calculations for three main reasons.

First, accounting for off-balance sheet transactions of banks meets the basic principles, requirements, and standards of Basel III.

Second, off-balance sheet liabilities occupy a high share of the total debt of Russian banks, and this share tends to grow (*Fig. 1*).

Third, changes in the volume of off-balance sheet liabilities are highly volatile (*Fig. 2*).

Based on the above, the debt ratios of the banking sector (financial leverage) can be calculated using the following formulas:

$$Zb = B / C, \quad (1)$$

$$Zo = (B + V) / C, \quad (2)$$

where Zb — balance sheet leverage; Zo — total leverage; B — balance sheet liabilities of the banking sector, mln rub; V — off-balance sheet liabilities of the banking sector, mln rub; C — capital of the banking sector, mln rub.[7]

Compared to the indicators already used in banking sector analysis, the proposed indicator has the following advantages:

- It implies a simplified nature of settlements, which increases the possibility of its use by analytical services that do not have access to all primary bank reports;
- Official statistics on this indicator are available and are updated regularly;
- The indicator can be used to measure the debt burden of the banking sector at both the macro and micro levels of the economy.

The use of two measures of bank debt (1), (2) necessitated the study of two types of relationship between bank debt and economic cyclicality. In theory, this relationship can be described in the following models:

$$Y = f(Zb), \quad (3)$$

$$Y = f(Zo), \quad (4)$$

where Y — Credit-to-GDP ratio.

[5] Bank of Russia, 2019a. On determining the stage of the credit cycle and the procedure for establishing a national countercyclical capital buffer requirement. Public consultation report. URL: http://cbr.ru/Content/Document/File/72455/Consultation_Paper_190617.pdf (accessed on 16.01.2022).

[6] Bank of Russia, 2016. Report on the national countercyclical capital buffer requirement. Bank of Russia. URL: http://www.cbr.ru/Content/Document/File/50246/Report_1612.pdf (accessed on 20.01.2022).

[7] Bank of Russia, 2018. On methods of determining own funds (capital) of credit institutions (Basel III). Bank of Russia regulation No. 646-P dated 04.07.2018 (ed. 06.06.2019). URL: http://docs.cntd.ru/document/901853155 (accessed on 30.01.2022).

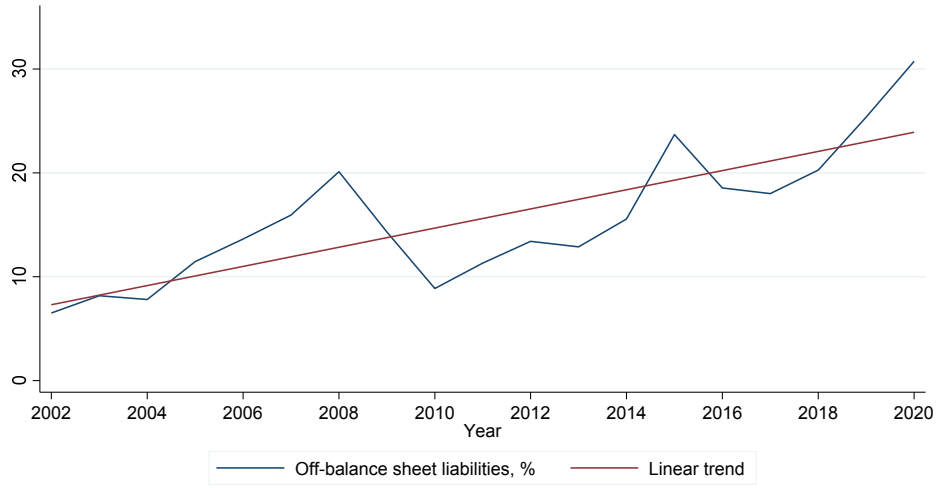

Fig. 1. **Share and Linear Trend of Off-Balance Sheet Liabilities in Total Russian Banking Sector Liabilities (%)**

Source: Compiled by the authors based on data from the official website of the Bank of Russia www.cbr.ru

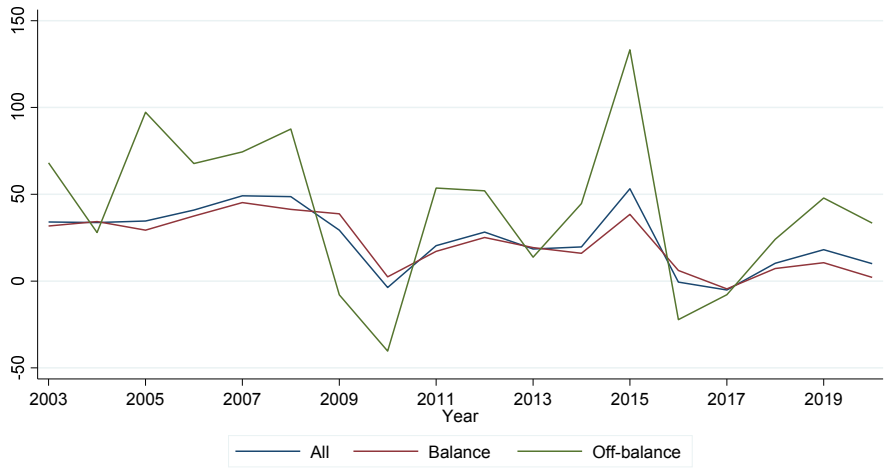

Fig. 2. **Growth Rates of Balance Sheet Liabilities, Off-Balance Sheet Liabilities, and All Russian Banking Sector Liabilities, %**

Source: Compiled by the authors based on data from the official website of the Bank of Russia www.cbr.ru

RESULTS

Changes in the indicators under review over time are shown in *Fig. 3*.

Since the data used (*Fig. 3*) are similar to non-stationary time series, we start with the unit root tests. Each of them could be performed as the well-known Dickey-Fuller [44] test of $\rho = 1$ in the model:

$$y_t = \alpha + \rho y_{t-1} + \delta t + u_t, \quad (5)$$

where y_t is the value of indicator of interest in month t, and u_t is an identically independently distributed error term with zero average. However, in such a regression, serial correlation is possible. To control for that, we use the Augmented Dickey–Fuller (ADF) test which fits the model:

$$\Delta y_t = \alpha + \beta y_{t-1} + \delta t + \sum_{j=1}^{k} \varsigma_j \Delta y_{t-j} + \varepsilon_t. \quad (6)$$

Testing $\beta = 0$ is equivalent to $\rho = 1$ that means that y_t is a unit root process. By other words, the null is that y_t contains a unit root, and the (one-sided) alternative is that the process is stationary.

We separately applied model (6) to each of *Y*, *Zb*, and *Zo* testing for unit root. The number of lags *k* in ADF regressions was chosen based on the conditions for minimizing information criteria (FPE, AIC, HQIC). According to these criteria, $k = 4$ for series *Y* and $k = 1$ for *Zb* and *Zo*.

Fig. 3. **Dynamics of *Y*, *Zb*, and *Zo***

Source: Compiled by the authors based on data from the official website of the Bank of Russia www.cbr.ru

Table 1

ADF Tests for Unit Root

	No trend	With a trend
Y	–1.065	–1.097
Δ*Y*	–5.047***	–5.090***
Zb	–0.832	–2.763
Δ *Zb*	–5.133***	–5.162***
Zo	–0.130	–3.029
Δ *Zo*	–4.447***	–4.664***

Source: Compiled by the authors.

Note: *** – significance level 1%.

The results of the tests are presented in *Table 1*. The Table shows that the variables in focus are integrable processes of the first order, $I(1)$.

Taking into account that the series of interest are non-stationary in levels but stationary in the first difference, we estimate two cointegrating regressions in the form:

$$y_t = \beta_1 + \beta_2 x_t + z_t, \quad (7)$$

where *Y* was used as dependent variable and *Zb*, and *Zo* as explanatory variables in each of the both. After that two auxiliary regressions were estimated to reveal whether the residuals of (7), $\hat{z}_t = y_t - \hat{\beta}_1 - \hat{\beta}_2 x_t$, are *I*(0):

$$\Delta\hat{z}_t = \gamma\hat{z}_{t-1} + u_t, \quad (8)$$

the corresponding results are presented in *Table 2*.

R.F. Engle and C.W.J. Granger [30] suggest several tests for determining if z_t is stationary (which means that y_t and x_t are cointegrated). One of them, namely the Durbin-Watson (DW) statistic for the cointegration equation is also presented in *Table 2*.

DW value significantly different from zero rejects the hypothesis that residuals are a random walk [30]. The critical value at the 5% level for the hypothesis of *I* (1) versus *I* (0) is 0.17 [30], so that *Table 2* gives an evidence that *Y* and *Zb* are cointegrated. Unfortunately, we could not use the "classical" critical values for t-statistic in (8) to reject the null hypothesis of the unit root of the cointegrating residuals, $\hat{z}_t$.

To avoid the problem with critical values we use Johansen vector error-correction model (VECM) framework using Stata's command *vec*. The results are presented in *Table 3*.

Table 3 represents estimates of parameters of the following models:

$$\Delta y_t = \alpha\beta' y_{t-1} + \Gamma\Delta y_{t-1} + \gamma + \nu_t, \quad (9)$$

where y is a 2×1 vector of $I(1)$ variables, $\begin{pmatrix} Y \\ Zb \end{pmatrix}$ and $\begin{pmatrix} Y \\ Zo \end{pmatrix}$.

From the first column it is easy to see parameter estimates for the first model represented by (9):

$$\hat{\alpha} = (-0.007 \quad 0.020)$$

Table 2

Explanatory variables	Model (7)	Model (8)	Model (7)	Model (8)
Zb	5.546***			
	(0.273)			
Zo			3.140***	
			(0.156)	
$\hat{z}_{t-1}$		−0.106***		−0.052*
		(0.037)		(0.028)
Constant	1.920		14.296***	
	(1.955)		(1.367)	
Observations	136	135	136	135
R-sq. adjusted	0.753	0.052	0.749	0.019
F-st.	412.6***	8.4***	404.1***	3.6*
DW	0.19	2.02	0.01	1.91

Source: Compiled by the authors.

Note: Standard errors in parentheses; * $p < .1$, ** $p < .05$, *** $p < .01$.

$$\hat{\gamma} = (0.022 \quad 0.008)$$

$$\hat{\Gamma} = \begin{pmatrix} 0.733 & -0.082 \\ 0.184 & -0.011 \end{pmatrix}$$

By the same way we can identify VECM parameter estimates which correspond to the second column of *Table 4*. Vectors βs are also estimated and they are $\hat{\beta} = (1 \quad -6.678)$ and $\hat{\beta} = (1 \quad -3.064)$. These results with the necessary descriptive statistic are presented in *Table 4*.

Tables 3 and *4* indicate that the models fit well. *Table 4* reports coefficient on *Zb* and *Zo* in the cointegrating equations are statistically significant. The results indicate strong support for that $Y - 6.678Zb + 5.445$ and $Y - 3.064Zo - 15.705$ should be stationary series.

DISCUSSION

As a result of the study, two econometric models were constructed that characterize the impact of business models of Russian banks on the sustainability of economic development. The indicator "Credits to GDP" was used as a dependent variable in both models. An independent variable in one model is the indicator "Ratio of balance sheet liabilities to the capital of banks", and in the other model — "The ratio of total (balance sheet and off-balance sheet) liabilities to the capital of banks".

It is important to note that the ratio "liabilities to equity" is similar to "leverage" in its traditional interpretation. This indicator is widely used in the analysis of the stability of the non-financial sector of the economy, but it is never applies to the banking sector. In their study of banking leverage as a tool for diagnosing and regulating financial stability, most authors rely not on financial leverage, known as the debt-to-equity ratio, but on other types of leverage: balance sheet, economic, and embedded E. Kaya and Y. Koksal [27]. Moreover, the regulatory requirements for banks imposed by international financial institutions and national regulators are also based on a specific interpretation of the leverage ratio. For example, to improve the effectiveness of bank regulatory reform, the Basel Committee on Banking Supervision has recommended that central banks in countries introduce a new standard with requirements for the leverage ratio. The leverage ratio was defined by the BCBS as the ratio of Tier 1 capital to total assets (including balance sheet and off-balance sheet items), unweighted by risk. The proposed leverage ratio is essentially similar to the capital adequacy ratio, the only difference being that its calculation is based on a very wide range of assets, including off-balance sheet liabilities.[8] This ratio makes it difficult for banks to use many of the strategies created to circumvent capital requirements and acts as an additional capital requirement for banks. Based on BCBS recommendations, central banks use the term "leverage" in a similar interpretation. For example, starting from January 01, 2018, the Bank of Russia introduced a financial leverage ratio (H1.4), which is calculated as the ratio of a bank's fixed capital

[8] Basel Committee on Banking Supervision (BCBS), 2014. Basel III leverage ratio framework and disclosure requirements. URL: https://www.bis.org/publ/bcbs270.htm (accessed on 30.01.2022).

Table 3

Explanatory variables	Model (9) for $y = \begin{pmatrix} Y \\ Zb \end{pmatrix}$	Model (9) for $y = \begin{pmatrix} Y \\ Zo \end{pmatrix}$
Adjustment coefficient α	−0.007	−0.013
	(0.008)	(0.008)
ΔY_{t-1}	0.733***	0.719***
	(0.062)	(0.062)
ΔZb_{t-1}	−0.082	
	(0.104)	
ΔZo_{t-1}		−0.028
		(0.079)
Constant	0.022	0.019
	(0.023)	(0.023)
Adjustment coefficient α	0.020***	0.014
	(0.007)	(0.009)
ΔY_{t-1}	0.184***	0.217***
	(0.052)	(0.070)
ΔZb_{t-1}	−0.011	
	(0.088)	
ΔZo_{t-1}		0.032
		(0.089)
Constant	0.008	0.018
	(0.020)	(0.027)
Observations	134	134
AIC	−2.582	71.413
SBIC	0.190	0.742
HQIC	0.075	0.627
Log likelihood	9.3	−27.7
R-sq. 1	0.570	0.574
chi2 1	172.3	175.2
R-sq. 2	0.130	0.091
chi2 2	19.5	13.0

Source: Compiled by the authors.

Note: Standard errors in parentheses; *** — significance level 1%.

to the amount of balance sheet assets weighted by credit risk (100%); credit risk on credit-related contingent liabilities; credit risk on transactions with derivatives; credit risk on transactions for the purchase and sale of securities without derecognition with the obligation to resell (buy) securities and on securities

Table 4

Cointegrating Equations

Variables	Coefficients	
Y	1	1
Zb	−6.678***	
	(0.985)	
Zo		−3.064***
		(0.747)
Constant	5.445	−15.705
Observations	134	134
chi2	46.0***	16.8***

Source: Compiled by the authors.

Note: Standard errors in parentheses; *** — significance level 1%.

lending transactions[9] (Bank of Russia, 2019b). The H1.4 calculation algorithm shows that the financial leverage ratio, despite its name, remains essentially a capital adequacy requirement for banks and not a requirement to limit the volume of resources raised. This interpretation of financial leverage complicates the analysis of the formation of banks' funding base, identifies debt cycles in this sector of the economy, and develops regulatory requirements to maintain an optimal ratio between own and borrowed funds.

Model testing confirmed the presence of a statistically significant cointegration relationship between the analyzed indicators. Thus, the results of the study showed that changes in the business models of banks in terms of the ratio of borrowed and own funds are a good indicator for identifying the sustainability of economic development. This finding confirms the findings of P. Cavelaars et al. [4], P.M. Tanzi, E. Aruanno and M. Suardi [5], R. Karkowska [6], M. Farnè and A.T. Vouldis [7], which note that, depending on the chosen business model, banks can increase the procyclicality of the financial and economic system, and analysis of the relationship between banks' business models and financial cycles is a useful tool to better understand the nature of risk inherent in each business model of banks.

The regression coefficients obtained in the developed models indicate the presence of a direct dependence of the debt of banks from the debt of the economy. This conclusion is consistent with the findings for research

[9] Bank of Russia, 2019b. On mandatory norms and surcharges to capital adequacy ratios of banks with universal license. Instruction of the Bank of Russia No. 199-I dated 29.11.2019. URL: http://docs.cntd.ru/document/564062416 (accessed on 22.01.2022).

by F. Dong and Z. Xu [17], S.G. Gadzo, H.K. Kportorgbi and J.G. Gatsi [19], E. Kaya and Y. Koksal [27], T. Virtanen et al. [18], M. Gross, J. Henry and W. Semmler [28] and others, who claim that debt in the banking sector can lead to unstable dynamics. The study also confirmed the findings of M. Jarmuzek and R. Rozenov [25] and D. Schoenmaker and P. Wierts [26]. J. de Haan, Y. Fang and Z. Jing [24], conclude that leverage can be used as an indicator of the cyclical nature of the economy.

The peculiarity of the study is that the developed models are based on aggregate indicators of bank liabilities and can be considered as a "core" for developing their modifications. Models can be modified and possibly improved by using only the most significant liabilities of banks in terms of their impact on the cyclical economy, and not the aggregate liabilities of banks. In essence, these modifications will mean the transition from single-factor models to multi-factor ones. In addition, the developed models can be the subject of further research in terms of their adaptation to the economies of different countries.

CONCLUSIONS

The purpose of the study was to identify the relationship between the business models of banks and the cyclical nature of the economy. As a result of the study, two econometric models were constructed that characterize the relationship between the debt burden of banks and the debt burden of the economy. One of the models characterizes the impact of banks' balance sheet liabilities on the economy's cyclicality, while another model characterizes the impact of banks' total (balance sheet and off-balance sheet) liabilities on the economy's cyclicality. The coupling coefficients obtained in the models were interpreted as a multiplier of banks' debt.

The use of indicators "the ratio of balance sheet liabilities to the capital of banks" and "the ratio of total liabilities to the capital of banks" as independent variables in the models were not found in similar studies and characterizes the novelty of the developed models.

The resulting models were applied to the Russian economy. For the first model, the debt multiplier of Russian banks was 6.7, and for the second model was 3.1. This means that with an increase in the ratio of balance sheet liabilities of banks' capital by 1%, comes an increase in the debt burden of the economy by 6.7%; and with an increase in the ratio of total liabilities to the capital of banks by 1% — an increase in the debt burden of the economy by 3.1%. With a decrease in the debt burden of banks, there will be a corresponding decrease in the debt burden of the economy.

The models developed in this study apply to crisis forecasting in a manner similar to traditional early warning models. The advantage of models is simplicity and ease of use. The resulting bank debt multipliers are additional tools for predicting the phase of the credit cycle. In addition, the banking sector's debt multiplier can easily be included in financial stability supervisors' tools.

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ABOUT THE AUTHORS

Galina G. Gospodarchuk — Dr. Sci. (Econ.), Prof., Department of Finance and Credit, N.I. Lobachevsky National Research University of Nizhny Novgorod, Nizhny Novgorod, Russia
https://orcid.org/0000-0003-3660-6779
Corresponding author:
gospodarchukgg@iee.unn.ru

Andrey V. Aistov — Cand. Sci. (Phys. and Math.), Assoc. Prof., Department of Economic Theory and Econometrics, HSE University, Nizhny Novgorod, Russia
https://orcid.org/0000-0003-4747-0803
aaistov@hse.ru

Ekaterina O. Suchkova — Senior Lecturer, Department of Banking, Deputy Dean of the Faculty of Economics, Academic Supervisor of Master's Program "Finance", HSE University, Nizhny Novgorod, Russia
https://orcid.org/0000-0001-5943-4645
esychkova@hse.ru

***Authors' declared contribution*:**
G.G. Gospodarchuk — problem statement, development of article concept, critical review of the literature, development of methodology, description of results and formation of research conclusions.
A.V. Aistov — development of an empirical model and interpretation of the results, formation of research conclusions.
E.O. Suchkova — critical review of the literature, development of methodology, collection of statistical data, tabular and graphical presentation of results, description of results and formation of research conclusions.

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Government Tax Regulation in the Agricultural Sector in Conditions of Import Substitution Policy

M.E. Kosov[a], E.V. Golubtsova[b], E.S. Novikova[c]
[a] Financial University, Moscow, Russia;
[a, b, c] Plekhanov Russian University of Economics, Moscow, Russia

ABSTRACT

The **relevance** of the research is defined by the promotion of food security improvement for Russia and the importance of government regulation in this process. The **purpose** of the paper is the hypothesis verification on the positive impact of the revealed methods in the government tax regulation on the national agricultural industry development in conditions of import substitution policy with further increase of food security level in the country. The **task** of the paper is the analysis of government regulation methods for the development of agricultural sector. Key **methods** of the research are the collection and analysis of statistical data, their comparative analysis, the study of normative data base in tax regulation of agricultural sector and other documents related to the food security of the country. Authors analyze the dependence of national agricultural industry on import components. Based on that the main problems of food security in the country are revealed including the low seed fund, the lack of breeding stock, the lack of veterinarian vaccines and other medicine, weak investments in fixed capital and productive capacity, the lack of research institutes and laboratories in this sector of economy. In accordance with these reasons, authors consider the tools of government regulation in the agricultural sector of economy including the tax stimulation, grants and subsidies, preferential loans and other mechanisms, which could support the effective development of national agricultural complex. The analysis of statistical data by Federal Tax Service of Russia has indicated the effectiveness of government tax stimulation of agricultural producers, which is proved by the growth of tax revenue from this category of taxpayers, despite their decrease. Researchers indicate the development of government tax regulation measures by targeted use of tax tools for the target of a decrease in the loss of tax revenue and increase investments in fixed capital in the agricultural sector.

Keywords: import substitution; agricultural sector of economy; government regulation; agricultural producers; tax support; preferential loans; food security; subsidies; fundings; export; import; investments

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INTRODUCTION

The development and success of any country's agriculture have a direct impact on its food security, and thus on the survival of the population in a given economy during various types of crises, both natural and man-made. When there is a natural crisis, such as a possible crop failure or natural disasters, there is a possibility of obtaining the necessary products from partner countries or using the harvested products of the past years. If we are talking about man-made crises due to influencing some countries on others or creating competitive advantages of some companies against others, there is a more difficult task of increasing the level of independence of the national agriculture from the external environment, which has become a key goal of the import substitution policy of the Russian Federation since 2014.

The independence of Russian agriculture from imported food was first considered after the collapse of the Soviet Union in 2010 with the adoption of the first Food Security Doctrine.[1] According to this Doctrine, the share of domestic products in the Russian market was to grow to 80–95% by 2020, and also set a goal of price availability of products for the population of the country throughout its territory. The latter includes the possibility of a direct impact on the nutritional balance of the country's citizens, resulting in a reduction in chronic diseases, and thus an increase in life expectancy of all segments of the population.

Based on the latter statistical information, the import substitution policy in the field of agriculture for the last 8 years can be called one of the most successful in comparison with other sectors of the Russian economy: the share of imported products in the retail sector decreased from 36% (2005) to 24% (at the end of 2021), the turnover of plant crops increased by 3.5 times — to 3.6 trln rub. from 2010, and livestock — twice — to 2.9 trln rub.[2]

Of course, the results are there, and there is a positive dynamic, which indicates the right strategy of support for agriculture by the state, which requires its analysis for use in other sectors of the domestic economy.

LITERATURE REVIEW

Food Security Issues was also the first to identify at the World Food Conference in Rome in 1974 [1]. In accordance with established Doctrine, the basic principles of food security for all countries were considered: economic accessibility of food, stable access to safe and quality food, availability of food, as well as consumption of the required amount of food according to the relevant dietary standards.

Subsequently, the World Food Summit in 1996 defined food security by which every person must have both physical and economic access to sufficient, safe and nutritious foodFurther particular emphasis was placed on socio-economic access to food, which was formalized by the Declaration of the World Summit on Food Security [2, 3].

Among foreign scientists should be noted those who laid the theoretical basis and methodological principles of studying the problem of food security of the country, including P. J. Ericksen, T. Lang and D. Barling, A. Moragues-Faus etc. [4–6]. These scientists were able to identify the interlinkages of the global food production system, including health, trade and logistics, environment, technological and scientific progress, policy and economics in general.

Criteria and indicators for food production include the level of food independence, the level of production of basic agricultural products, and the level of budgetary support for agricultural producers [7].

[1] Decree of the President of the Russian Federation "On approval of the Food Security Doctrine of the Russian Federation". URL: https://base.garant.ru/73438425/ (accessed on 10.11.2022).

[2] Share of expenses of Russians on food. "Vedomosti". 2020. URL: https://www.vedomosti.ru/economics/news/2020/12/14/850883-analitiki-otsenili-dolyu-rashodov-rossiyan-na-edu (accessed on 20.12.2022).

Some researcher, especially the Scandinavian countries, use the ratio of consumption and household income to evaluate food security, including the value of the market basket in each region of the country [8]. In recent years, there has been much research on the impact of the pandemic on the food security of countries with regard to the gap of global value chains between economies and entire regions [9–11].

As for the import substitution policy in agriculture, the theoretical aspects and the evolution of its development were examined in the papers by Z. S. Podoba, A. A. Moldovan and A. A. Faizova [12]. These theoretical aspects were also considered using mathematical models, including input-output model for various countries, including Russia [13, 14]. The issues of differentiation of consumption of basic agricultural products according to the level of income of the population were studied by V. V. Maslova, V. S. Chekalin and M. V. Avdeev [15]. The problem of dependence of the domestic agro-industrial complex on the supply of imported equipment and other logistics was analysed. At the same time, factors of effective agricultural food import substitution in Russia were presented by M. Lyavina [16].

Thus, food security issues, as well as estimates of its critical level have been studied by both foreign and Russian scientists over the past 70 years, which is explained, on the one hand, by the significant economic growth of the all-world economy, and on the other hand — limited resources, which directly affects the food supply of countries. At the same time, import substitution policy becomes one of the fundamental for the further sustainable development of domestic agriculture, in which connection it is important to consider the positive results of state regulation of the industry, and possible next steps for its development with analyzed problems in this sector of the economy.

METHODOLOGY

The task of this study — analysis of methods of state regulation for the development of agriculture under conditions of import substitution and its impact on the food security of the country.

The object of the study — agriculture under the conditions of import substitution policy. The subject of the study are measures of state regulation aimed at reducing the dependence of the domestic economy on imported products in agriculture.

The purpose of the paper — verification of hypothesis about the positive impact of the revealed methods of state tax regulation on the development of domestic agriculture in the context of the policy of import substitution with the subsequent increase in the level of food security of the country.

The main methods used in this study include the collection and processing of statistical data, their comparative analysis, the study of the regulatory framework for the tax regulation of the agro-industrial sector and other documents related to food security of the country.

MAIN RESULTS

If we consider the dynamics of development of import substitution policies in agriculture of the Russian Federation over the last decade, the main successes were achieved in the production of domestic pork (0.2% of imports), flour (1.1% of imports), cereals (1.1% of imports), sausage products (1.3% of imports) and poultry meat (4.7% of imports).

The high import share remains in cheeses (32.5%), animal oils (29.5%), vegetable oils (17%), beef and sub-products (27.6%). In the Russian import structure, the share of food and agricultural raw materials for 2021 was 12%, ranking third after imports of machinery and equipment (47%) and chemical products (18%).[3]

[3] URL: https://rosstat.gov.ru/storage/mediabank/Ejegodnik_2021.pdf (accessed on 11.11.2022).

The greatest dependence of the Russian economy in agriculture is in the supply of fruits and nuts (17%), various beverages (10%), dairy products, eggs and honey (8.7%), seeds and fruits (7%), fats and oils (6.4%), fish and seafood (6.3%).[4]

The main food suppliers to Russia are Belarus (13.5%), Turkey (5.5%), Brazil (4.7%), Ecuador (4.3%) and China (4.2%).

If we consider the level of self-sufficiency of Russia by product categories, the main attention should be paid to the cultivation of their own fruits and berries in accordance with the climatic zone, and production of food salt also (*Fig. 1*).

Agriculture there are problems that should be dealt with as soon as possible. One such problem is seed shortages for the main agricultural crops of the national selection.

Thus, there are difficulties in the seed bank of sugar beet and potatoes, the seeds of which are imported to Russia mainly from France and Germany. Dependence on sunflower seed supply is almost 75%, and key seed suppliers are Turkey, USA, Spain and France. Dependence on corn is lower, but it is still 55%, and the key countries — suppliers of culture are Romania and Serbia (*Table 1*).

In addition to the seed bank of crops, there are problems in modern livestock: the share of imported bull semen at the end of 2020 amounted to 40%, and a quarter of the data of supply is carried out from the USA. Inseminate cows are also imported: almost 50 thous. cows (15% import) from Germany, Denmark and the Netherlands arrived in 2021. Imports of chicken incubation eggs at the end of 2021 accounted for 20% of the total Russian production, and the main suppliers are also the Netherlands and Germany.

The second unresolved problem in agriculture is the number of imported veterinary vaccines or their components on the Russian market. At the moment, the industry itself of veterinary products according to the classifiers of economic activities does not exist, so there can be no question of subsidies from the State. Hungary (1 532 tons), the Netherlands (1 262 tons), the USA (849 tons), Spain (657 tons), Mexico (323 tons) and Belarus (309 tons) were the main importers of veterinary vaccines over the past five years.

Belarus, which was in a better position after the collapse of the Soviet Union and was able to maintain research and development and fixed assets in strategic sectors of the economy, can help to solve this problem.

Third problem remains the issue of investment in fixed capital and productive capacity in agriculture. If investments in fixed assets from 2017 to 2020 increased by 65.5 billion rubles, amounting to 466 billion rubles, then most of the equipment is imported from other countries, taking into account the constant indicators on the production of basic agricultural machinery, i.e. investments received are spent on the acquisition of missing equipment (*Table 2*).

At the same time, it is worth mentioning the development of research institutes and laboratories in the field of agricultural development, which, for the most part, after the collapse of the Soviet Union, were bankrupted and closed for the purpose of purchasing imported products. Work in this direction is carried out. Budget financing of such institutes in the sphere of agricultural sciences increased from 6.6 bln rub. in 2013 to 15 bln rub. in 2021. 114 new laboratories in the field of selection, seed production and molecular genetics have been created in the last three years with the involvement of 1.1 thous. new researchers.[5]

Another problem is the uncompetitive wages of this sector of the economy as

[4] URL: https://rosstat.gov.ru/storage/mediabank/Ejegodnik_2021.pdf (accessed on 11.11.2022).

[5] Website of the Ministry of Science and Higher Education of the Russian Federation. The funding of the research institute in the sphere of agriculture is doubled. 01.02.2022. URL: https://minobrnauki.gov.ru/press-center/news/novosti-ministerstva/46630/ (accessed on 14.11.2022).

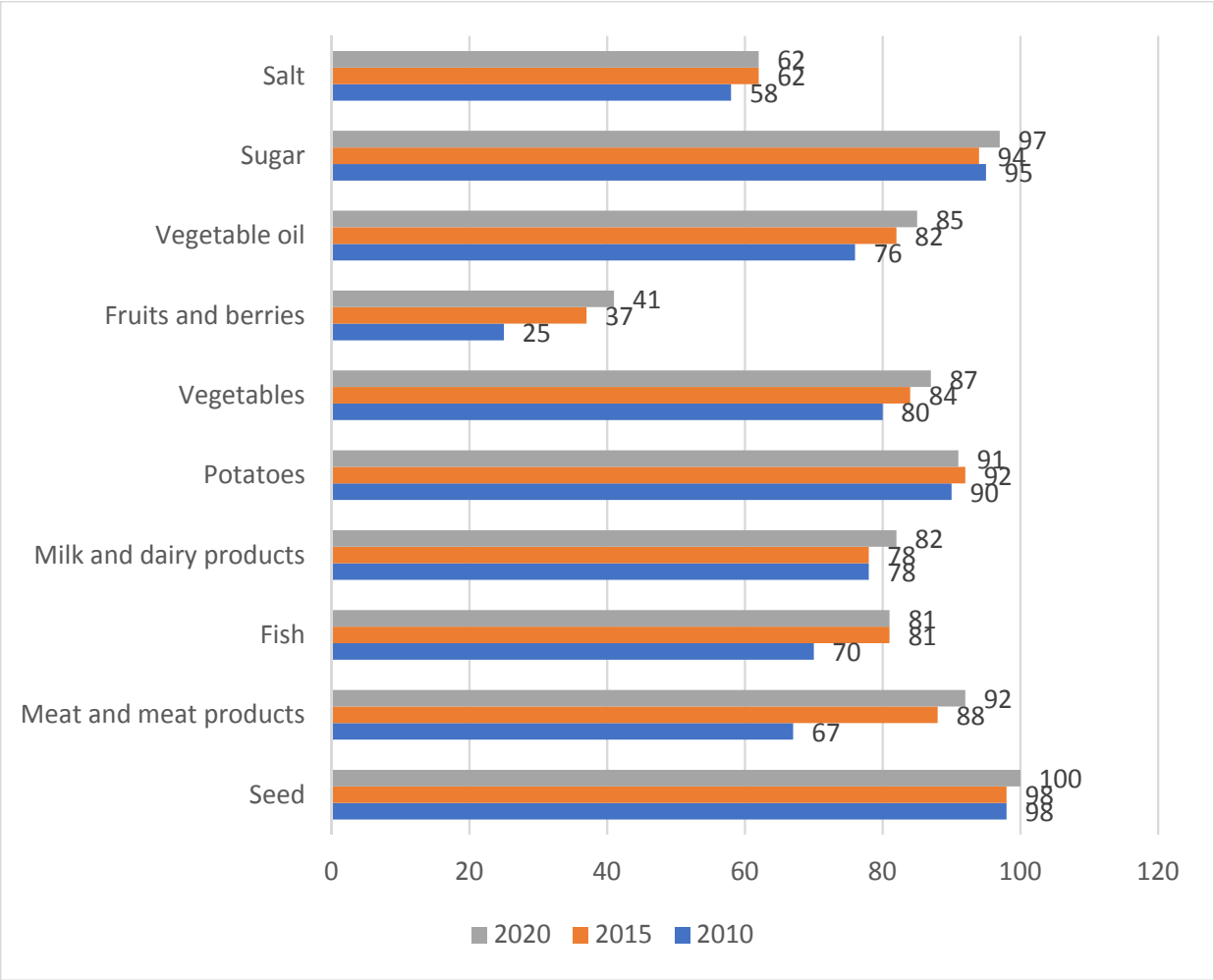

Fig. 1. **Share of Russian Food Products in the Domestic Market, %**

Source: tatistical manual 2021. URL: https://rosstat.gov.ru/storage/mediabank/Ejegodnik_2021.pdf (accessed on 11.11.2022).

Table 1

Share of the Russian Seeds by Various Crops in the Russian Agricultural Sector, 2021

Variety of crops	Volume of seeds (thousands of ton)	Share of Russian seeds (%)
Winter wheat	3330.4	90.5
Spring wheat	2454.4	82.2
Barley	1702.9	63.2
Sugar beet	3.9	0.6
Vegetable crops	5.3	43
Sunflower	37.2	26.5
Potatoes	777.3	9.7
Corn	77.7	45.8
Rapeseed	9.3	31.7
Soybean	346.2	41.8

Source: Ministry of Agricultural Industry in Russia. URL: https://mcx.gov.ru/upload/iblock/46c/3gb0awoe1q4k2amabk3g36tzi9rwfvmp.pdf (accessed on 11.11.2022).

Table 2

Production of the Main Types of Agricultural Machinery Equipment (Thousand Pieces)

Category	2018	2019	2020
Tractors	7,1	6,6	7,2
Cultivators	40,7	47,5	43,6
Rippers	33,4	30,1	35,7
Machines for tilling the soil	5,9	5,7	5,2
Press for straw and hay	3,3	3,3	3,4
Harvesters	4,6	4,8	5,4

Source: Statistical manual 2021. Rosstat. URL: https://rosstat.gov.ru/storage/mediabank/Ejegodnik_2021.pdf (accessed on 11.11.2022).

compared to other sectors, which hinders the development of agriculture.

Agriculture, health, education, manufacturing based on average wages in the country are not considered as priority and strategically important sectors for the domestic economy (*Fig. 2*).

Nevertheless, Russia has all the opportunities to make agriculture its competitive advantage [17]. This is a strategic area where economic sovereignty can be achieved. State support mechanisms for the agricultural sector include not only grants and subsidies for agricultural producers, but also preferential loan programmes and tax preferences. Tax solutions help to stimulate import substitution, attract investment in agriculture and increase employment in this industry [18]. Tax mechanisms can compensate for budget losses over time by increasing the number of taxpayers and broadening the tax base in the future.

Agricultural producers can apply special tax regimes, which significantly reduces the tax burden. The most attractive conditions for this category of taxpayers provide unified agricultural tax (UAT),[6] but conditions of transition to it — the most difficult among all special tax regimes. Only those organizations and individual entrepreneurs whose share of proceeds from the sale of own-made agricultural products makes at least 70% can apply UAT. The UAT rate is 6% with the difference between income and expenses, while the organization are exempt from tax on profits paid at 20%. In addition, the use of UAT exempts from the need to pay a tax on real estate used in agricultural activities. FTS data show a steady increase in UAT's budget revenues, both from organizations and individual entrepreneurs (*Fig. 3*). It should be noted that the number of UAT tax payers for the same period has been constantly decreasing (*Fig. 4*). This, in our view, confirms the positive impact of the tax regulatory function. The use of UAT allowed successful agricultural producers to significantly increase the tax base, which had a positive impact on the tax revenues of the budget.

UAT — this is not the only special tax regime that agricultural producers can apply to optimize their tax payments. Simplified tax system (STS) is available for the organization and individual entrepreneurs of this sphere, and when operating in Moscow, Moscow or Kaluga regions, and also in Tatarstan can be used by a new experimental regime of taxation— automated simplified tax system (ASTS). In addition, individual entrepreneurs can use the patent system of taxation and professional income tax.

Under the general taxation regime, an organizational income tax credit can be used, which provides for zero rate of return on

[6] Chapter 26.1 of the Tax Code of the Russian Federation. URL: http://www.consultant.ru/document/cons_doc_ LAW_28165/6e115134a13db9e972d7d94237b5ed95fcb00d14/ (accessed on 20.12.2022).

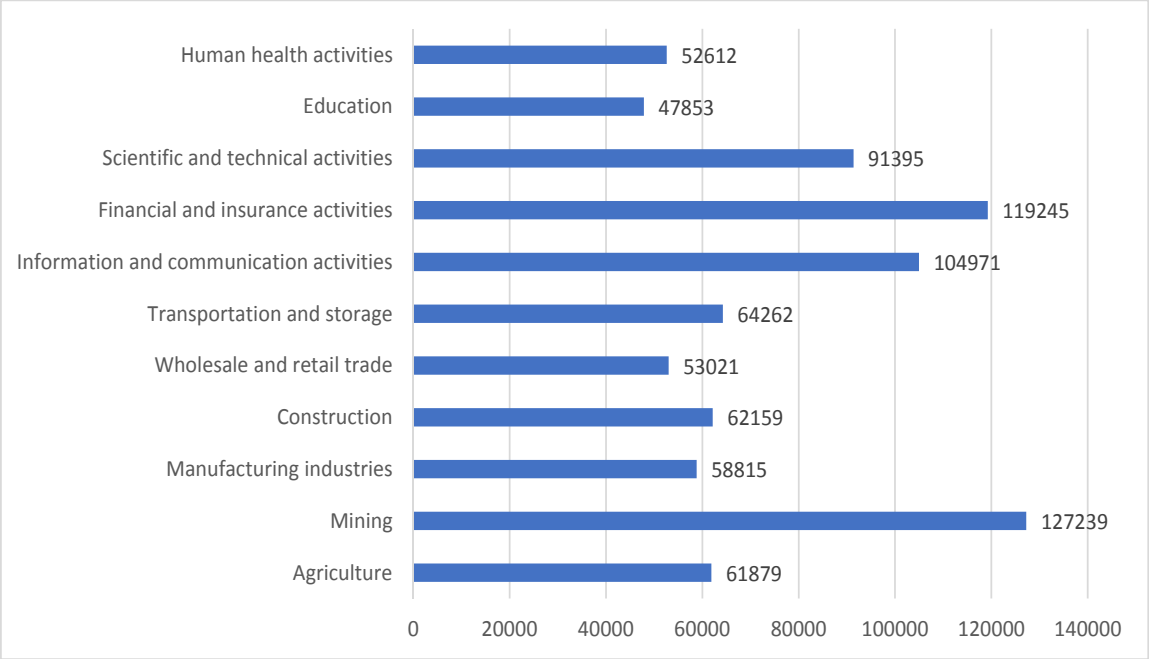

Fig. 2. **Average Salary in Various Sectors of the Russian Economy, 2021**

Source: Statistical manual 2021. Rosstat. URL: https://rosstat.gov.ru/storage/mediabank/Ejegodnik_2021.pdf (accessed on 11.11.2022).

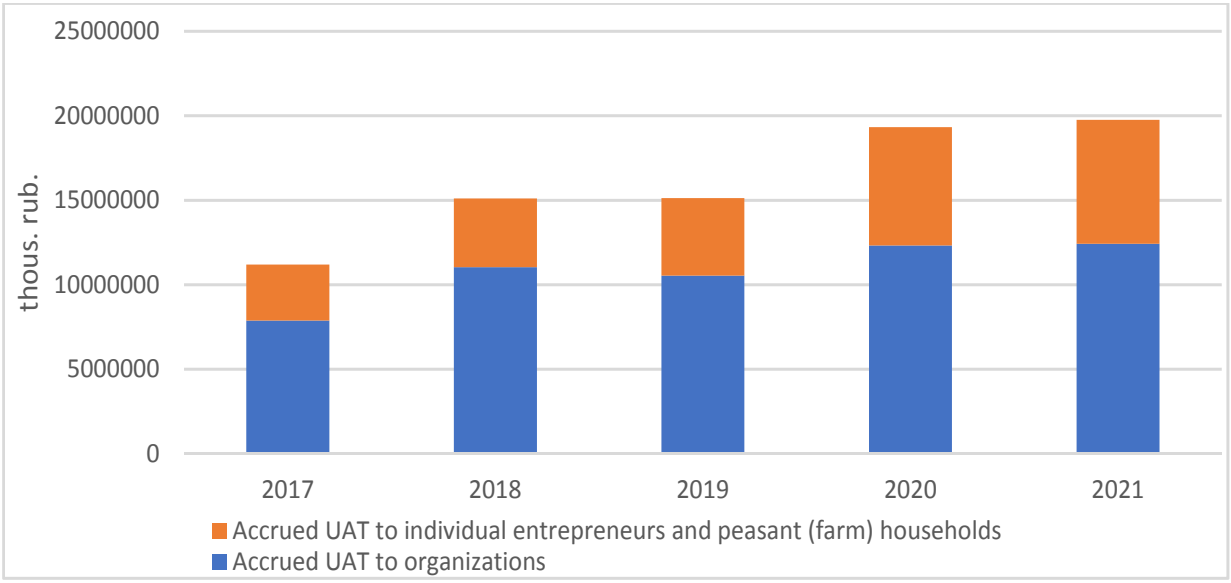

Fig. 3. **Tax Accruals for UAT**

Source: data of the Federal Tax Service of Russia in the form 5-UAT. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/ (accessed on 20.11.2022).

agricultural products produced and processed by the taxpayer himself.[7] The scale of the benefit is confirmed by the data of the Federal Tax Service of Russia, according to which, due to the application of zero rate by organizations of agricultural producers in 2021 in the consolidated budget, 142 690 339 thous. rub. were underpaid, which is 24.6% more than in 2020.[8]

[7] Art. 284, Para. 1.3 of the Tax Code. URL: http://www.consultant.ru/document/cons_doc_ LAW_28165/eb9180fc785448d58fe76ef323fb67d1832b9363/ (accessed on 20.12.2022).

[8] Data of the Federal Tax Service of Russia on No. 5. URL: https://www.nalog.gov.ru/rn77/related _activities/statistics_and_analytics/forms/ (accessed on 20.12.2022).

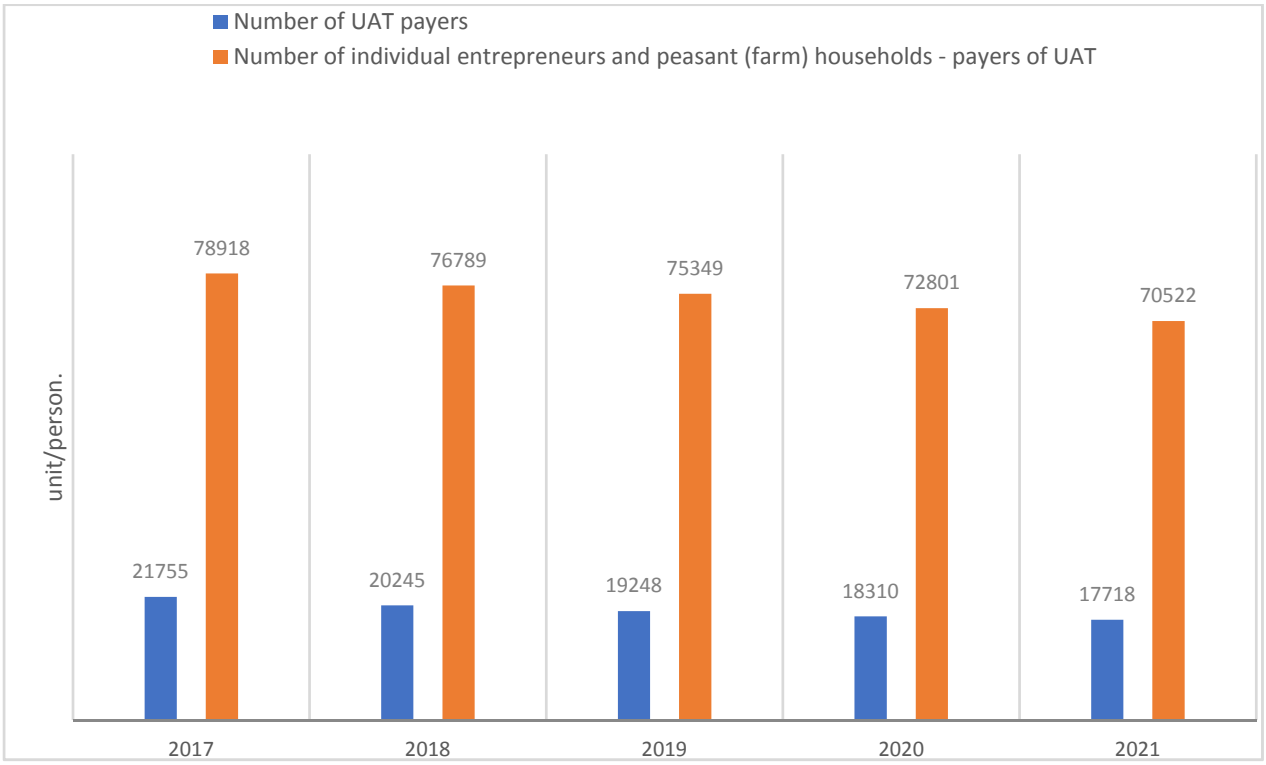

Fig. 4. **Number of Taxpayers Paying UAT (Unit/Person)**

Source: data of the Federal Tax Service of Russia in the form 5-UAT. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/ (accessed on 20.12.2022).

The effectiveness of tax incentives can be judged by the number of agricultural producers, the volume and structure of tax revenues from this category of taxpayers (*Table 3*) [19]. According to the Federal Tax Service of the Russian Federation, 6,275 agricultural cooperatives were registered in the Unified State Register of Legal Entities (USRLE) as of 1 January 2022, 6 216 peasant (farm) households and 117 732 peasant (farm) households were registered in the Unified State Register of Individual Entrepreneurs (USRIE). These indicators show a negative trend on 1 December 2022. Thus, the number of agricultural cooperatives decreased by 6.27%, of peasant (farm) households in the USRLE — by 1.37%, of peasant (farm) households in the USRIE — by 8.14%. Data on the number of legal entities registered and terminated indicate that in recent years there has been a decrease in the number of both registered and terminated agricultural cooperatives (*Fig. 5*).

Tax revenues in the consolidated budget are increasing despite the decrease in the number of taxpayers in this category. *Table 4* shows the growing popularity of the new special tax regime such as the professional income tax [20]. Tax revenues increased by 41 times in 2021 compared to 2020, while the patent tax system increased the budget in the same period by 3.4 times. These indicators point to an increasing demand for experimental tax treatment by the self-employed in the agricultural sector. This is a positive sign also because many taxpayers in this category have previously conducted business without registration and have not paid taxes at all.

A significant factor in the growing revenue in state extrabudgetary funds (*Table 3*) indicates an increase in the wage fund in crop and livestock production. This trend continued even during coronavirus infection. This is despite the fact that agricultural producers, registered as small and medium-sized enterprises, apply reduced insurance

Table 3

Tax Revenues from Crop and Livestock Production (Thous. Rub.)

Year	TOTAL taxes received by the consolidated budget of the Russian Federation from crop and livestock production	Of them		Insurance contributions to state off-budget funds
		taxes provided for by special tax regimes		
		Patent taxation system	Professional Income Tax	
2021	134877467	141099	34911	153365636
2020	89591943	41955	852	141116315
2019	94369832	40825	0	134043098
2018	82646638	–	–	127038741
2017	76359175	–	–	119405820

Source: Data of the Federal Tax Service of Russia in the form 1-NOM. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/ (accessed on 20.12.2022).

premiums. In total, this rate is 15% instead of 30% and applies to the taxable monthly payments to each employee, but only to the part that exceeds the federal minimum wage.

CONCLUSION

The conducted analysis in the field of state regulation of agriculture under the conditions of import substitution policy suggests the following conclusions for this sector of the economy:

- Agriculture is one of the few sectors of the domestic economy that has shown a positive trend in reducing dependence on imports of relevant products in their field.
- Further effective development of the agro-industrial sector of the domestic economy largely depends on overcoming such current problems as: high dependence on seed imports from western producers, especially sugar beet and potatoes; Lack of domestic veterinary vaccines and other medicines for livestock development; low level of investment in fixed assets and productive capacities of the industry; lack of research institutes and agricultural development laboratories.

The sustainable development of the country's agro-industrial complex has a direct impact on the share of the population's expenditure on food from all available monthly income. At the moment, Russia occupies intermediate positions in the international ranking, which indicates the problem of the food production cycle within the economy in comparison with poor countries, cannot afford to support domestically produced food due to climatic conditions (Nigeria, Cameroon, Algeria).

Analysis of the statistical data of the Federal Tax Service of the Russian Federation showed the effectiveness of measures of state tax stimulation of agricultural producers, which is confirmed by the growth of tax revenues from this category by the taxpayer, despite the decrease in their number. Further development of measures of state tax regulation should be carried out through the

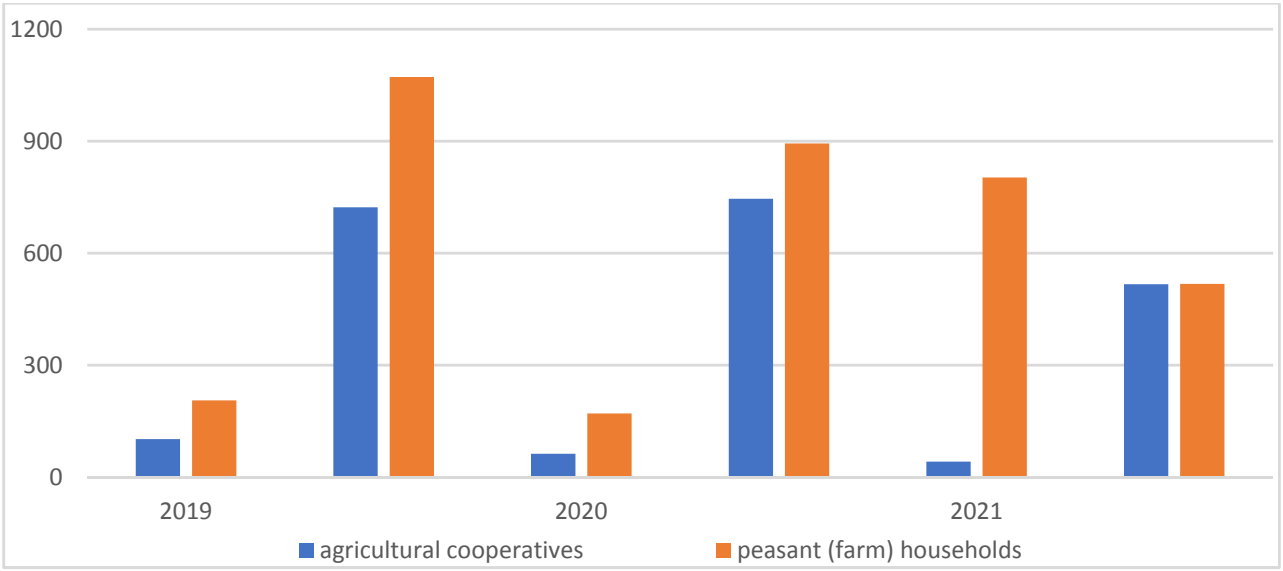

Fig. 5. **The Number of Registered and Terminated Agricultural Cooperatives and Peasant (Farm) Enterprises According to the Unified State Register of Legal Entities (Un.)**

Source: Data of the Federal Tax Service of Russia in the form 1-YUR. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/ (accessed on 20.12.2022).

point application of tax instruments and their adjustment following the monitoring of the effectiveness of the provided benefits. Priority areas for tax incentives should be agricultural research and investment in fixed assets for agricultural production and processing. In that regard, we suggest:

- to supplement the list approved by the Government of the Russian Federation No. 988 from 24.12.2008, on the right to apply an increase factor of 1.5 to actual expenditures in the calculation of corporate income tax, R&D in agriculture;
- to include a list, approved by the Government of the Russian Federation No.1299 from 20.06.2017, allows an increase factor of not more than 2 to the depreciation rate, agricultural equipment of domestic production.

In addition, tax exemptions for those taxpayers who do not use not only agricultural land but also property complexes will help reduce budget losses.

Thus, the efficiency of further development of domestic agriculture depends on the state regulation of various programs, including as tax preferences, and various subsidies and grants to support the strategic sector of the domestic economy.

Further research is planned to be conducted by constructing an empirical mathematical model on the basis of the correlation measurement, allowing to determine the optimal level of reduction of the regional rate UAT. This rate should not only reduce the tax burden of agricultural producers, but should not have a negative impact on the level of tax revenues under the UAT.

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ABOUT THE AUNHORS

Mikhail E. Kosov — Cand. Sci. (Econ.), Assist. Prof., Department of Public Finance, Financial University, Moscow, Russia; Head of Department of State and Municipal Finance, Plekhanov Russian University of Economics, Moscow, Russia
https://orcid.org/0000-0002-1067-0935
Corresponding author:
Kosov.ME@rea.ru

Ekaterina V. Golubtsova — Cand. Sci. (Econ.), Assoc. Prof., Department of State and Municipal Finance, Plekhanov Russian University of Economics, Moscow, Russia
https://orcid.org/0000-0002-7762-794X
golubtsova.ev@rea.ru

Ekaterina S. Novikova — Cand. Sci. (Econ.), Assoc. Prof., Department of Economic Theory, Plekhanov Russian University of Economics, Moscow, Russia
https://orcid.org/0000-0003-2342-6939
novikova.es@rea.ru

***Authors' declared contribution*:**
M.E. Kosov — formulation goals and objectives of the study, hypothesis development of the article and its verification based on the data obtained.
E.V. Golubtsova — research and description of the results obtained by the tax analysis.
E.S. Novikova — the literature review in accordance with the study, the analysis of the government regulation at the macro level.

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ORIGINAL PAPER

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Estimating Value Added Tax Gap in Uzbekistan

I.M. Niyazmetov
The Banking and Finance Academy of Republic of Uzbekistan, Tashkent, Uzbekistan

ABSTRACT

The **subject** of the paper is to study of the theoretical literature on evaluate the effectiveness of the value added tax (VAT) mechanism, and identification of criteria for the analysis of the VAT mechanism. The **purpose** of the paper is to investigate methods for evaluating the effectiveness of VAT mechanism and, on that basis, to evaluate the VAT gap in Uzbekistan and the factors influencing it. The **importance** of the paper is confirmed by the significant contribution of the tax to the sufficiency and stability of budget revenue in countries with consumption tax mechanisms. A mathematical **approach** based on the C-efficiency (Collection efficiency) ratio is used to calculate the VAT gap. This model evaluates the discrepancy between actual VAT income and the maximum amount of tax revenue that could be obtained by taxing all (and only) final consumer spending in the economy. The **novelty** of the paper is justified by adaptation of model to the specification of VAT structure of Uzbekistan and recent data to estimate VAT gap. The **research concluded** that Uzbekistan's VAT mechanism is twice as inefficient as its ideal mechanism. Estimates for 2016 and 2020 indicate that on average a quarter of potential VAT revenue is not collected due to Compliance Gap, while Policy Gap is responsible for over a third of the ideal loss of VAT revenue. In order to improve compliance, it is recommended to optimize the collection and control systems in addition to policy modifications that include reforms of tax objects, subjects, rates, incentives, and other tax elements.

Keywords: VAT; tax gap; tax evasion; value added; consumption; VAT mechanism

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INTRODUCTION

In the context of international tax competition, policymakers are becoming increasingly difficult target their fiscal policy simultaneously to increase budget revenue around the world and attract foreign direct investment without prejudice integrity of the tax system or taxpayer confidence on the fairness of tax system. To achieve these policy objectives, first of all, it is necessary to modernize tax system based on fundamental principles of economic theories and the scientific foundations of taxation. Secondly, governments are required to ensure high collection efficiency of tax mechanisms by improving tax administration.

To this end, it is indispensable for governments to assure major taxes, that contribute a significant share of budget revenue, to have well-designed mechanism and enforcement strategies. Despite having different tax systems, most of the countries rely on indirect taxes, especially the value added tax (VAT), to raise sufficient and stable budget revenue.

Since its first introduction in the 1950s in France VAT has become one of the world's the most dominant revenue generators in less than a century [1]. VAT`s role as a "money machine" in raising revenue for government expenditure and its neutrality have made it an attractive mechanism for taxing consumption [2]. This is evidenced by the fact that VAT has been adopted in more than 160 countries and accounts for on average 20 percent of total tax revenues of these countries. Besides, VAT also has a crucial role in tackling the shadow economy. It is one of the most effective tax mechanisms in taxing the informal sector indirectly [3]. The effectiveness of the VAT mechanism in this regard depends primarily on the extent to which it captures each stage of value chain in the economy and its collection capability.

In Uzbekistan VAT was introduced in 1992, instead of the turnover tax that was in force at that time. Despite the fact that VAT continues to play a substantial fiscal role, accounting for almost a quarter of overall tax collections, studies have shown that Uzbekistan's current VAT system is the relatively complex, multilayered, and underdeveloped [4].

Given that the government of Uzbekistan has been implementing large-scale economic reforms in

recent years, maintaining sufficient budget revenue has become more vital than ever. In this regard, improving the collection efficiency of VAT is of utmost importance which, in turn, depends on the compliance and policy issues.

Thus, in this research, it would be primarily to estimate the VAT compliance gap, by identifying gaps in its mechanism, and provide possible policy recommendations to mitigate the compliance gap of the VAT in Uzbekistan.

LITERATURE REVIEW

Efficiency of the VAT is determined by its ability to accomplish its functions both theoretically and practically. A well-functioning VAT system is characterized by its consumption-oriented approach, comprehensiveness, and multifunctionality, which allows VAT to be levied at all stages of the production chain [5]. In this perspective, L. Ebrill et al. [5] assert that the ideal VAT mechanism is achieved only when the entire tax base (final consumption) is taxed at a single rate.

One of the diagnostic tools that enables evaluating VAT mechanism by considering aforementioned aspects is the C-efficiency (Collection efficiency ratio) indicator. The concept of C-efficiency of VAT was first used in the study of L. Ebrill et al. [5]. M. Keen [6] conducted a detailed scientific study and modeled this indicator by interpreting C-efficiency as an indicator of deviation of the current VAT mechanism from the ideal mechanism. In other words, C-efficiency is based on assessing the difference between actual VAT revenue and the ideal tax revenue that can be collected by taxing all (and only) final consumption expenditures in the economy at a single tax rate. This indicator reveals the shortcomings of the VAT mechanism by dividing it into policy and compliance gaps, allowing analysis of the factors of the VAT efficiency as a whole.

- The policy gap here reflects the extent to which the current VAT system deviates from the ideal VAT mechanism, which taxes only final consumption costs (without any incentives and with VAT recovered on intermediate use of goods) at a single tax rate.
- The compliance gap represents the imperfect enforcement of the current VAT mechanism as a result of the tax administration`s insufficient control capability and low tax morale.

M. Keen [6] provides a mathematical illustration of C-efficiency (E^C) by compliance gap (Γ) and policy gap (P) as follows:

$$E^C = (1-\Gamma)\times(1-P). \quad (1)$$

As for M. Keen [6] this indicator should ideally be equal to 1 coefficient or 100 percent if all compliance and policy gaps eliminated.

However, in the most developing countries including Uzbekistan, even if policy is ideal the imperfect implementation of tax legislation and taxpayer compliance issues deters revenue agencies from collecting all potential tax liability imposed by law. This, consecutively, leads to expansion of not only a compliance gap but also policy gap as well. In this regard, this research focuses primarily on estimating compliance gap and its factors to analyse VAT efficiency of Uzbekistan.

In order to understand and evaluate compliance in Uzbekistan, it is important first to set a clear definition of tax compliance.

According to R. Bruno [7] it is a matter of imperfect enforcement of tax law, the tax authority's structural architecture, taxpayer ethics, and tax morale, or a complicated combination of these factors. All of this leads to tax gaps which are the common indicator of the tax evasion. In this context, tax noncompliance refers to both deliberate and inadvertent failures to fulfil tax liabilities [8].

The IRS[1] and HMRC[2] provide institutional definition of tax gap as "the difference between what the taxpayers are supposed to pay and what they actually pay on a timely manner".

There have been extended number of studies on measuring the VAT compliance gap, all of which in one sense or another define it as the difference between actually collected revenue and potential revenue that could be collected with perfect enforcement, given

[1] Internal Revenue Service of the USA (IRS). Tax Gap for Tax Year 2006 Overview. Washington DC: 2012. URL: https://www.irs.gov/pub/newsroom/overview_tax_gap_2006.pdf (accessed on 18.09.2022).

[2] Her Majesty's Revenue and Customs (HMRC). Measuring tax gaps 2018 edition — Tax gap estimates for 2016–17. 2018. London: HMRC: URL: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/ (accessed on 18.09.2022).

the policy framework that was in place during that year [6, 9, 10].

Theoretically, the elements underlying the compliance gap involve the state of negligence in enforcing reported tax amount, inaccuracies made in estimating the tax base, incomplete filed tax returns, tax avoidance due to loopholes in legislation, and tax evasion caused by hidden activities.[3] In particular, the compliance gap can be broken down into three components: the non-filed revenue, the underreported revenue, and the underpaid tax amount due [11].

Similarly, M. Thackray and M. Alexova [12] in their study analysed the gap by dividing it into allocation gap and unexplained gap. The former is determined by the difference between potential tax payments and total value of tax revenue, while the letter explains to what extent allocation gap diverges from total compliance gap.

Similarly, E. Hutton [13] group compliance gap into two main components, namely the collections gap (i.e., deviation of declared amount from estimated amount) and assessment gap (i.e., difference between declared amount as that is evaluated being obliged and the total potential VAT revenue).

M. Keen [6] proposes the bottom-up approach which adds up operational data audits and other sources to compute VAT that is due but not paid. Thus, he defines it as the percentage difference of principle VAT payable from actual VAT revenue or accrued collected.

Unlike M. Keen [6] and G. Poniatowski et al. [10] in own research using top-down approach estimated VAT gap in European Union member countries. According to them VAT gap is not just a measure of tax fraud but also include legitimate tax avoidance, unpaid part of the recognized amount as well as different due to the data accuracy and data availability. The studies reveal that the largest part of the non-compliance is due to unintended miscalculations, informal economy, and illicit economic activities. The remaining part can be explained by the low rate of taxpayer trust in government, corruption in collection of tax and public spending policy of executive bodies, and complexity of legislation [14].

In this regard, estimating the VAT compliance gap may be a valuable guide for policymakers and tax agencies to identify the origins and extent of non-compliance, evaluate revenue authorities' performance, and enhance the efficacy of resource allocation to fight against tax evasion.

Although conceptual and methodological frameworks of measuring VAT compliance gap have been developed relatively earlier, and used by researchers to quantify the gap mainly for developed countries, there is a lack of study that develops the Uzbekistan VAT mechanism and its efficiency. This study contributes to the existing literature by focusing on specific aspects of taxing consumption through Uzbekistan VAT mechanism.

METHODOLOGY

To estimate compliance gap in the VAT mechanism of Uzbekistan first it needs modeling. Based on the literatures discussed above under any policy design (i.e., perfect or imperfect) the compliance gap is the difference between the potential revenue under the existing policy settings and actual revenue (see *EBEF* area in *Fig. 1*).

Generally, there are two approaches that are used to estimate the gap:

1. *Bottom-up approach* requires calculation of potential VAT on the final consumption of each product.

2. *Top-down approach* relies on data from the national accounts.

The detailed mathematical model of the compliance gap can be illustrated by bottom-up approach as follows [6]:

$$\Gamma = \left(\frac{\sum_{i=1}^{N} T_i^* (C_i - C_i^*)}{\sum_{i=1}^{N} T_i^* C_i} \right), \qquad (2)$$

where Γ — represents VAT compliance gap; T^* — is for standard VAT rate; C_i — denotes final consumption expenditure on all goods and services; C_i^* — stands for final consumption expenditure on taxable goods services under current policy design.

Due to lack of micro-data in this study top-down approach is employed to measure potential VAT revenue.

[3] International Monetary Fund (IMF). Republic of Estonia technical assistance report — revenue administration gap analysis program — the value-added tax gap. Washington, D.C.: International Monetary Fund. 2014. Organization for Economic Cooperation and Development (OECD). Consumption Tax Trends 2012. (Paris: OECD) 2012.

By assessing the gap between estimated potential and actually received revenue, a top-down approach attempts to give a thorough evaluation of total noncompliance losses. The procedure for calculating the gap is done in the following three steps:

Step 1. Estimation of potential revenue under the existing legal framework, PR (Box ACDF in *Fig. 1*).

Step 2. Identifying actual (collected) revenue, AR (Box BCDE in *Fig. 1*).

Step 3. Computation of VAT compliance gap PR-AR (Box ABEF in *Fig. 1*).

First, we start by estimating the potential VAT revenue, which is the amount of VAT calculated based on the aggregates of the national accounting system and the structure of the tax rates and incentives under effective statutory framework. In other words, this is the total tax liability, which is the value of all final consumption and intermediate expenses that are subject to VAT under the existing tax legislation [10]. It consists following three major components:

1. Final consumption expenditure of Households, Government and Non-profit institutions serving households (NPISH). It also includes non-recoverable VAT on taxable goods and services used by the government and NPISHs providing services for households.

2. Input VAT for intermediate consumption — the purchase of taxable goods and services by tax-exempt industries (for example, medical services) and non-VAT payers (for example, small businesses).

3. Input VAT for the costs of gross capital formation (investment) — the acquisition of equipment and raw materials by enterprises who is not entitled to account for input VAT.

The transactions that generate potential VAT components according to Uzbekistan's tax law is shown in detail in *Fig. 2* and *3*.

According to the *Fig. 2*, the first component of the potential VAT revenue is calculated based solely on the value of goods and services subject to taxation provided by a VAT-paying entities. Similarly, the second component of potential VAT is the amount of the non-recoverable input VAT that arise from intermediate consumption of taxable goods by VAT non-payers.

Figure 3 presents the third component of potential VAT. It is calculated based on the expenses for the gross capital formation (i.e., the amount of investment in fixed assets and inventories) by the entities that do not have the right to account for input VAT.

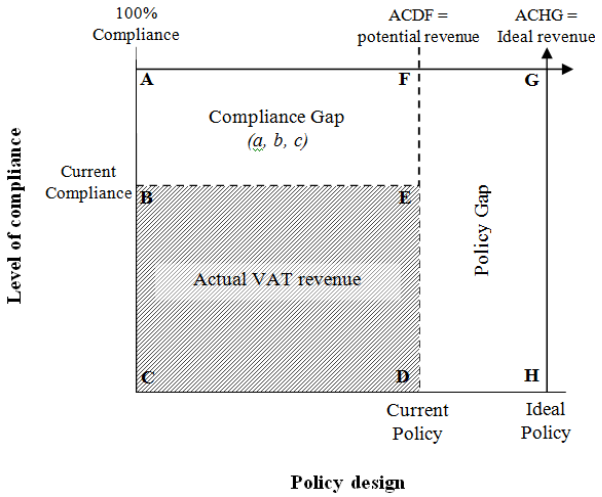

Fig. 1. **Illustration of VAT Gap and its Components**

Source: Compiled by the author based on the study of M. Keen [6].

ANALYSIS AND DISCUSSION OF RESULTS

Since its inception, VAT has played a significant fiscal role in the formation of state budget revenues of Uzbekistan. Until 2019, there were not significant changes to the mechanism of this tax. During this time, the sale of goods and services was the object of taxation. The tax base is determined by the consumption type, and the amount of VAT is calculated based on the invoice-based credit method.

The tax rate was initially set at 30 percent in 1992, and has been gradually reduced in recent years. From 2000 to 2019, the VAT base is taxed at a standard rate of 20%. With the adoption of the new concept of tax policy in 2018, radical reforms have been implemented in order to improve its mechanism. In particular, to prevent the status of "small enterprise" from being abused, enterprises with an annual turnover of more than 1 billion Uzbek sum (UZS) or that reached a certain amount during the year are required to enter the general tax regime and become VAT payers. In addition, in order to alleviate the problem of increasing burden of VAT, from 2019, the VAT rate was reduced from 20 to 15%.

The elimination of many VAT exemptions, as well as the reduction of the tax rate, resulted in a 16.7 — fold increase in the number of VAT payers in 2018–2020, thereby expanding the tax base and increasing VAT revenues by more than twofold (see *Fig. 4*).

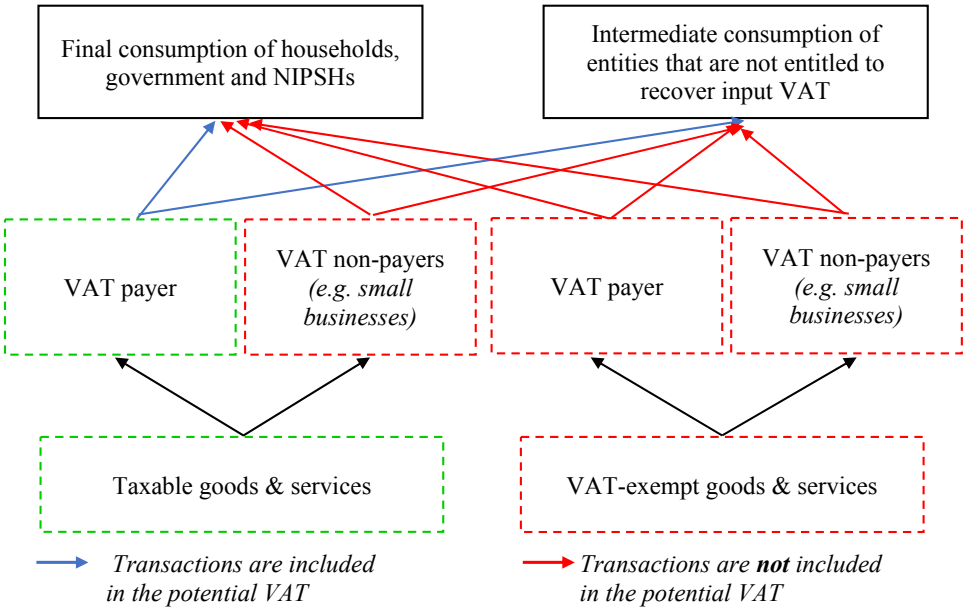

Fig. 2. **Illustration of 1st and 2nd Components of the Potential VAT for Uzbekistan**

Source: Compiled by the author on the basis of Tax Code of Uzbekistan. URL: https://lex.uz/docs/5535180 (accessed on 18.09.2022).

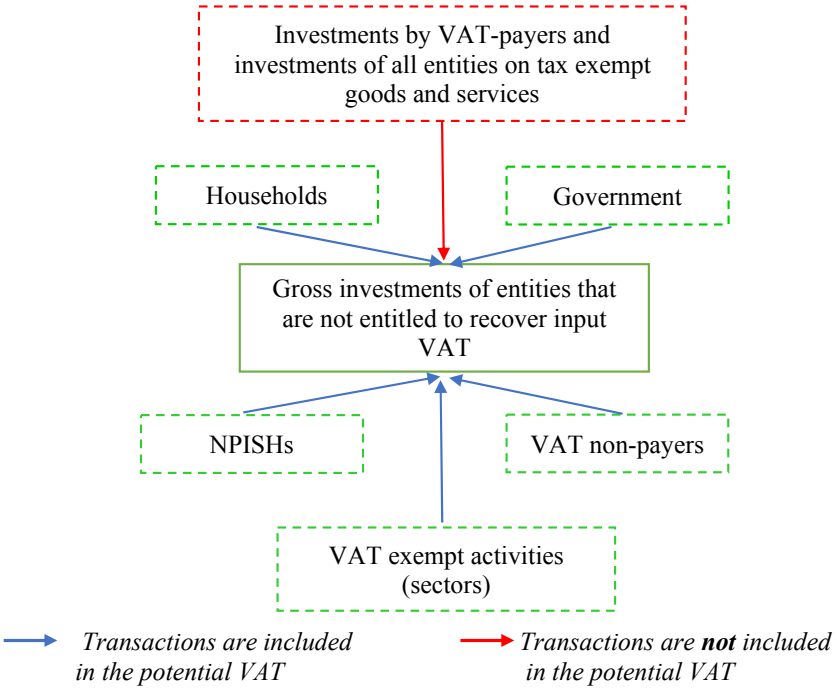

Fig. 3. **Illustration of the 3rd Component of Potential VAT for Uzbekistan**

Source: Compiled by the author on the basis of Tax Code of Uzbekistan. URL: https://lex.uz/docs/1286558 (accessed on 18.09.2022).

Although these indicators show that the tax system and its reforms have a general trend with VAT revenue, they do not provide detailed information on the level of efficiency of the VAT system and to what extent they could mitigate compliance gap, or the factors influencing it.

To determine the extent to which the VAT mechanism and its application are effective in reducing non-compliance before and after reforms, we use a top-down approach to measure the VAT compliance gap.

Following three step top-down approaches, in the first step the potential VAT revenue (PR) is calculated based on "Resources and their use" (or input-output table) table provided by the State Statistics committee of Uzbekistan. This *Table* reports data on the sectors

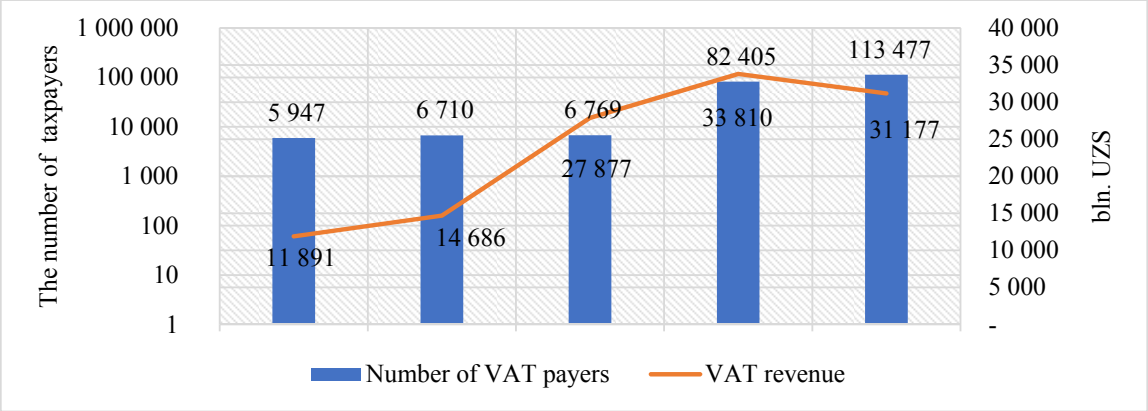

Fig. 4. **Comparative Indicators of VAT Revenue, 2017–2020**

Source: Compiled by the author on the basis of data from the State Tax Committee of Uzbekistan. URL: https://soliq.uz/other/open-portal (accessed on 18.09.2022).

of the economy in which 83 groups of goods and services are produced in the economy, as well as the distribution of final and intermediate consumption and gross investment costs by sector. The share of small businesses was calculated on the basis of additional data from the State Statistics Committee and the State Tax Committee.

In the second step, actual (collected) VAT revenue (AR) is identified by the information taken from the State Tax Committee.

Finally, in the third step compliance gap is identified by deducting actual revenue (AR) from potential revenue (PR). To determine the extent to which noncompliance is causing budget revenue loss, the difference between potential and actual revenue is divided by the potential VAT revenue.

Table 1 below shows the results of the calculation of potential VAT and its components, as well as actual VAT revenue in 2016–2020, based on the above approach and the data obtained.

According to the results, over 2016–2020 the average potential VAT revenue was 32.9 trln UZS, while the actual VAT revenue was 23.9 trln UZS and the gap accounted for about 9.0 trln UZS. To get a clearer picture of the situation, the gap is also shown as a percentage of potential revenue and GDP. In 2016 compliance gap was 21.7 and 36.2% in 2020.

In addition, *Table 1* shows the share of potential VAT components in the total average, based on which it can be concluded that the current VAT system of Uzbekistan is targeted more on taxing intermediate consumption (54%) of non-taxable entities, (i.e., intermediate consumption of raw materials — 35% and investments — 19%), rather than final consumption (46%).

One of the primary reasons for this is can be explained by the large number of interruptions in the VAT chain caused by incentives and special regimes as well as the inappropriateness of the reforms to the capacity of tax administration. In fact, despite the fact that incentives have been reduced and the average tax rate for the entire period has been reduced to 18.4% as a result of a 15% reduction in the tax rate beginning in the fourth quarter of 2019. Tax evasion and delayed payment have increased significantly due to a sharp increase in the number of taxpayers. This, in turn, resulted in, increase of the compliance gap to 26%. As shown in *Fig. 5*, the number of taxpayers increased by 11.2 times in 2019 compared to the previous year, while VAT arrears increased by 1.2 times, which is the part of the compliance gap.

During 2020, significant changes were made in tax policy, as well as in the VAT systems. In particular, the new Tax Code was adopted, VAT rate was reduced to 15%, electronic invoicing was introduced for all businesses, and most of the existing VAT exemptions were abolished. As a result, the number of VAT payers increased by 31072 compared to the last year (see *Fig. 5*).

However, during the COVID-19 pandemic, certain goods and services were temporarily exempted from taxes in order to support the population and businesses, in addition to incentives such as defered payment of taxes to VAT payers. As a result, tax revenues decreased by 8% and VAT arrears (untimely payment of tax

Table 1

Components of Potential VAT and Compliance Gap

Years	Potential VAT (in trln UZS)	Of which			Actual VAT (in trln UZS)	Gap (±) (in trln UZS)	Comopliance Gap, (%)
		household consumption	inter-madiate use	gross fixed capital formation			
2016	15.2	6.9	6.5	1.8	11.9	3.3	21.7
2017	19.6	8.6	7.8	3.2	14.7	4.9	25.0
2018	35.5	15.7	12.0	7.8	27.9	7.6	21.4
2019	45.4	20.9	15.3	9.2	33.8	11.6	25.6
2020	48.9	22.9	16.1	9.8	31.2	17.7	36.2*
Avg. & share of avg. (2016–2020)	32.9	45%	35%	19%	23.9	9.0	25.9

Source: Calculated by the author on the basis of data from the State Statistics Committee and the State Tax Committee of Uzbekistan. URL: https://soliq.uz/other/open-portal; URL: https://stat.uz/uz/rasmiy-statistika/national-accounts-2 (accessed on 18.09.2022).

Note: * This value (36.2*) are not adjusted for increased unpaid tax liability due to deferrals and other relieves because of COVID-19. That is why very high.

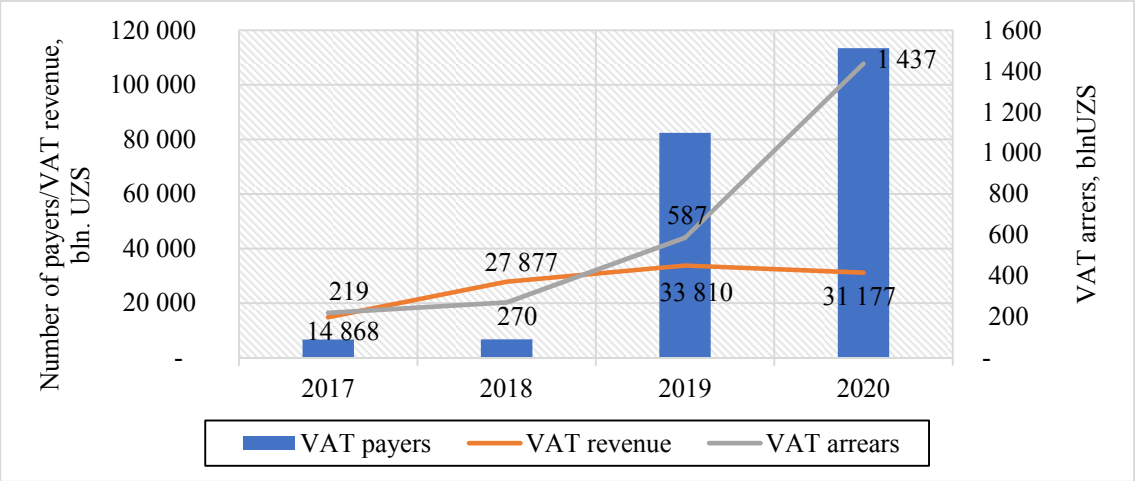

Fig. 5. **Comparative Indicators of VAT Revenue, 2017–2020**

Source: Compiled by the author on the basis of data from the State Tax Committee of Uzbekistan. URL: https://soliq.uz/other/open-portal (accessed on 18.09.2022).

liabilities due to concessions) increased by 145%. This, in turn, led to the widening of compliance gap to 36%.

In general, VAT revenues have increased in recent years as a result of tax policy and administration reforms. This is primarily due to the elimination of special tax regimes (i.e., single tax payment for small enterprises), and the elimination of multiple tax breaks and privileges, which have been targeted for the expansion of VAT coverage.

To get the full picture of the VAT gap in Uzbekistan, it is necessary to identify Policy gap. By re-arranging equation (1), Policy gap (P) can be expressed mathematically as follows:

$$P = 1 - (E^C / (1 - \Gamma)). \quad (3)$$

Table 2 provides results of Policy gap estimations using data obtained for C-efficiency from International Monetary Fund (IMF) database and Compliance gap results from *Table 1*.

According to results in *Table 2*, it can bee seen that C-efficiency has been improved from 33.6%

Table 2

VAT C-Efficiency and its Components

Years	C-efficiency* (E^C)	Components of C-efficiency	
		Compliance Gap** (Г)	Policy Gap (*P*)
2016	33.6	21.7	57.1
2017	35.6	25.0	52.6
2018	54.3	21.4	30.9
2019	51.4	25.9	30.6
2020	49.1	36.2	23.2
Avg. of 2016–20	**44.8**	**26.0**	**38.8**

Source: Calculated by the author on the basis of data from International monetary fund (IMF) datebase. URL: https://www.imf.org/external/np/fad/tpaf/pages/vat.htm. (accessed on 18.09.2022).

in 2016 to 49.1% in 2020. Positive change in VAT performance mainly attributable to decrease in Policy gap which can be explained by elimination of several incentives, minimizing threshold for VAT registration, and tax cut. However, the sudden increase in the number of taxpayers deteriorated tax compliance, increasing the VAT gap from 21.7% in 2016 to 36.2% in 2020. As for average of 2016–2020, out of 44.8% of ideal loss of VAT revenue is explained 38.8% by shortcomings of VAT policy while Compliance gap is responsible for more than a quarter of potential VAT revenue loss.

In view of the above, it can be concluded that the fiscal potential of VAT has dramatically improved over the preceding five years as a result of improvements made to the framework of tax policy and administration. This improvement has considerably contributed the growth of real tax revenues.

However, due to a number of persistent deficiencies current tax policy is resulting in a loss of potential VAT revenues. The major limitations include, in particular, co-existence of two different mechanisms for taxing consumption in the country, namely VAT and turnover tax, as well as an ineffective preferential incentives system. Another shortcoming arises from the ineffective incentive system that has not been addressed fully yet. As a result, the VAT mechanism is constrained by the relatively higher taxation of intermediate consumption as opposed to final consumption. This system also limits the taxation value created by non-VAT payers. Furthermore, the low level of compliance due to the current high rate and weak tax administration undermine the VAT mechanism from operating at full capacity.

CONCLUSION

The study showed that the current VAT system of Uzbekistan has a complex and relatively underdeveloped mechanism. According to the results of analysis VAT mechanism of Uzbekistan is more targeted taxation of intermediate consumption of raw materials and investment due to incentives in the form of full or partial tax exemption. As a result of which both policy and compliance gap of VAT is widening, thereby leading to the loss of potential tax revenues.

The policy gap is primarily caused by the simultaneous use of two universal excise types —VAT and turnover tax — in the same system for taxing consumption. This practice causes a number of issues with the VAT mechanism, particularly because intermediate consumption is taxed more heavily than final consumption in the economy due to the two-mechanism system. Due to this circumstance, the value added (produced) by the entities paying turnover tax is not taxed. Additionally, the inability of small business entities to account for input VAT increases their tax burden, which raises the risk of tax fraud and widens the compliance gap as well.

The low level of VAT compliance is primarily due to the tax burden, and this indicator has improved slightly as the tax rate has been reduced in recent years. This, in turn, suggests that there is a chance to enhance compliance by further lowering the tax rate to an optimal level.

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ABOUT THE AUTHOR

Islombek M. Niyazmetov — Dr. Sci. (Econ.), Head of department of Tax policy, Banking and Finance Academy of the Republic of Uzbekistan, Tashkent, Uzbekistan
https://orcid.org/0000-0001-8075-9938
islambekniyazmetov2022@gmail.com

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The Relationship Between Industrial and Financial Stress in the Russian Economy in the Context of a Change in the Monetary Regime

M. Yu. Malkina[a], I.A. Moiseev[b]
[a] Lobachevsky State University of Nizhni Novgorod, Nizhny Novgorod, Russia;
[b] Ozon holdings PLC, Moscow, Russia

ABSTRACT

The **relevance** of the paper is defined by significant impact of financial shocks on various sectors of the Russian economy, which undermines the stability of the country's economic system. Therefore, it is essential to study the sources of financial shocks, the mechanisms of their distribution and ways to manage them. The **purpose** of the paper is to specify the impact of financial stress on industrial stress in the Russian economy and to determine the role of monetary policy in their interaction. The **novelty** of the research consists in the development of a methodology for constructing financial and industrial stress indices, the establishment of the mechanism of their interaction under different monetary regimes of the central bank. The construction of stress indices is carried out on the basis of the selected indicators of the financial market and industrial sector of the economy, the use of the principal component analysis for their aggregation, and mathematical transformation of the first principal component. The direction of interaction between financial and industrial stress in the Russian economy is determined using the Granger causality test. The construction of autoregressive distributed lag models (ARDL models) allows estimating the impact of financial stress, as well as monetary policy parameters (the scale of lending by the central bank to commercial banks and the deviation of the central bank's key rate from the market rate borrowing) on industrial stress in the Russian economy. The research **results** in estimates of the strength of the relationship between financial and industrial stress in the Russian economy in two periods: before the change in the monetary regime (2006 — end of 2014) and after the change in the monetary regime (end of 2014–2019). It is **concluded** that in the first period the impact of financial stress on industrial stress was faster and stronger. In the second period, the weakening and distancing of this influence in time is explained by the change of the monetary regime of the Bank of Russia, which indicates an increase in the effectiveness of the monetary policy tools of the Bank of Russia to counter "financial contagion" of the industrial sector.

Keywords: stress index; financial and industrial stress; monetary policy; monetary regime; Granger causality test; Russian economy

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INTRODUCTION

The problem of financial instability and its impact on the development of the real economy received a new research impulse after the Great Recession 2008–2009. Since then, there's been a lot of paper devoted to both the assessment of the level of financial stress and its relationship with the production sector.

Scientists developed a large number of indices on the state of the financial sphere. Some of the more popular ones include: 1) Financial Conditions Index (FCI) by the Federal Bank of Chicago, Bloomberg Agency, Goldman Sachs Investment Bank, etc.; 2) Financial Stress Index (FSI) of a number of central banks, such as the Bank of England, the Federal Reserve Bank of Saint Louis, the International Monetary Fund, the Financial Research Office of the US Treasury (OFR Financial Stress Index) and others; 3) Volatility Index (fear index) of Chicago Board options exchange (CBOE, VIX).

The construction of financial stress or financial conditions indices is based on key indicators of money, stock, currency markets [1]. They also take into account a number of macroeconomic indicators such as inflation, sovereign debt, etc. In some cases, institutional variables such as the level of political risk are also included in the private variables on which the composite index is based [2]. The construction of stress indices uses relative indicators such as spread of money and stock market yields, spread of short- and long-term treasury bonds yields, risk premium, etc. According to [3, p. 97], the spread between the real estate price index and the 30-year mortgage rate index in the USA can be regarded as the reliable predictor of the financial crisis.

In Russia, individual scientists and institutions have also developed analogues of financial market indicators suitable for domestic economy. They took into account both the specifics of the Russian crises and the features of the official information available for their construction. Examples of such indices are the composite leading indicators of the Centre for Macroeconomic Analysis and Short-term Forecasting (CMASF); Financial Stability Index of the Economic Policy Institute (EPI). Of special note are the two financial stress indices developed and calculated by the analytical credit rating agency ACRA: 1) ACRA FSI index based on analysis of financial market volatility and interest rate spread[1]; 2) structural index ACRA SFSI, based on the analysis of the financial condition of economic agents and the impact of various risks on it.[2]

Russian researcher M. I. Stolbov, using a dynamic factor model, developed a composite index of financial stress for Russia, accumulating the influence of twelve recognized metrics of financial instability, including credit gap indicators, debt service and real estate prices. In 2008–2018, this index demonstrated a statistically significant average negative relationship with Russia's industrial production index [4].

Other researchers, Yu. A. Danilov, D. A. Pivovarov and I. S. Davydov [5], constructed Russian Financial Conditions Index (FCI) based on a number of financial market indicators such as: general and industrial indices of the Moscow Stock Exchange, interbank loan rate, spread of Federal Loan Bond (FLB) and interbank market rates, Russian Volatility Index (RVI), residential property price index and exchange rate of the ruble to the USD. Negative influence of financial conditions index on Russia's real GDP with a two-quarters lag is proved.

Scientists propose different methods of constructing stress indices that differ in the way of rationing, weighting and aggregation of private indicators. The most commonly used methods are: factor analysis, principal

[1] URL: https://www.acra-ratings.ru/criteria/129 (accessed on 27.10.2021).

[2] URL: https://www.acra-ratings.ru/criteria/520 (accessed on 27.10.2021).

component analysis (PCA), equivalent variance method, economic weights, cumulative distribution functions (CDF), logit model construction and others. For example, principal component analysis is used in calculations of the stress index of the Russian agency ACRA[3] and in some foreign studies [2, 6]. In some cases, econometric and economic-mathematical methods are proposed for the construction of stress indices: multi-dimensional (multivariate) GARCH models and portfolio approach [1]. Application of portfolio or so-called credit weighting — with share of "managed" wealth — allows to conduct additive decomposition of stress by sources: market types or financial spheres [7].

A number of studies focus on the impact of financial stress indicators on the production sector and its individual industries, as well as the functioning of commodity markets. According to [8], financial and geopolitical shocks affect commodity prices and cause significant volatility in energy and metal markets in the short term. Using the non-linear vector autoregression (VAR) model and quantile regressions, article [9] investigates the influence of the financial stress index (FSI) of developed countries on the the exchange market pressure index (EMPI) in Brazil, China, Mexico, Russia and South Korea.

A special issue in the study of financial stress is the identification of causal relationships in its interaction with the real economy. Thus, article [10] shows that the financial stress index of the Financial Research Office of the US Ministry of Finance (OFR FSI) not only predicts financial shocks in the economy well, but also, according to Granger's causality test, is the predictor for the Chicago Fed National Activity Index. In the work of V. Baranova [11] based on the ACRA financial stress index, the construction of a threshold structural VAR model and the conduct of an extended Granger — Toda-Yamamoto causality test, proves negative impact of financial shocks on business activity in the Russian economy.

In the article on the economy of Luxembourg [12], the authors consider the two-way links between financial stress and economic activity. In addition to the Granger test, they use a spectral method that takes into account frequency, nonlinearity, and causality cycles. The study of American economy [13] with coherent and wavelet analysis shows that the impact of financial stress on the real economy (economic growth, unemployment and inflation, 10-year treasury rate) is noticeable over long periods of study and manifests itself during severe financial shocks. The study of Czech economy [14] using the structural VAR model also proved that the financial stress in 2004–2014 had an impact on output, prices and interest rates, with the maximum reaction occurring about a year and a half after the shock.

To identify periods of financial stress on the real economy sector, researchers propose different methodological techniques. In particular, in the paper [15] dating of periods of crisis is carried out on the basis of an autoregression model with two Markov switching and one threshold vector autoregression. In the study of Turkish economy [16] structural autoregression models SVAR were used. The authors identified significant impacts of stress indices of changes in consumer prices and industrial production in the country, but also found the reverse impact of industrial stress on financial stress.

Another important field of application of financial stress indices is the study of cross-border spread of systemic risk [17]. The main channels of transmission of financial contagion from the developed to the emerging markets are changes in exchange rates [9] and capital flows between countries [18]. A number of papers explore the influence of the news background on the transmission of negative

[3] URL: https://www.acra-ratings.ru/criteria/129 (accessed on 27.10.2021).

impulses from one financial market to another. For example, in the article by E.A. Fedorova, etc. [19] based on sentiment analysis (tonality analysis) of news reports about Russia in foreign media, it has been proved that the crisis macroeconomic processes not only directly, but also indirectly (through formation of negative news background and investor sentiment) influence the dynamics of the stock index of the Moscow Stock Exchange.

The impact of financial stress on the real economy depends on counter-acting measures taken by monetary and fiscal authorities to respond to the crisis. The preference for certain tools of monetary regulation in the anti-crisis policy of the government is explained by their ability to react promptly to the situation. Thus, according to a study of the American economy [20] for both crises (the financial crisis of 2008 and the pandemic of 2020), the negative impact of the external shock decreased after the US Federal Reserve announced the introduction of new quantitative easing measures, which maintained investor confidence and refocused investor behavior. Another paper [21] concludes on the positive impact of non-conventional monetary policy on the "calming" of financial markets and prevent a decrease in the real economy.

The purpose of this study is to reveal features of the influence of financial stress on industrial stress in the Russian economy and to determine the role of monetary policy as for the period 2006–2019 under review, so separately for periods before and after the monetary regime change (transition to inflation targeting and floating ruble exchange rate).

DESCRIPTION OF DATA

Official data from Rosstat, the Central Bank of the Russian Federation, and the financial agency Investing.com were used to construct stress indices. The calculations involved monthly data from January 2006 to December 2019 (i.e. before the 2020 pandemic crisis).

Industrial stress index (ISI) is calculated on the basis of a number of private indicators reflecting the output of the country's main industries, such as: mining of coal, oil, gas, production of food and chemicals, metallurgical production.

Financial stress index (FSI) is formed from the three main financial indicators: exchange rate of ruble to USD, Moscow Stock Exchange index, average Brent oil futures contract price.

The Census X-13 seasonal smoothing procedure was implemented in the EViews package for all private indicators. By calculating the growth rates of the seasonally smoothed indicators, their stationary time series were formed, which were the basis for the calculation of stress indices.

The analysis of the relationship of the stress indices with the main parameters of monetary policy used a number of additional indicators of the Bank of Russia for the same period of time in the monthly representation:

1) Bank of Russia claims on credit institutions — CB_LOANS.[4] We used the natural logarithm of the seasonally adjusted indicator — LN_CB_LOANS;

2) key interest rate of the Bank of Russia — CB_R,[5] for which the average for each month was calculated based on daily values;

3) average weighted interest rate of credit institutions on loans to non-financial institutions in rubles for up to 1 year, including demand loans (excluding "Sberbank") — RATE.[6] Deviation of credit rate from key interest rate was also used — ΔRATE.

[4] URL: https://www.fedstat.ru/indicator/44591 (accessed on 27.10.2021). Description of "Claims on credit institutions" indicator is presented on the website of the Bank of Russia: Methodological comment. URL: https://cbr.ru/statistics/macro_itm/dkfs/Methodological_commentary_1/ (accessed on 27.10.2021).

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[6] Interest rates on loans and deposits. URL: http://www.cbr.ru/statistics/bank_sector/int_rat/ (accessed on 27.10.2021).

Finally, we have identified two research periods:

1) 2006 — October 2014;

2) November 2014–2019.

This division is explained by the change in the monetary regime of the Russian economy in 2014, that is:

official transition of the Bank of Russia to inflation targeting policy since the beginning of 2014;

transition in November 2014, in the midst of the crisis caused by sanctions for the Russian economy, to the ruble floating regime.

As our previous paper [22] showed, this transition has been enabled by the Bank of Russia to respond more quickly to changes in demand for money, which strengthened endogeneity of money supply and its attachment to the needs of the economy.

METHODOLOGY

Stress index construction method

During the calculation of the industrial and financial stress indices, we used the method first proposed in our work [23].

The growth rates of seasonally smoothed private indicators, reflecting the development of the industrial or financial sphere, were aggregated with the principal component analysis (PCA):

$$PC_t = \sum_{i=1}^{n} \alpha_i \cdot (X_{it} - \bar{X}_i) / \sigma_i , \qquad (1)$$

where PC_t — the value of the first principal component in the time period t; α_i — specific weight (load) of i-indicator in PC, calculated empirically by maximizing PC variance; X_{it} — value of the i indicator in the time period t; $\bar{X}_i$ — inter-temporal average of i-indicator; σ_i — its inter-temporal standard deviation.

Further on the first principal component, the stress index (SI_t) is calculated in dynamics as the difference between the moving standard deviation σ_{PCit} and the moving average value μ_{PCit} of the first principal component for every seven months with a one-month shift:

$$SI_t = \sigma_{PCit} - \mu_{PCit} . \qquad (2)$$

This method allows to get time series of indices of industrial and financial stress (ISI_t and FSI_t).

Modeling relationships between stress indices and monetary policy parameters

The relationship between stress indices and their relationship to monetary policy parameters (LN_CB_LOANS and ΔRATE) is verified using the Granger causality test.

In order to achieve that, the time series should be checked for stationarity using the Augmented Dickey Fuller (ADF) test. If the null hypothesis of a unit root time series is not supported at a certain level of significance, then it can be argued that the studied series is stationary or integrated of a zero order $I(0)$. Otherwise, a statement about the stationary of the series in the first differences and further is taken, the Engle-Granger test for time series cointegration is conducted, and the VECM (vector error correction) model is built.

For stationary time series, a vector autoregression model (VAR) is built. The lag order in the model (k) is selected based on the information criteria of Akaike, Schwarz and Hannan-Quin. Granger causality test is performed for VAR model of k-order. For each equation of the model, the null hypothesis is tested that X is not a cause for Y, and Y is not a cause for X.

The relationship of the studied time series is further investigated on the basis of the construction of the autoregression and distributed lag model (ARDL-model) for the two selected periods:

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=0}^{k} \beta_j X_{t-j} + e_t . \qquad (3)$$

Based on the estimated coefficients and degree of their importance, it is concluded that the influence of financial stress and monetary policy parameters on industrial stress in the Russian economy has increased/decreased.

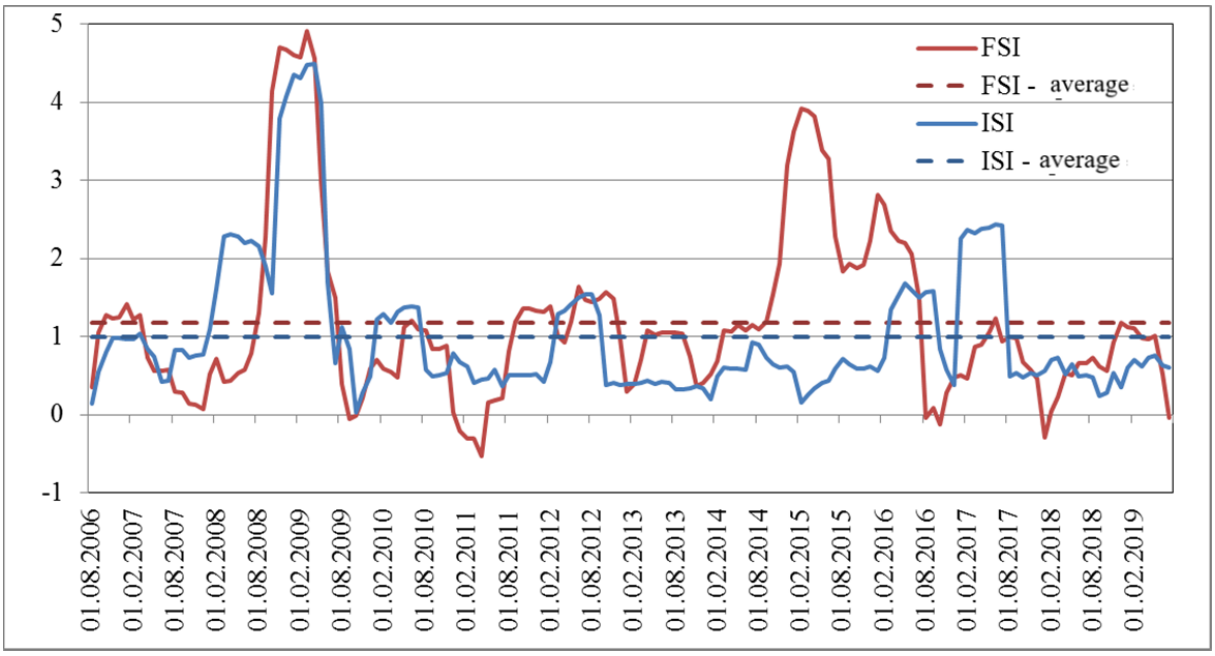

Fig. 1. **Dynamics of Industrial and Financial Stress Indices**

Source: Completed by authors.

RESULTS AND THEIR ANALYSIS

Fig. 1 presents dynamics of calculated indices of industrial and financial stress. First of all, the average financial stress index exceeds the average industrial stress index, although the principal component method largely eliminates the variation of indicators.

In addition, *Fig. 1* demonstrates a closer relationship of stress indices before changing the monetary regime than after changing it. Indeed, in August 2006 — October 2014, the linear correlation of industrial and financial stress indices is $R = 0.783$. In the period from November 2014 to December 2019, there is no lag-free relationship between the two indices.

In the first study period there is a simultaneous increase in industrial and financial stress during the crisis 2008–2009. In the second period, some autonomy of two types of stress is evident. In 2014 — the first half of 2016 there is a significant predominance of financial stress over industrial. Further until mid-2017, by contrast, industrial stress is stronger than financial. A year-and-a-half later both stress levels are below average.

The alternation of two types of stress in the second period of the study can be explained by the immediate reaction of financial markets in the context of floating exchange rate to shocks associated with the tightening of sanctions regimes of the Russian economy. At the same time, proactive public policies aimed at import substitution and encouraging public investment have led to a delayed response from the industrial sector to external shocks. It is also possible that the change in the interaction between the two types of stress was due precisely to the change in the monetary regime.

In this paper we analyze the policy of the Bank of Russia in both periods. *Fig. 2* shows the average weighted key interest rate, loan rate and the Bank of Russia claims on credit institutions.

It is easy to notice that in the first period of the study (before the change of monetary regime) during the crises there is an increase in both average lending rates and the official key interest rate (which is a response to increased risks, including inflation). During the crises, refinancing of credit institutions has increased, which is due to the Central Bank's desire to

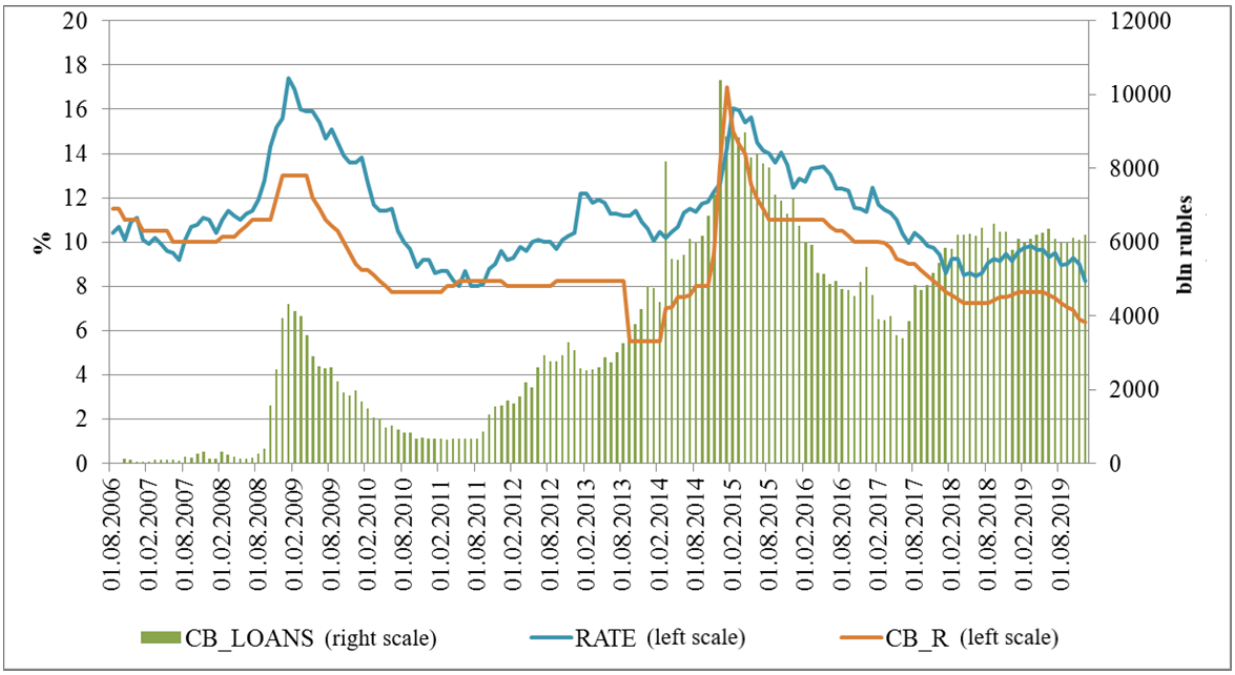

Fig. 2. **Dynamics of Interest Rates and the Amount of Loans of the Bank of Russia to Credit Institutions**

Source: Compiled by the authors based on data of the Bank of Russia.

counteract the crisis. In the second period we see a change in the scale of lending to commercial banks by the Central Bank.

Analysis of stress indices relationship in the Russian economy in 2006–2019

Testing the stationarity of time series for two calculated stress indices (ISI and FSI) and monetary policy parameters (LN_CB_LOANS and ΔRATE) with Augmented Dickey Fuller test (ADF-test) leads to mixed results (*Table 1*).

For the test with a constant, the stationarity in the series levels is only confirmed for the financial stress index at the significance level $\rho < 0{,}05$ and for the industrial stress index at the significance level $\rho < 0{,}1$. For the test without a constant, the stationarity in the series is confirmed for the loans rate deviation from the Bank of Russia rate (ΔRATE) with $\rho < 0{,}05$ and for the logarithm of the Bank of Russia claims on credit institutions (LN_CB_LOANS) with $\rho < 0{,}1$. The time series are stationary in the first differences. The Engle-Granger cointegration test does not confirm the presence of a long-term dependency, which makes the construction of a VECM-model impractical. Therefore, taking into account the proximity of the time series to the stationary state in the series levels, the construction of the VAR model is applicable.

Next, for the time series studied, we conducted a Granger causality test. The Table 2 presents short-term time series dependencies in the period 2006–2019, obtained with VAR-models. The order of lag in them was determined using Akaike, Schwarz and Hannan-Quin information criteria.

Based on the results obtained, we constructed a chain of causal relationships between the investigated variables in 2006–2019 (*Fig. 3*).

Thus, financial stress causes both industrial stress and monetary changes. First of all, the traditional financial crisis is accompanied by a fall in oil prices and stock indices, and devaluation of the ruble. Increasing volatility of financial markets, growth of speculative expectations and inflationary threats lead to an increase in interest rates. Worsening forecasts and increasing credit risk have contributed to a decline in commercial bank lending to private sector.

Table 1

Results of ADF Unit Root Test for 2006–2019

Variable	*P*-value			*P*-value for first difference		
	Without constant	With constant	With constant and trend	With constant	Without constant	With constant and trend
ISI	0.1137	0.0542	0.0789	0.0001	0.0000	0.0018
FSI	0.1221	0.0149	0.0618	0.0001	0.0000	0.0011
ΔRATE	0.0484	0.2138	0.2116	0.0000	0.0000	0.0000
LN_CB_LOANS	0.0947	0.9697	0.2340	0.0000	0.0000	0.0025

Source: Calculated by the authors.

Table 2

Results of Short Run Granger Causality Test in 2006–2019

Dependent variable	Independent variable	Chi squared	*p*-value	Conclusion	Lag order
ISI	FSI	7.048	0.008	ISI<=FSI	1
FSI	ISI	0.163	0.686	–	1
ISI	ΔRATE	4.496	0.034	ISI<= ΔRATE	1
ΔRATE	ISI	0.005	0.943	–	1
ISI	LN_CB_LOANS	17.822	0.022	ISI<= LN_CB_LOANS	8
LN_CB_LOANS	ISI	4.171	0.841	–	8
FSI	ΔRATE	1.390	0.499	–	2
ΔRATE	FSI	14.518	0.001	ΔRATE <= FSI	2
FSI	LN_CB_LOANS	2.154	0.341	–	2
LN_CB_LOANS	FSI	10.849	0.004	LN_CB_LOANS <= FSI	2

Source: Calculated by the authors.

In such circumstances, the central bank tries to counteract the negative processes in the economy and, with the increase in the key interest rate, expands the refinancing of credit institutions, including backed by long-term non-market liabilities. In the short term, with the decline in demand for loans and the growth of borrowers' defaults, the active money emission does not have a significant positive effect on the economy. Fueling speculative demand for money, it

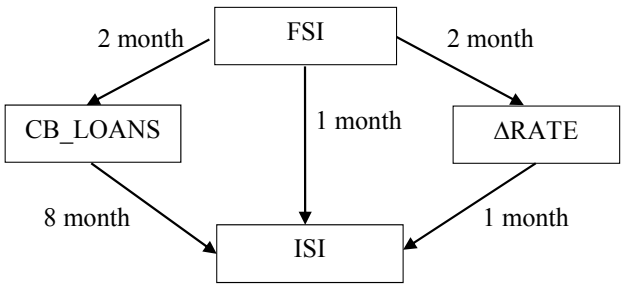

Fig. 3. **Causal Relationships in the Model**

Source: Compiled by the authors.

Table 3

ARDL Model for ISI

Variable	Coefficient	Standard error	*t*-statistic	*p*-value
Period: 2006M10–2014M10				
ISI (–1)	0.982	0.087	11.337	0.000
ISI (–2)	–0.184	0.081	–2.279	0.025
FSI (–1)	0.659	0.083	7.935	0.000
FSI (–2)	–0.532	0.089	–6.008	0.000
LN_CB_LOANS	–0.084	0.042	–1.989	0.050
ΔRATE	0.051	0.031	1.648	0.103
Const	1.133	0.535	2.116	0.037
Period: 2014M11–2019M09				
ISI (–1)	0.403	0.113	3.572	0.001
FSI (–1)	0.181	0.053	3.382	0.001
LN_CB_LOANS	–1.649	0.362	–4.555	0.000
ΔRATE	0.091	0.048	1.915	0.061
Const	25.822	5.655	4.567	0.000
Model criteria			Period: 2006M10–2014M10	Period: 2014M11–2019M09
R-squared			0.911	0.762
Adjusted *R*-squared			0.905	0.745
S.E. of regression			0.314	0.325
F-statistic			153.672	45.593

Source: Calculated by the authors.

carries threats of further inflation and ruble devaluation and pushes for another rise in the key interest rate. But, in the long term, active monetary policy, together with a reduction in interest rates, can have a stabilizing effect on the real economy.

To clarify the direction and strength of influence of the financial stress index (FSI) and monetary policy parameters on the industrial stress index (ISI), we have constructed ARDL models separately for periods before and after the change of monetary regime (*Table 3*).

ARDL model estimates show positive and statistically significant impact of financial stress on industrial stress in both periods. However, in the second period this influence is noticeably less. The positive deviation of the weighted average interest rate on commercial loans from the key interest rate of the Bank of Russia also directly and statistically significantly affects industrial stress. The increase in the estimated coefficient at ΔRATE indicates an increase in the sensitivity of industry to the relative

level of interest rates. A negative sign for LN_CB_LOANS confirms the positive impact of the central bank's active lending to commercial banks on reducing industrial stress. Significant increase in absolute value of the coefficient estimates with LN_CB_LOANS in the second period indicates an increase in the impact of refinancing policy on the reduction of stress in the economy under the new monetary regime.

CONCLUSION

By implementing an index approach using the principal component analysis, conducting a series of econometric tests and building models of the ARDL type, we proved the significant relationship between financial and industrial stress in the Russian economy and the significant impact of the first stress on the second. In this case, the transformation of the interaction character of two types of stress under the influence of the change in the monetary regime of the Bank of Russia in late 2014 was found. With the transition to inflation targeting and a floating ruble exchange rate, the impact of financial stress on industrial stress has been significantly reduced. This could be due to both the change of the monetary regime and the new industrial policy of the Russian state, including the policy of import substitution, but identifying its effects requires independent research.

The influence of monetary tools (key interest rate and volumes of refinancing of credit institutions by the Bank of Russia) on industry has increased, which indicates an increase in the monetary and credit policy efficiency and greater adequacy of the new monetary regime to the needs of the economy.

In the current circumstances, the Central Bank should reduce inflation risks and dampen negative impulses from the financial sector to the real economy by adjusting the key interest rate to the market situation. The positive impact will be felt in the short term. However, high interest rates, reducing inflationary stress, impose other stresses on the real sector, suppressing business activity and economic growth. Therefore, amid crisis, it is advisable for the Central Bank to increase refinancing of the banking sector, which will have a corrective positive impact on the industrial sector, but most likely in the long term.

The new realities of 2022–2023 indicate that in the context of stringent sanctions regimes, the Central Bank has to introduce non-market regulatory tools and abandon a number of market-based tools (as for currency regulation). At the same time, both main tools of monetary policy (interest rate and refinancing of credit institutions) continue to play a regulatory role in the management of stress in the economy.

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ABOUT THE AUTHORS

Marina Yu. Malkina — Dr. Sci. (Econ.), Prof., Department of Economic Theory and Methodology, Head of the Center for Macro and Microeconomics, Lobachevsky State University of Nizhni Novgorod, Nizhny Novgorod, Russia
https://orcid.org/0000-0002-3152-3934
Corresponding author:
mmuri@yandex.ru

Igor A. Moiseev — research analyst, Ozon holdings PLC, Moscow, Russia
https://orcid.org/0000-0001-5642-9859
igorm32014@gmail.com

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ORIGINAL PAPER

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Fraud in Public Budgeting: Evidence from Indonesia

N.W. Rustiarini
Universitas Mahasaraswati Denpasar, Denpasar, Bali, Indonesia

ABSTRACT

Fraudulent behavior of participants in the budgetary process depending on situational and individual factors is studied in this research. The situational factors included obedience pressure and opportunity. The individual factor included Machiavellianism. This study was a laboratory experiment with blended methods. The **subjects** were accounting employees in the public and private sectors of Indonesia. The **results** indicate that the authorities' pressure significantly influenced their subordinates in decision-making. This opportunity is a root cause of fraud. This research also confirmed that individuals with high Machiavellianism have more fraudulent behaviors than those with low Machiavellianism. The sensitivity test found that the proportion of female participants did not affect the primary outcome. Similar to gender analysis, there was no difference in fraudulent behaviors between the accounting employees in the Indonesian public sector and those in the private sector. The Government understand the factors causing the employees' fraudulent behaviors in budgeting. State institution will strive to maintain public trust and resources efficiently and effectively.

Keywords: budgeting; fraud; Indonesia; public sector

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INTRODUCTION

Budgeting in the public sector is a complicated and long-term process [1]. Budgeting is a forum to meet the power of budget actors with different interests. The budget impacts the political bargaining process for legitimization, system maintenance, or organization control. These interactions are susceptible to causing dysfunctional behavior, such as fraud.

Fraud in the budgeting process often occurs in developing countries, including Indonesia. The misuse of the government budget is considered a culture. Budget documents are also immediately revised and changed several times within one budget year. The revised budget process allows the budget actors to commit fraud. In terms of supervision, the executive commonly made collusion with the legislative and even with the budget inspectors [1]. However, several studies examining government budgeting often ignore the processes and roles of the actors involved. Compared to the budgeting studies conducted in western countries, only limited studies have examined fraud in developing countries, particularly Indonesia.

Based on these phenomena, academicians emphasize the importance of research on the budgeting process. Studies on the budget process require a deep understanding of factors influencing the decisions made in budget allocation. Some previous studies revealed that the legislature had more role in the budgeting process [2], while only limited studies analyzed the behavior of executives (bureaucrats). Bureaucrats will involve fraud when perceiving fraud as "normal" and internalized within the organizational and administrative structures [1, 3]. This study combined situational and individual factors to understand the behavior of budget actors. Situational factors will affect an individual's probability of reacting to an event, while an individual's characteristic will affect the reaction quality.

This research aimed to investigate the influence of situational and individual factors on fraudulent behavior in the public budgeting process. Obedience pressure and opportunity are the foundation of the fraud triangle concept. The theoretical frameworks included both Obedience and Routine Activity Theories. Meanwhile, individual factors were viewed by discussing their Machiavellian personality as Dark Triad. Individuals with Machiavellian personalities showed their unique characteristics [4]. Individuals

with Machiavellian personalities will be stronger when interacting with certain situations or environments [5]. Nevertheless, the studies on individuals with Machiavellian personalities in the public (nonprofit) sector still needed to be completed.

The results indicated that both situational and individual factors influenced the behavior of budget actors. In high obedience pressure conditions, fraudulent behavior was more likely experienced by those with higher opportunities than those with lower opportunities. However, in high or low opportunity conditions, the fraudulent behavior of those with high obedience pressure is not different from those with low obedience pressure. In high opportunity conditions, the fraudulent behavior of those receiving high or low pressure was equally high. This result confirmed that individuals tended to focus on opportunities to commit fraud instead of obedience pressure from their superiors. Therefore, opportunity is one main factor increasing an individual to commit fraud, while obedience pressure is only a trigger. This study also supported some previous studies that individuals with high Machiavellianism were more likely to follow their superiors' instructions and take the opportunities to commit fraud.

This study has both theoretical and practical contributions. Theoretically, this study has two contributions to the accounting field: first, to the literature on budget-making by expanding previous results, mainly related to the budget actors' fraudulent behavior in the budgeting process, and second, to the accounting ethics literature by studying individuals with Machiavellian traits to predict the fraudulent behaviors. These individual characteristics interacted with the situational factors influencing the budget actors' behavior. In practical terms, the government should effectively and efficiently minimize these factors to the public resources.

The following section discusses the literature review, hypothesis formulation, research method, and discussion. The last section presented the research conclusions.

LITERATURE REVIEW AND HYPOTHESIS

Obedience Pressure and Fraudulent Possibility

Obedience pressure is one predictor of fraudulent behaviors. The obedience theory explains that an individual influences others' behavior through authority to control subordinates. The superiors collaborated to commit fraud for the organization's interests. Thus, honest or law-abiding individuals commit fraud when pressured by other individuals with authorities [6]. In the public budgeting process, the intervention of superiors to their subordinates, usually occurs in top-down budgeting. A public sector organization with a structure and hierarchy of power confirmed that those with legal power should obey the orders. Initially, the fraud might be temporary, yes, acceptable, and expected. Thus, fraudulent behaviors were considered "normal" [1]. The obedience pressure has become an initial mechanism of an organization's fraudulent behavior. This fact supported the previous studies mentioning that budget misreporting occurred more often in authoritative budgeting [7]. Thus, the research hypotheses were formulated as follows:

H1: Fraud possibility is higher when an individual is given higher than low pressure.

Opportunity and Fraudulent Possibility

Opportunity refers to an organization's situation, which allows a fraud to happen. Routine Activity Theory states that fraud happens due to the conditions potentially used by the actors to commit fraud [8]. According to budgeting theory, a budget results from a routine, patterned, and interdependent budgeting process. Budgeting activity has a stable cyclic pattern subject to a strict time limit. The potential actors use these conditions to commit fraud. Therefore, the environment is essential to influence an individual's behavior [1].

The government budget, which lacks control over the program plans in public budgeting, enabled the budget actors to mark up the budget. These situations became worse since the government did not clearly describe the programs. Thus, it took a lot of work to estimate the budget [9] appropriately. The frequently revised budget has been one-factor enabling individuals to commit fraud. Through supervision, there needed to be an integrated inspection of the program plans and realizations, program evaluation, and budget evaluation in the following year. External supervision has been usually a post-financial audit, while internal supervision was an audit only before

post-audit or when a fraud case occurred. The punishment given to the convicted had no deterrent effect. Thus, the formulated hypothesis is:

H2: Fraud possibility is higher when an individual has a high than low opportunity.

Machiavellianism and Fraudulent Possibility

Machiavellianism is classified into two categories, high and low Machiavellianism. An individual with high Machiavellianism has goal-oriented characteristics [10]. Various goals encouraging individuals to participate in fraudulent activities include bonuses, salary increases, promotions, etc. These traits increased after interacting situational factors, e.g., pressure from an organization's superior. High Machiavellianism has pressure and follows the superior's instruction under pressure conditions. An individual's desire to get higher status was under the control of others, causing them to believe that manipulation was one most appropriate mechanisms to achieve the goal [4, 5]. Therefore, high Machiavellianism was more willing to involve fraud.

H3: Fraud probability is higher in individuals with high Machiavellianism than those with low Machiavellianism.

An individual with high Machiavellianism would obey the superiors' pressure to do the budgetary slack. They had more positive attitudes towards budgeting activities to get significant resources. They would be unethical if they gained personally benefit from such actions [10]. The main reason was considering the budgeting process, which provided something to their intention. This condition was in contrast to those with low Machiavellianism. They would not change their behavior in such situations even though they were pressured [11]. Thus, the formulated hypothesis is:

H4: Machiavellianism moderates obedience pressure and fraud probability.

Routine activity theory emphasizes that rational individuals, including those with high Machiavellianism, will be interested in profit opportunities. Those individuals will show friendly and cooperative behaviors as manipulative actions or strategies to utilize the situations or others to achieve their personal goals [5]. Individuals with high prefer to work with others when earning more money. They will take the opportunities to maximize their benefits, mostly when the committed fraud is least probably known. They also tended to look for new opportunities to improve their positions. Individuals will be more interested in fraud when situational factors facilitate their behaviors [10]. Thus, the formulated hypothesis is:

H5: Machiavellianism moderates opportunity and fraud probability.

METHODOLOGY

Research Subjects

A total of 96 subjects participated in this research. The subjects were of the accounting employees in Indonesia's public and private sectors. Subjects were voluntary participants attending the training events to prepare their working plans and budgets. Before collecting the data, the subjects filled out the informed consent as evidence of approval for these experimental actions. The participants were also offered to have the door prizes drawn after completing the task [12]. Seventeen men (17.71%) and 79 women (82.2%) participated in this experiment. Most participants had 5–10 years of working experience (57.30%) and worked in the private sector (60.41%).

Research Design

This research was considered a laboratory experiment with a 2×2×2 mixed design. The experimental matrix consisted of eight groups. Four groups had subjects with high Machiavellianism, while the others had low Machiavellianism. The subjects were randomized into groups to ensure that the group subject conditions were equivalent. Each subject received two high/low obedience pressure treatments and high/low opportunity. The subjects under high obedience pressure and high opportunity became the experimental group members, while those with low obedience pressure and low opportunity were the control group members. The number of participants in Groups 1 and 4 was equal, with each consisting of 17 people. Meanwhile, the number of participants in Groups 2 and 3 were also equal, with each consisting of 15 people. Furthermore, the number of participants in groups 5, 6, 7, and 8 were equal, with each consisting of

Table 1

Experiment Matrix

Obedience Pressure	High Machiavellianism		Low Machiavellianism	
	Opportunity		Opportunity	
	High	Low	High	Low
High	Group 1 *N* = 17	Group 2 *N* = 15	Group 5 *N* = 32	Group 6 *N* = 32
Low	Group 3 *N* = 15	Group 4 *N* = 17	Group 7 *N* = 32	Group 8 *N* = 32

Source: Designed by the researchers.

32 people. This figure indicates that the number of participants with high Machiavellianism was lower than those with low Machiavellianism. The experimental design matrix is shown in *Table 1*.

Participants read a short scene during the experiments and assumed that the researchers were also in the scenario situations. The advantage of using a short, simple, and easy scenario was clearly describing and focusing on the tasks and questions related to the given cases. The case scenarios referred to the previous instruments [1, 13] and were modified according to Indonesia's actual conditions' public budgeting process. Interviews were conducted with several budgeting practitioners in the Development Planning Agency at Sub-National Level to make relevant scenarios.

Operational Definition and Measurement of Variables

The dependent variable was fraudulent behavior. The participants were given scenarios illustrating the budgeting process. The subjects acted as the budget actors drafting the working and budget planning and preparing a budget for the upcoming year. One of the working plans outlined in the working and budget planning was a cattle development program estimated at IDR 100,000,000 (around US$ 7.150). At the meeting on budget revision, this program obtained additional funds relevant to one of the regional government's flagship programs. The subjects of colleagues in the procurement department conducted a re-survey and estimated an additional fund of IDR 50,000,000. Therefore, the subjects had to revise the budget to IDR 150,000,000. The Head of the Regional Working Unit asked the subjects to mark up the prices in this condition. If the participants had to obey the superior's instructions to mark up the budget, the participants were considered inclined to commit fraud, and vice versa. The participants' responses were measured on a seven-point scale, with the tendency from strongly disagree to agree.

The independent variables were obedience, pressure, opportunity, and Machiavellianism. The obedience pressure conditions consisted of two schemes: high and low. This study operationalized the superior figures through role-playing using "Heads of Regional Work", instructing each participant to mark the budget. This method showed that the instruction was not a part of the planned experiment, yet the incoming instruction would benefit the parties involved in public budgeting. In a high obedience pressure scenario, the superiors provided direct instructions to mark the budget. Due to the low obedience pressure scenario, the superiors did not force the participants to mark up the prices, yet entirely gave the participants authority without any sanction.

The second independent variable was an opportunity. This information was presented in high and low opportunities. A high opportunity scenario was illustrated as a conducive working environment to fraud — organizations did not have to describe the budget clearly. There was no integrated budget supervision or decisive action against non-compliant budget execution. The low opportunity scenario was illustrated with a working environment contrasting with high opportunity conditions.

The third independent variable was Machiavellianism, a personality that tended to be selfish, manipulative, and aggressive.

Machiavellianism was measured with the Mach IV Scale, as outlined in 20 statement items [14]. The participants' responses were measured with a seven-point scale, 1 = "Strongly Disagree" to 7 = "Strongly Agree". The Machiavellianism score was calculated by accumulating the participants' scores, then added with a constant value of 20. The individuals were called having high Machiavellianism when the Mach score was above 100 and having low Machiavellianism when the Mach score was below 100. 100 is Mach's neutral score. The questionnaire has passed the validity and reliability tests. The validity test results showed that the Pearson Correlation value ranged between 0.311–0.674 > 0.03. Meanwhile, the reliability test results showed that the Cronbach Alpha value was 0.782 ⩾ 0.70.

Procedures

The participants answered the questionnaires manually during the experiments. The experiments consisted of two sessions. In the first session, four groups of participants worked with two types of modules. Those four groups returned to work on the other two modules in the next session, separated from the first. One experimental session lasted for 30 minutes. The experimental procedures were as follows:

1. The participants entered the room and were asked to complete a Machiavellian questionnaire. The committee calculated the Machiavellian scores and grouped them into high and low Machiavellianism.

2. The participants were randomized with lottery numbers into eight groups based on the Machiavellian scores during the event. The participants then sat according to the number to facilitate the experimenters in distributing the modules-the first information related to the participant's working environment. The superiors asked the participants to assume being in the situation described in the scenario.

3. Next, the presenter introduced the Heads of Regional Work as the superiors to the participants. The presenter asked the participants to follow the instructions from the Heads of Regional Work.

4. In the module containing a high obedience pressure scenario, the superiors asked the participants to mark the budget and mention the values used. The superiors also stated firmly that they would give sanction (mutation) if the participants did not follow the instructions. Meanwhile, in a low obedience pressure scenario, the superiors instructed the same information without any pressure. The superiors used their full authority to the subordinates to use reasonable values. The superiors also asked the participants to adjust their actions to the opportunities provided in the related institutions.

5. The participants were then asked to determine one answer to complete the manipulation-check questions. The superiors asked the participants to collect the modules after completing the questions. The second session was similar to the first one.

The participants were debriefed and told that the activities would be beneficial for the participants after completing all sessions. The debriefing aimed to help the participants return to the situations and emotions experienced before the pre-manipulation conditions.

RESULTS AND DISCUSSION

Manipulation Check

The participants will pass the manipulation check if they correctly answer two of three questions. At the beginning of the experiment, 105 participants were involved. Only 96 participants (91.43%) were entitled to participate in further tests.

Group Descriptive Statistics

Table 2 shows the average values and deviation standard of dependent variables and the number of participants in eight groups.

Hypotheses Testing Results

Hypothesis 1a predicts that fraudulent behavior is lower in high obedience pressure of individuals with low opportunity than those with high opportunity. Hypothesis 1b predicts that fraudulent behavior is higher in low obedience pressure of individuals with high opportunity than those with low opportunity. *Table 3* shows that fraudulent behavior was higher in high obedience pressure of individuals with high opportunity than those with low opportunity (t = –6.27, p = 0.00). Similarly, in low obedience pressure, individuals with high opportunity had

Table 2

Dependent Variable Descriptive Statistics

Obedience Pressure	High Machiavellianism		Low Machiavellianism	
	Opportunity		Opportunity	
	High	Low	High	Low
High	Group 1 Mean: 5.24 SD: 0.75	Group 2 Mean: 3.2 SD: 1.52	Group 5 Mean: 3.71 SD: 1.33	Group 6 Mean: 2.19 SD: 1.15
Low	Group 3 Mean: 4.13 SD: 1.81	Group 4 Mean: 2.76 SD: 1.3	Group 7 Mean: 3.37 SD: 1.86	Group 8 Mean: 1.97 SD: 0.99

Source: Calculation result.

Table 3

Results of the Fraudulent Behaviour Difference Test (Obedience Pressure and Opportunity)

Hypothesis	Group	Treatment	Mean	*t* value	Sig (2-tailed)
Condition: High obedience pressure					
1a	Group 2, 6 – Group 1, 5	Low opportunity High opportunity	2.51 4.24	–6.27	0.00
Condition: Low obedience pressure					
1b	Group 3, 7 – Group 4, 8	High opportunity Low opportunity	3.62 2.24	4.31	0.00
Condition: High Opportunity					
2a	Group 3, 7 – Group 1, 5	Low obedience pressure-High obedience pressure	3.62 4.24	–1.88	0.06
Condition: Low opportunity					
2b	Group 2, 6 – Group 4, 8	High obedience pressure-Low obedience pressure	2.51 2.24	1.03	0.30

Source: Calculation result.

higher fraudulent behavior than those with low opportunity (t = 4.31, p = 0.00). The results supported hypotheses 1a and 1b.

Hypothesis 2a predicts that in high opportunity, fraudulent behavior is lower in individuals with low obedience pressure than in individuals with high obedience pressure. Hypothesis 2b predicts that in low opportunity, fraudulent behavior is higher in individuals with high obedience pressure than in individuals with low obedience pressure. The results in *Table 3* also show that the fraudulent behavior of individuals with high obedience pressure in high opportunity was not different from individuals with low obedience pressure (t = –1.88, p = 0.06). The results were similar in low opportunity (t = 1.03, p = 0.30). Fraudulent behavior in high and low pressure was equally high in high opportunity. Although this empirical evidence did not support hypotheses 2a and 2b, these facts confirmed that opportunity was one key element in fraudulent behaviors.

Hypothesis 3a predicts that fraudulent behavior is lower in high obedience pressure of individuals with low Machiavellianism than those with high Machiavellianism. Hypothesis 3b states that fraudulent behavior is higher in individuals with high Machiavellianism than those with low Machiavellianism

Table 4

Results of Fraudulent Behaviour Difference Test (Machiavellianism)

Hypothesis	Group	Treatment	Mean	*t* value	Sig (2-tailed)
Condition: High Obedience Pressure					
3a	Group 5, 6 – Group 1, 2	Low Machiavellianism High Machiavellianism	2.95 4.28	–4.13	0.00
Condition: Low Obedience Pressure					
3b	Group 3, 4 – Group 7, 8	High Machiavellianism Low Machiavellianism	2.67 3.41	2.05	0.04
Condition: High Opportunity					
3c	Group 5, 7 – Group 1, 3	Low Machiavellianism High Machiavellianism	3.55 4.72	–3.47	0.00
Condition: Low Opportunity					
3d	Group 2, 4 – Group 6, 8	High Machiavellianism Low Machiavellianism	2.97 2.08	3.16	0.00

Source: Calculation result.

in low obedience pressure. *Table 4* shows that the results supported hypothesis 3a ($t = -4.13$, $p = 0.00$) and hypothesis 3b ($t = 2.05$, $p = 0.04$).

Hypothesis H3c predicts that in high opportunity, fraudulent behavior is lower in individuals with low Machiavellianism than those with high Machiavellianism. The H3d hypothesis states that fraudulent behavior is higher in individuals with high Machiavellianism than those with low Machiavellianism in low opportunity. The results supported hypothesis 3c ($t = -3.47$, $p = 0.00$) and hypothesis 3d ($t = 3.16$, $p = 0.00$) presented in *Table 4*.

DISCUSSION

The test results on hypotheses 1a and 1b revealed that in high obedience pressure and high opportunity, individuals with high opportunity had higher fraudulent behavior than those with low opportunity. This result indicated that a top-down governmental budgeting process enables superiors to instruct subordinates to mark up the budget for various objectives, such as obtaining personal benefits, maintaining budget allocations for the upcoming year, or accommodating other activities related to budget politics [9]. The form of public sector organizations maintaining the structure and hierarchy of power confirmed to obey the instructions. Some reasons making it difficult for a subordinate to disobey the instructions included: 1) no courage to disobey the authorities even in extreme cases, 2) thinking that the related individual was only an agent, so the responsibilities were handed to those having the authority, 3) having an obligation to return the favor, such as receiving payment or wage, so that the related individual had to obey the orders [6]. In public sector organizations, obedience is based on the institution's social norms and authorities' behavior [15]. In this case, the existence of a "tone at the top" can encourage or prevent the occurrence of unethical behavior. These research results were consistent with the previous studies that misreporting of budgets occurred more often in authoritative budgeting [7].

In high opportunity, the test results of hypotheses 2a and 2b showed that the fraudulent behavior of individuals with high obedience pressure was not different from those with low obedience pressure, similarly in low opportunity. In high opportunity, the fraudulent behavior of individuals in both high and low pressure is equally high. These facts confirmed that opportunity was the critical element of fraudulent behavior. Individuals with high opportunity tended to commit fraud even though they did not get high pressure from their superiors. A high opportunity

Table 5

ANCOVA Analysis

Source	Sum of Square	df	Mean Square	F	Sig
Corrected model	192.540	9	20.282	10.769	0.000
Intercept	73.234	1	73.234	38.885	0.000
Obedience pressure	11.727	1	11.727	6.226	0.013
Opportunity	106.957	1	106.957	56.790	0.000
Machiavellian trait	43.106	1	43.106	22.999	0.000
Gender	3.419	1	3.419	1.816	0.180
Institution	2.027	1	2.027	1.076	0.301
Error	342.772	182	1.883		
Total	2438.000	192			
Corrected Total	525.313	191			

Source: Calculation result.

was a chance to attract potential actors to commit fraud. Opportunity is the primary condition, while high pressure is only a trigger intensifying fraudulent behavior. In low opportunity, the individuals felt they were hindered from committing fraud if the possibility of being detected was high enough or had solid legal sanctions. Individuals preferred to disobey their superiors even if given high pressure. Thus, in high or low opportunity, the fraudulent behavior of individuals in high or low obedience pressure showed no differences [1]. These conditions supported the Routine Activity Theory, stating that the occurrence of a crime depends on opportunity.

The test results of hypotheses 3a, 3b, 3c, and 3d showed that fraudulent behavior was higher in individuals with high Machiavellianism than those with low Machiavellianism, both in high obedience pressure and high opportunity. Machiavellianism was perceived to have manipulative properties to achieve the desired goals [10]. The superiors more easily persuaded individuals with high Machiavellianism to act in unethical ways as long as they knew the personal benefits gained from these actions [16]. These results were consistent with their opportunistic and calculative nature in decision-making. Conversely, individuals with low Machiavellianism will keep their behaviors the same following these conditions even if their superiors give into intense pressure. These findings were consistent with the Machiavellian literature mentioning that organizational context influences individuals' Machiavellianism. Individuals with high Machiavellianism will take the opportunity to work with others to earn more money or maximize their profits [16]. Individuals can quickly put their morality aside to violate norms. Most experts in this field agree that one of the most distinctive features of Machiavellian traits is the desire to fulfill extrinsic motivations, such as achievement, financial success, status, rewards, or prizes [17].

A SENSITIVITY TEST

This research also conducted a sensitivity test using ANCOVA with gender as a covariate to examine if gender affected the results. Table 5 showed that gender had a probability value lower than 0.05. The proportion imbalance of female participants (82.29%) did not affect the primary outcomes of this research. Both male and female subjects committed fraud, especially obedience pressure and opportunity. Similar to gender analysis, this research found no difference in fraudulent behavior between accounting employees in both public and private sectors. *Table 5* shows a significance value of lower than 0.05. This result indicated that although both institutions had various organizational structural forms, their employees' attitudes and

behaviors were not significantly different. Both tended to commit fraud when under high obedience pressure and high opportunity.

CONCLUSION

The budget actors' behaviors are one essential problem in the public budgeting process. This research showed that situational and individual factors influenced by the employees' involvement in the fraud. The results also had theoretical implications in which opportunity was one central element of the Fraud Triangle presented in each fraud, while pressure was one trigger for committing fraud. This finding confirmed that some fraudsters did not need the pressure to commit fraud but opportunity, which is a high probability of taking action with a low risk of being caught. Thus, Obedience Theory was only relevant to explain fraudulent behavior if individuals were in a permissive organizational environment against fraudulent activities. The crucial findings showed that opportunity was considered the "root cause" of fraud. Machiavellianism also had an essential role in the fraud. Individuals with high Machiavellianism were more susceptible to fraudulent behaviors than those with low Machiavellianism. These findings also indicated that Machiavellianism interacted with the situational factors intensifying the individuals' fraudulent behaviors.

The practical implication of this study is that the government will understand the factors causing the employees' fraudulent behaviors in budgeting. The government may impede the widespread fraud cases by strengthening organizational governance. These results also indicated that the budget act personality was an organizational consideration in preparing the budgeting staff. In public sector organizations, individuals with high Machiavellianism were less committed to prioritizing other people's interests. Those should fill the position of budget compilers with low Machiavellianism. The related organizations will effectively and efficiently maintain public trust and use resources.

This research has some limitations. First, the research on fraudulent behaviors could not be separated from social desirability bias, such as a person's tendency to answer questions in such a way as to make him look positively by following the norms in society. Many studies on fraudulent behaviors asked the participants to do things in certain situations. The challenge of this method was due to the participant's accuracy in providing information or answers to the related conditions faced. Although some participants were given honest answers, the participants commonly responded to the cases in such a way as to make them appear to have a socially acceptable character in the related community. The researchers tried to anticipate these by convincing the participants that their answers in these experiments were confidential. Further research is recommended to conduct the social desirability tests using the Marlowe-Crowne Social Desirability Scales. This questionnaire has ten statement items to determine whether participants answered honestly or tried to "look good". Second, this experiment only involved individual decisions, while the budgeting processes involved many parties (groups). Although it was expected that each budget compiler had high integrity and professionalism in performing their work, it was undeniable that individual interactions in groups could affect an individual's behavior. Next, the researchers can study the differences in fraudulent behaviors made by the individual and group contexts. The decision-making in groups will undoubtedly produce different behaviors.

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ABOUT THE AUTHOR

Ni Wayan Rustiarini — Assoc. Prof., Lecturer, Accounting Department, Universitas Mahasaraswati Denpasar, Bali, Indonesia
https://orcid.org/0000-0001-7403-8042
rusti_arini@unmas.ac.id

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ORIGINAL PAPER

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On the Question of Transparency of Financial Reporting: Doctrine of "Piercing the Corporate Veil"

M.I. Sidorova, D.V. Nazarov
Financial University, Moscow, Russia

The paper is dedicated to the memory of Professor of St. Petersburg State University V. V. Kovalev

ABSTRACT

In the context of the globalization of the world economy, the task of ensuring the transparency of information about the company's financial position remains relevant. The **purpose** of the paper is to recommend the transformation the economic entity principle in the doctrine of "piercing the corporate veil" formed in international legal practice, the essence of which is to identify the ultimate beneficial owners of a business. To achieve this purpose, the following **tasks** are performed: to identify the scope of the "corporate veil" concept in international practice, to establish the relationship of the described issues with the conceptual framework of international financial reporting, and also to propose ways to overcome the insufficiency of the principle of economic entity to ensure the transparency of financial reporting in the current economic conditions. The **object** of the research is represented by a set of economic and legal interpretations of the "economic entity" and "corporate veil" concepts in their historical development. The **subject** of the research is the impact of the "piercing the corporate veil" doctrine on the composition and structure of consolidated financial statements. The authors conducted a comparative analysis of legislative acts in different countries of the world aimed at increasing the transparency of financial reporting and the availability of information about beneficial owners of the business. The empirical basis of the research involves materials of court cases and journalistic investigations related to the veiling of the company's ownership structure, as well as the published reports of international, multinational public companies. The authors have identified the stages and described the logic of transformation of the principle of economic entity in the global accounting practice. The authors have developed **recommendations** for the application of the principle of additional liability to ensure transparency and reliability of information about the financial position of the company in the current economic conditions. The **results** of the paper can be used in the preparation of corporate legislation and the development of international and national financial reporting standards.

Keywords: financial reporting; economic entity principle; reporting entity concept; "piercing the corporate veil"; additional responsibility principle

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INTRODUCTION

The purpose of financial reporting — to provide users with an objective picture of the financial state and financial results of business. At the same time, the issue of transparency of financial reporting, i.e. its openness and accessibility, remains the focus of attention of both academics and practitioners. One aspect of this problem is the recognition of information about the ultimate beneficial owners of the business in the financial statements in the case of the formation of financial liabilities as a result of the company's activities harmful to individual counterparties or society as a whole. These situations, when there is a need "to look behind the curtain", behind which the real owners of the business are hidden, become the subject of litigation, key issues of analytical reviews of consulting agencies, topics of scientific publications. For example, such court cases of recent years as the bankruptcy of the company Parmalat (Italy, 2014), and the collapse of the chain of restaurants "Taras Bulba" (Russia, 2018) were widely resonated.

Actions on disclosure of information about real business owners are united by a rather unusual term — "piercing the corporate veil". Conditions remain debatable, in which such actions are possible, legitimate and perceived by society as fair. The problem of "penetration the corporate veil" is considered in the paper of domestic [1–10] and foreign researchers [11–17] in law.

In a globalizing world economy, it should be easy to provide transparent information on a company's financial situation: more information bases are being created, the Internet is becoming more widespread, analytical tools are becoming more complex. It may not be necessary to focus on the improvement of information processing techniques, but rather to review accounting concepts that have seemed to be intact for many years. An attempt is made to attract the attention of the professional accounting and finance community to the problem of developing new accounting principles that will increase the usefulness of the information presented in financial reports in the transformation of global economic environment. As a principle of proposed to use the principle of "additional responsibility" in financial reporting of companies in some situations.

REVIEW OF SCIENTIFIC PUBLICATIONS

The doctrine of "piercing the corporate veil" originated in the UK [7]. The term "piercing the corporate veil" was first used by Maurice Wormser, Professor of Law at the New York Law Institute in 1912, when he compared the managers and shareholders who used the "corporate veil" to hide the true owners of the business to "thieving wolves" [4]. In Russian literature the term is presented in various translations as "removal (tearing, puncturing, piercing) of corporate veil", "penetration the corporate curtain", which are used as synonyms.

Russian scientists dedicate their work to the comparative analysis of the norms of American, British and European law in the sphere of application of the concept of "piercing the corporate veil", identifying a list of conditions under which this becomes possible [3, 7, 10].

T. A. Filippova and M. V. Litskas [8] analyze approaches to the practical application of the doctrine in India and China and cite data that the number of cases in which the court makes a positive decision to penetration the corporate veil, increases in recent years exponentially. A. N. Vashchekin and K. A. Rostovtseva [1] suggest formalizing the process of developing criteria for the need to penetration the corporate veil through economic and mathematical modeling. V. G. Golubtsov analyzes the evolution of legislative approaches for accountability of controlling persons due to which the

company was bankrupt [2]. Tax aspects of the problem are investigated by I.A. Khavanova [9].

The publications of foreign researchers can be divided into two groups. Some authors focus on specific aspects of practical application of the concept of "piercing the corporate veil" in modern economic conditions. So, L. Wang [17] analyzes the impact of information about real business owners on the market price of shares. D. Lustig [15] considers the impact of "penetration through the corporate veil" on the global economic order. The second group of studies consists of publications on the application of the principle of "piercing the corporate veil" in selected countries. K. Alawamleh etc. [11] consider the Jordanian experience, A. Beebeejaun [13] — Court cases of environmental offences in the Republic of Mauritius. S. Sudiyana and D.P.B. Asri [16] analyze judicial precedents in Indonesia related to damage and search for the true perpetrators of forest fires. A. Auer and T. Papp [12] focused on the legal practice and professional opinions of auditors regarding caution and loyalty in managing a firm in Hungary. T. Fadi etc. [14] explore the opposition between "legal independence" and "economic dependence" of subsidiaries in Egypt.

This article is focused on the relationship of the concept with the principles of the formation of consolidated financial statements and the possibility of ensuring the usefulness of the information presented in it, as opposed to a large number of publications on the application of the doctrine of "piercing the corporate veil" and terms of its enforcement.

WHY NEED "PIERCING THE VEIL" TODAY?

Here are some examples from the financial scandals of the last two decades. One of them was the collapse of the transnational company Parmalat. In 2002, Parmalat was a huge company, which owned 148 plants in 31 countries of the world, with a total staff of 37 thous. people. However, in 2003, it was reported that Parmalat's money had disappeared in the bank accounts of numerous offshore companies. The investigation revealed,[1] that K. Tanci, the owner of Parmalat, hid the fact around 10 billion euros leakage, that equivalent to 1% of Italy's GDP. Fraudulent schemes hidden behind the corporate veil, led to huge losses 200 thousand shareholders of the company, negatively affected the results of many partners.

A significant attention in the Russian judicial practice of recent years received the case of the owner of the restaurant chain "Taras Bulba" Yu.A. Beloiwan. Business owner hid behind more than a dozen limited liability companies and individual entrepreneurs. All of them submitted individual reports on time, but during the tax audit, none of the legal entities could pay a fine to the Tax Inspectorate for concealment of revenues. The founder of the restaurant chain was attracted to subsidiary liability, as a result of which he was fined in favor of the tax inspection more than 4 million rubles.[2]

17 August 2020, the Chamber for Commercial Disputes of the Supreme Court of the Russian Federation considered an appeal in a case on prosecution for concluding a fictitious transaction on the manufacture of a civil aircraft YK-7UB.[3] The amount of the claim amounted to more than 19 million

[1] Landler M., Wakin D.J. The Rise and Fall of Parma's First Family. The New York Times, 11 January 2004. URL: https://www.nytimes.com/2004/01/11/business/the-rise-and-fall-of-parma-s-first-family.html (accessed on 19.12.2022).

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[3] Decision of the Chamber for Commercial Disputes of the Supreme Court of the Russian Federation No. 305-ЭС20–5422(1,2) from 24.08.2020 on the court case No. 40–232805/2017. URL https://legalacts.ru/sud/opredelenie-sudebnoi-kollegii-po-ekonomicheskim-sporam-verkhovnogo-suda-rossiiskoi-federatsii-ot-24082020-n-305-es20–542212-po-delu-n-a40–2328052017/?ysclid=lffje48tu569966579 (accessed on 19.12.2022).

rubles. Formally the sole owner of "Key" LLC was Missis K., but actually the transaction was planned, organized and controlled by someone M., married to her sister. In the course of the trial, the consistency of M. 's actions with the head of the design bureau of W., this organization was used by M. to create the appearance of aircraft assembly. Thus, Key" LLC became cover for concealing the true beneficiaries of the transaction, and only "piercing the veil" allowed to bring them to justice.

Thus, in domestic and international practice, the consideration of judicial disputes, the resolution of which is possible only in the case of an in-depth analysis of the structure of legal entities and individuals cooperating in business, as well as the delineation of their areas of responsibility. The doctrine of "piercing the corporate veil" has been developed in international legal practice to resolve such disputes. The essence of it consists in "put to shareholders or other legal entity member's liability for the company's debts, regardless of the principles of property autonomy and separate legal entity" [4, p. 88].

CONCEPT OF "PIERCING THE CORPORATE VEIL" IN LEGAL PRACTICE ABROAD

The root of the problem lies in the definition of "legal entity". At the end of the 20th century in the legal sphere two groups of theories of the company were formed, explaining the purpose of creation and essence of the company as a legal entity: fictional and realistic. The first group of theories represents a legal entity as a separate artificially created object. Supporters of this view were M.I. Brun, A.F. Brinz, M. Planiol. In 1881 the German scientist-lawyer R.F. Jhering put forward a different concept — he proposed to see behind the legal entity the beneficiaries of its activities — its owners [18].

At the end of the 19th century, the principle of economic entity's property was enshrined in regulations — in the laws on companies of various countries: Germany, Spain, France, the UK, the USA. As a result, the courts faced restrictions in bringing to justice those who really have an interest in the results of the company's activities and had to resort to the concept of "piercing the corporate veil". The term is found in various forms in French, German, Belgian and Dutch investment law (e.g., the Convention on the Settlement of Investment Disputes between States and Nationals of Other States of 18 March 1965). The doctrine of "piercing the corporate veil" is widely applied also in the law enforcement practice of the USA, it is beginning to find its application in recent years in Russia. The table shows examples of legal claims in recent years where the concept of "piercing the corporate veil" is used in making decisions.

In the sphere of legislative and judicial practice the concept of "piercing the corporate veil" is applied in various areas. First, bankruptcy cases in which those responsible for the actions that caused the firm to go bankrupt are identified, as it is possible to increase the insolvency estate at the expense of those persons and to satisfy more creditors. Second, these are cases of tax offenses, in which through "piercing the veil" determine those responsible for the non-payment of taxes and losses for the budget of the country. Third, often the responsibility of those hiding behind corporate veils is raised in the course of environmental investigations, as they usually have significant and tragic consequences for society. The fourth topical area of application of the concept of "piercing the corporate veil" is the search for end beneficiaries in the sphere of countering the laundering of criminal proceeds and the financing of terrorism.

THE CONCEPT OF "PIERCING THE CORPORATE VEIL" IN THE LEGAL FIELD OF RUSSIA

In a report prepared on the results of a study by the Russian Institute of Directors on the disclosure of information on

Table

Examples of Lawsuits in which Decisions were Made Using the Concept of "Piercing the Corporate Veil"

Parties to the lawsuit	Judicial body
United States v. Bestfoods	U.S. Supreme Court
Peterson Farms, Inc v. C&M Farming Limited	Commercial Court of the London Chambers of Commerce and Industry
Long v. Silver	4th USA Arbitration Court of Appeal
Decarel Inc. v. Concordia Project Mgmt Ltd	Quebec Court of Appeal (Canada)
Adams v Cape Industries plc	Court of Appeal (England and Wales)
Balwant Rai Saluja & Anr Etc.Etc. v. Air India	Supreme Court of India
Sukumar v. Secretary, ICAI & Ors., Special Leave Petition	Supreme Court of India
Office of the Federal Antimonopoly Service for the Novgorod region against PJSC "P" and LLC "TV"	Novgorod OFAS Russia
Bankruptcy manager of LLC "Dal'nya Doroga" vs LLC "HS-BC Bank (PP)" and HSBC Management Company	Chamber for Commercial Disputes of the Supreme Court of the Russian Federation
Yambulatova M.M. vs LLC "South Fuel Company" and LLC "Yzhnaya Havan'"	Arbitration Court of Krasnodar Krai

Source: Compiled by the authors on the basis of [1, 4–8].

corporate governance in the Russian Federation, concluded that there was a lack of transparency in the information provided by companies on the persons who actually control the business.[4] The study was conducted in 2011, but news agency publications confirm that the situation has not changed much now.[5]

In 2013–2014, the legal community attempted to incorporate the doctrine of "piercing the corporate veil" into the Russian legal field: article 53.1 of the Civil Code of the Russian Federation "responsibility ... of persons determining the actions of a legal entity" was introduced.[6] In 2017, the Federal Law of the Russian Federation "On insolvency (bankruptcy)"[7] was supplemented by Article 61.10 "debtor's controlling person".

[4] Research of the Russian Institute of Directors. Disclosure of information on corporate governance in the Russian Federation. URL: http://rid.ru/upload/resech/2010_CG_Russia_final.pdf (accessed on 19.12.2022).

[5] Official site of the Interfax Information Group. Demenkov A. Defamatory Connections. How the stock structure of Russian business changes. URL: https://spark-interfax.ru/articles/porochashchie-svyazi-21102022 (accessed on 19.12.2022).

[6] Civil Code of the Russian Federation (part one) No. 51 from 30.11.1994. URL: https: www.consultant.ru/ document/cons_doc_LAW_5142/?ysclid=lbwmdgjntb246209859 (accessed on 19.12.2022).

[7] Federal Law "On Insolvency (bankruptcy)" No. 127 from 26.10.2002. URL: https: www.consultant.ru/ document/cons_doc_LAW_39331/?ysclid=lbwno8gpba51534185 (accessed on 19.12.2022).

But to determine this controlling person, until the company becomes bankrupt or the directors face significant claims, is almost impossible. Also in the Russian Federation, numerous legal claims and proceedings to determine the ultimate beneficial owners of business are related to the specific area of State activity — Anti-Money Laundering and Combating the Financing of Terrorism (AML/FT). The criminal environment uses a chain of interconnected legal entities to conceal the proceeds of drug trafficking, arms trafficking, etc. The Central Bank, Rosfinmonitoring, FTS develop many documents, regulating the presentation of information on the final beneficiaries in this field.[8]

Thus, lawyers and tax authorities of all countries have been actively "piercing the veils" for the last 20–25 years, but, as a rule, shareholders and senior management are targeted only those companies that are already experiencing economic difficulties, show signs of insolvency or work to the detriment of the budget. These facts indicate the need to develop new semantic structures to meet the public demand for more transparent reporting on the financial situation of business units.

PRINCIPLE OF ECONOMIC ENTITY'S PROPERTY IN ACCOUNTING

Accountants-economists do not yet react very actively to the ongoing processes of "devaluation", adhering to the principle of economic entity's property. Follow the logic of the formation and evolutionary development of this principle in the field of accounting, Professor M.L. Pyatov consider that the source of this principle is the norms of Roman law [20]. In the Middle Ages, the principle of of economic entity's property in accounting has not yet been clearly formulated. This principle, expressed in a strict list of balance sheet items belonging to a company rather than its shareholders, was formed in accounting only at the end of the 19th century. "Accounting" interpretation of this principle, according to Y.V. Sokolov, belongs to H. Vannier, who in 1870 wrote that "accounting is always conducted on behalf of the estate, not the owner of this estate" [21, p. 147]. In the 20th century IFRS (International Financial Reporting Standards) were created, in which the principle of economic entity's property was universal for accounting systems of any countries.

The interpretation of major accounting categories was initially significantly influenced by the legal approach. As applied to the economic entity's property principle, this meant that the balance sheet initially reflected only property owned by the legal entity in the ownership. With the development of the world economy, the theoretical doctrine has evolved in the direction of the legal interpretation of the content of accounting reports to the economic. So, in the second half of the 20th century the concept of "The Reporting Entity" emerged, which proposes to consider the group of legal entities as a single economic mechanism. The term "consolidation perimeter" appeared in accounting practice, which can change depending on the professional judgment of the accountant [22].

In 21st century new forms of interaction of individual legal entities have appeared: strategic alliances, network companies, virtual structures, etc. which leads to blurring the boundaries of the concepts of "legal entity" and "reporting entity". The objective fact is the expansion of the meaningful content of accounting principles. As the scientists from the Saint Petersburg State University note, "the essence of the changes — is in the change of the functional purpose of accounting: the dominant control and analytical function ... replaced

[8] Letter from Rosfinmonitoring on UFO No. 21–4011/6731 from 23.10.2020. URL: https://dogma58.com/zakony/pismo-mru-rosfinmonitoringa-po-ufo-ot-23–10–2020-%E 2%84%96–21–4011–6731/?ysclid=lb717eb01w301534012 (accessed on 19.12.2022).

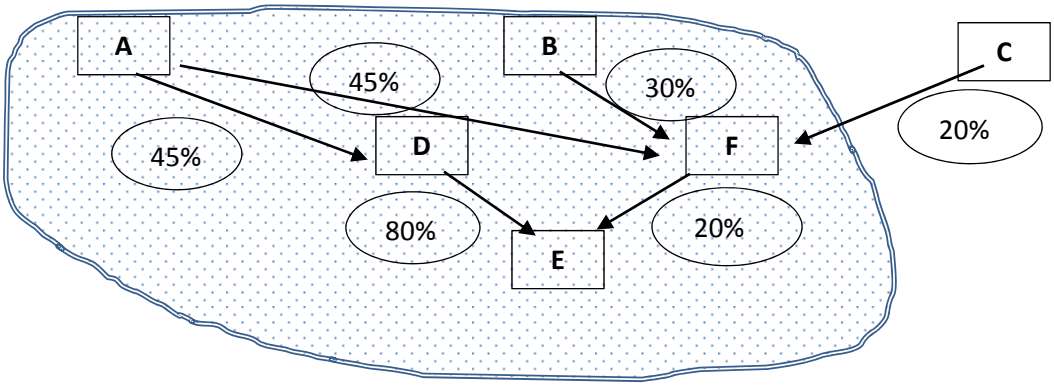

Fig. **Determination the Consolidation Perimeter for Indirect Ownership**

Source: Compiled by the authors.

by the dominant function of information-communicative" [23, p. 4]. The new version of the concept of "reporting entity", more flexible and informal, was adopted in 2010.[9] In 2013, the international standard IFRS 10 "Consolidated financial statements" was introduced, in which the content of consolidated reporting is expanded and based on the concept of "control". The *Figure* shows an example of a complex structure of uniting business entities through indirect ownership. On formal grounds (ownership of more than 50% of capital) only D and E companies would enter the consolidation perimeter.

In the case of individual reporting, the concept of control is implemented through the criteria of recognition of assets and liabilities in the balance sheet: the existence of control over the assets and the possibility of obtaining economic benefits from their use.

In the accounting practice of the Russian Federation, a legal approach to recognition of items in financial reporting was traditionally applied. Early version of the regulatory documents approved by 90s of 20th century[10] defined assets through ownership of the organization, with clear separation of the accounting rules for assets in balance sheet accounts and off-balance sheet accounts. Active convergence of domestic accounting standards with international standards in recent years leads to a predominance of economic approach. Regulations developed in 2000–2022 are formally based on the concept of control set out in IFRS.

However, domestic arbitration practice shows that unscrupulous business owners are comfortable with the principle of economic entity's property and limited liability for the obligations of companies. In this way, they try to avoid creditor claims in bankruptcy proceedings, organize the withdrawal of assets to dummy companies, which are the actual owners themselves. It is in such cases that attempts are made to hide the composition of the real owners behind the "corporate veil", and the concept of control turns out to be declared but unclaimed. Thus, despite the increasing volume of appendix and notes to financial statements, the level of transparency of financial reporting remains rather low.

CONCLUSION

There is an insufficiency of the principle of economic entity's property in the preparation of financial statements,

[9] Official website of the Ministry of Finance. URL: https://minfin.gov.ru/common/upload/library/2014/06/main/kontseptualnye_osnovy_na_sayt.pdf (accessed on 19.12.2022).

[10] Regulation on accounting and reporting in the Russian Federation, approved by the order of the Ministry of Finance of the Russian Federation No. 10 from 20.03.1992. URL: https://docs.cntd.ru/document/ 901608287?ysclid=lby4d2gcxq32899126 (accessed on 19.12.2022).

transparency of which is necessary for the formation of a civilized market space. Professional accounting community does not yet have a clear understanding of how to respond to this request. In these circumstances, it is proposed to start discussing the possibility of applying the principle of "additional responsibility", which is a logical consequence of the expansion of the content of the principle of economic entity's property in modern economic conditions.

Firstly, the additional responsibility of a certain group of persons having an actual influence on the activities of the business unit, including in some cases, the obligations of business owners, should be reflected in the financial statements. The professional judgement of the accountant as to how this information is to be reflected in the accounts is of particular importance. Options include both adding specific items to the balance sheet and creating a separate reporting form on comprehensive business equity. It is also relevant to include additional disclosures in the notes to the statement of financial position.

Secondly, the consolidation perimeter needs to be defined by identifying the controlling person(s). Regulator can set requirements of different severity for some situations. Normally, the consolidation perimeter is determined and declared by the organization itself on a voluntary basis, based on the professional judgment of the accountant. If there are some signs of bad faith or dysfunctional financial situation (for example, obtaining a qualified audit opinion, the presence of a large number of legal claims, etc.) in the perimeter of consolidation will fall all controlled enterprises, or separately disclose the group's transactions with controlling persons. A strong option of implementing the principle of additional responsibility implies disclosure of all controlling persons, which will ensure transparency and clarity of the governance structure of any business for users of published financial statements.

Thus, the shift from a legal to an economic approach to financial reporting leads to the need to revise fundamental accounting principles, including the transformation of the principle of economic entity's property.

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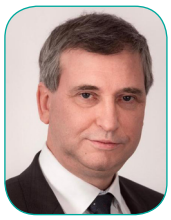
ABOUT THE AUTHORS

Marina I. Sidorova — Dr. Sci. (Econ.), Head of Anaplan Scientific and Educational Laboratory, Assoc. Prof., Prof. of the Department of Audit and Corporate Reporting, Faculty of Taxes, Audit and Business Analysis, Financial University, Moscow, Russia
https://orcid.org/0000-0002-8160-0993
Corresponding author:
misidorova@fa.ru



Dmitry V. Nazarov — Cand. Sci. (Econ.), Assoc. Prof., Department of Audit and Corporate Reporting, Faculty of Taxes, Audit and Business Analysis, Financial University, Moscow, Russia
https://orcid.org/0000-0001-7806-108X
dvnazarov@fa.ru

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ORIGINAL PAPER

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Financing "Green" Projects: Features, Risks and Tools

E.V. Chaikina[a], V.P. Bauer[b]
[a] Sevastopol State university, Sevastopol, Russia;
[b] Institute for Regional Economic Research, Moscow, Russia

ABSTRACT

The **subject** of the paper is the "green" projects of companies whose production activities are accompanied by a high level of anthropogenic emissions. The **purpose** of the paper is to study the features of analysis and practical application of the tools for financing "green" projects (hereinafter referred to as the tools). The **relevance** of the article is determined by the need **to solve the problems** of implementing in practice the provisions of Russian legislation on the development of "green" economy in the context of the need to develop and finance "green" projects by members of the National ESG Alliance. **The scientific novelty** of the paper is to develop the theory of development and practical use of tools, taking into account the peculiarities of their analysis and application. The paper uses theoretical and practical methods to the analysis of scientific publications and simulation results. The research is based on the provisions of normative and legal acts, monographs and scientific works devoted to the analysis, development and financing of "green" projects. Based on the research carried out in the article, the **following results were obtained**: an analysis was made of the specifics of the requirements for financing "green" projects; clarified the features of the classification of climate risks and formulated an approach to their transformation into corporate credit risks; the composition of the instruments is determined and their interpretation as controlled aggregates is proposed; the operator model of the units was developed, proposals for its practical use were made. The authors **recommend** that companies with a commodity product range use the operator model and cognitive maps developed on its basis to analyze existing and develop new tools. **In the future,** "green" companies are encouraged to use the tools obtained on the basis of the operator model and cognitive maps.

Keywords: "green" economy; "green" projects; financing instruments; operator model; climate risks; corporate credit risks; carbon-intensive products

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INTRODUCTION

Russia has adopted normative and legal acts regulating the capabilities of Russian organizations and individual entrepreneurs to develop and implement "green" projects "green" economy of the future, identified measures to account for and control greenhouse gas emissions and carbon footprint. The list of greenhouse gases in the territory of Russia approved.[1] A new category of property rights — carbon unit equivalent to one ton of carbon dioxide is provided. Adoption of the acts is a consequence of Russia's participation in the Paris Climate Agreement.[2,3]

Environmental, Social and Corporate Governance (ESG) accounting and regulatory standards are being developed and implemented by governments and interested commercial banks and companies in 110 countries around the world for climate purposes [1]. The initiative forms a long-term ethical trend of international "green" business, including the principles, mechanisms and tools needed to achieve the sustainable development goals of both banks, companies and the economy and society as a whole [2].

Russian commercial banks and companies of raw materials industries (ESG-leaders) have joined the National ESG-alliance to solve urgent problems in ecology, industry and finance.[4] Banking and corporate resources are needed for financing "green" projects of participating economic entities. In order to attract resources, the authors propose the use of appropriate tools used in practice as controlled aggregates. To achieve this, based on the international and Russian experience, firstly, the features of developing "green" projects are specified, secondly, the regularities of climate risk transformation into corporate credit risks are analyzed and, thirdly, taking into account the identified types of tools, it is proposed their operating model with various forms of asset security, which allows in a managed adaptive mode to analyze the consequences of financing of various for the purpose of "green" projects. Then the main conclusions are presented and the directions of further research that promote "greening" activities of Russian carbon intensive companies are determined.

"GREEN PROJECTS": DEVELOPMENT FEATURES

The specificity of the development of "green" projects in Russia is determined by the requirements set for them in normative and legal documents adopted over the last few years in the field of regulation of legal and institutional problems of the country's development, as well as long-term strategic planning policies in general. At present, the main documents regulating the low-carbon development of the Russian economy include: Federal Law,[5] Decree of the President of the Russian Federation,[6] Federal scientific and technical programme[7] and ensuring their implementation in practice of Orders of the Government of

[1] These are the following greenhouse gases: carbon dioxide (CO2); methane (CH4); nitrous oxide (N 2O); hydrofluorocarbons (GFC); perfluorocarbons (PFC); sulphur hexafluoride (SF6); nitrogen trifluoride (NF3). URL: https://www.profiz.ru/eco/8_2021/296-fz/ (accessed on 29.01.2022).

[2] Paris Agreement, adopted on 12 December 2015. URL: https://unfccc.int/files/ meetings/paris_nov_2015/application/pdf/paris_agreement_russian_.pdf. (accessed on 29.01.2022).

[3] Resolution of the Russian Government "On the adoption of the Paris Agreement" No. 1228 from 21.09.2019. URL: http://www.consultant.ru (accessed on 29.01.2022).

[4] National ESG Alliance established in Russia. URL: https://www.vedomosti.ru/ecology/esg/ news/2021/12/01/898565-v-rossii-sozdan-natsionalnii-esg-alyans (accessed on 25.02.2021).

[5] Federal Law "On limit greenhouse gas emissions" No. 296 from 02.07.2021. URL: https://www.garant.ru/products/ipo/prime/doc/401320454/ (accessed on 29.01.2022).

[6] Decree of the President of the Russian Federation "On the approval of the Fundamentals of the Russian Federation's state policy in the strategic planning sphere" No. 633 from 08.11.2021. URL: https://npalib.ru/2021/11/08/ukaz-633-id226070/ (accessed on 29.01.2022).

[7] Federal scientific and technical programme for environmental development of the russian federation and climate change 2021–2030. URL: http://science.gov.ru/media/files/file/wJgekXcVWebxcQmGATo4C 8EHE 2ZFjBh9.pdf (accessed on 29.01.2022).

the Russian Federation.[8, 9] The analysis and systematization of requirements to "green" projects, set out in these documents, leads to the following conclusions.

In the assessment of "green" projects, the key requirements are: state regulation, statistical accounting and environmental monitoring of greenhouse gas emissions characterizing the carbon intensity of products, as well as certification (confirmation) carbon credits to reduce emissions for sale by stakeholders.

The subject of monitoring is usually greenhouse gas emissions within the limits, and their excess performance, which may be a consequence of ineffectiveness of both development and implementation of "green" project, for example, insufficient consideration of energy conservation or renewable energy.

Emission certification uses methods that take into account raw materials, materials, energy and greenhouse gas emissions from the entire production chain of the finished product with the principles of "green" logistics. This makes it possible to estimate objectively the amount of greenhouse gas emissions per unit of product or service.

As the practice of a number of foreign countries shows, the introduction of effective monitoring mechanisms allows the State to gradually refine the optimal parameters of the carbon tax introduced for economic entities with the volumes of Russian export products [3].

Analysis shows that the specifics in the implementation of "green" projects with climate risks are:

- capacity to reduce greenhouse gas emissions by industry, activity and/or entity used to estimate trading in quotas potential;
- capacity to reduce greenhouse gas emissions by replacing individual fuel and energy resources (coal, diesel, etc.) with "green" energy sources;
- impact assessment of the implementation of "green" projects;
- development of tools to attract resources for these projects in order to increase the energy efficiency of production of products and/or services and reduce greenhouse gas emissions, including: "green" bonds, "green" loans, project financing, climate funds, etc.;
- development of carbon trading mechanisms, using, for example, the results of the experiment conducted in the Sakhalin region on carbon trading with the experience of scientific, legal and consulting support of the experiment.[10]

Sources of climate change risks and climate risks are represented in the papers [4, 5]. Specificity of climatic sources of financial risks for the development and implementation of "green" projects is investigated in documents G-20,[11] FSB[12] and highly competent reviews intended for the world banking community.[13] Analysis of these and other publications allows to identify two main groups of sources of climate risks: group of physical risks and group of risks of transition to "green" economy.

Physical risks are the impact of extreme natural and climatic events such as adverse weather conditions, rising sea levels,

[8] Order of the Russian Federation Government "On the development of investment activities and attraction of extra-budgetary funds in development projects in Russia" No. 3024 from 18.11.2020. URL: http://www.garant.ru/iv/request/?id=74929662 (accessed on 29.01.2022).

[9] Order of the Russian Federation Government "On approval of the strategy of socio-economic development of the Russian Federation with low greenhouse gas emissions until 2050" No. 3052 from 29.10.2021. URL: http://www.consultant.ru/document/cons_doc_LAW_399657/ba12a67ff89e1b6581fc0e37a3a6ff38f592f68e/ (accessed on 29.01.2022).

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desertification, freshwater depletion, soil depletion, forest fires, technological disasters leading to oil spills, radiation contamination of territories, water and soil pollution, etc.

The risks of transition to a "green" economy arise from the activities of states, institutions and companies aimed at addressing climate change and the environment.

The main categories of climate risks have multiple subcategories. The time horizons on which risks are considered also vary widely. For example, global warming risks are long-term, and natural disasters and the avoidance of technological risks are determined by the duration of force majeure. These risks, if any, are taken into account when assessing the risks of companies, usually either on the basis of statistics or on the basis of forecasts by international and Russian environmental organizations.

The risks of transition relate to human activities, human attempts to intervene and correct the processes of human activities that have increased in recent decades to negatively affect the nature, climate and ecology of the planet as a whole. The following trends can be identified:

- introduction and distribution of renewable and "green" energy projects (wind and solar), electrically "clean" engines;
- introduction of a system of trading in carbon emission quotas;
- transboundary carbon regulation, etc.

Objectives of climate risk management of financial institutions (support financial stability within prudential requirements of the regulator) are achieved through assessment and control of risks to which they are exposed. Here, most attention is paid to credit, market, operational, liquidity and underwriting risks [6].

ON THE TRANSFORMATION OF CLIMATE RISKS INTO CORPORATE CREDIT RISKS

One of the main obstacles in developing effective "green" projects is misunderstanding mechanism of transformation of climate risks into financial risks. One of the possible methods of solving the problem presented in the paper [7]. We will use its results for further research within the frame of the declared theme.

Financial companies may be exposed to physical climate risks directly, for example, in high-risk areas of natural disasters such as floods, forest fires, drought or heavy snowfall.[14] However, climate risks may have a much greater impact indirectly through the risks of companies and borrowers. Physical risks can affect companies and the economy as a whole through short-term shocks or long-term shifts.

For example, one of Texas's largest energy companies, the Brazos Electric Power Cooperative, declared bankruptcy in March 2021, due to numerous disruptions to the State's electricity system over seven days of extreme frost.[15]

Fires in Australia in late 2019 — early 2020 caused losses of 3.5 billion dollars, or 0.2–0.5% of the country's growth.[16]

Flood in Irkutsk region in July 2019 led to losses of more than 35 billion rubles, a significant part of which suffered infrastructure facilities (20 billion rubles), the population suffered from the loss of housing (about 11 billion rubles), the agricultural sector suffered losses (420 million rubles).[17]

Risks of transition in the process of development and introduction of "green" political and economic paradigm in the

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country, and requirements to business can take the following main forms.

1. Introduction of technological innovations that reduce the costs of renewable energy and, consequently, the fall of hydrocarbon prices. This will affect the income, cost and creditworthiness of mining companies. Bloomberg estimates that average wind and solar energy costs will decrease to 87% of coal generation costs by 2027 and to 73% by 2030.[18]

2. Introduction of a «green» regulatory policy that will lead to a sharp increase in carbon prices. The World Bank estimates that the world average carbon price in 2019 was 2 USD per ton, which is a small percentage of 75 USD per ton to increase temperature by no more than 2 °C.[19] The introduction of cross-border carbon regulation, which is being actively discussed by EU countries, could have a significant impact on pricing.

3. Changing consumer preferences and increasing loyalty to "green" companies. According to a 2019 study by Accenture consulting company, about 72% of respondents said that they were paying more attention to green products than five years ago.[20] Analysis confirms that the trend of changing consumer preferences will only increase.

The factors described above can primarily have a major impact on carbon-intensive assets. According to the Tsinghua University, the share of non-performing loans (NPL) of coal energy companies may exceed 20% by 2030 (current NPL level — less than 3%) due to the expected drop in the cost of "green" electricity.[21] HSBC Finance Group in its Global Research study estimated that a fall in demand and the introduction of a carbon tax could lead to a 40–60% decline in EBITDA of large fossil fuel corporations (Shell, BP, Total, Statoil etc.).[22] Researches conducted abroad based on climate change models have shown that by 2030, the cost of reducing warming to 2 °C will be 1–4% of global consumption (in the most efficient scenario — without delay of control measures).[23] Banks' losses in the most negative scenarios range from 8 to 30% of their own funds [8].

An example from the policy area of "green" regulation, which characterizes the transition risks for companies and industries of the economy, is cross-border carbon regulation, a measure that is planned by the EU within the "European Green Deal" to reduce carbon emissions and improve the competitiveness of European producers. In the development of policy, the European Commission has determined that this mechanism (Carbon Border Adjustment Mechanism — CBAM) will come into force in the transition phase from 1 October 2023, and will be permanently operational from 1 January 2026.[24]

The cost of transboundary carbon regulation for Russia is estimated at 6 billion euros annually.[25] Of course, this will lead revising the qualitative and quantitative assessments of credit risk by both lenders and borrowers of resources.

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TOOLS AS CONTROLLED AGGREGATES. OPERATOR MODEL

Problems of financing the development and implementation of "green" projects are devoted to a large number of publications having different, but close semantics. This is "green" financing [9, 10], "green" banking [11, 12], "ESG-banking" [13], etc. An analysis of data and other publications shows that two main theses are discussed.

The first thesis relates to the fact that in the current conditions of development of science, industry and economy there are no alternatives to the trends of "green" development of society.

The second thesis shows that the financing of "green" projects (in all its modifications) is the most important resource of transformation of branches of modern economy into "green" economy, creating a comfortable environment for humanity [14]. The effect is achieved by reducing the anthropogenic impact of economic entities on the environment by carbon regulation [15] of the carbon footprint characterizing the contribution of a project activity to the degree of pollution [16].

To achieve the goal in the article, and on the basis of practice of financing "green" projects [17], following the second thesis in the studies was evaluated by the authors of the article as more constructive, which allowed to interpret the tools as controlled aggregates. Based on this approach, and based on a number of paper analyses,[26, 27, 28] the tool parameters were aggregated as follows: application, purpose, asset of the tool, mortgaging maintenance of the tool, method of performance, rights and obligations of parties (see *Table*).

Approach to parametric description of tools as controlled aggregates allowed to develop their operator model [18]:

In/Out — operators of data input/output from the tool parameter analysis and transfer of the resulting funding model to the management decision-making;

A_1 — analysis of application the tool;

A_2 — determination of the purpose of the tool;

A_3 — determination of methods to achieve funding objectives;

A_4 — determination of actors involved in achieving funding objectives;

A_5 — analysis of mutual relations between the participating entities, identification of contradictions between them;

F_1 — formalization of input data on funding situation;

P_1 — check the shifts range of tool parameters;

St_1 — structuring the instrument parameters to financing objectives;

D_1 — decomposition of entities' objectives and assigning them to types of instruments and funding resources;

D_2 — decomposition of relationships of funding entities, determination of their sign, weight, linguistic significance, etc. parameters;

A_6 — analysis of the types of tools and the entities involved;

A_7 — analysis of the impact of relations between entities;

P_2 — check the adequacy of formed relations by an expert;

Sm — synthesis of the financing situation analysis model, including consideration of external and internal financing risks;

S_1 — synthesis of the organizational structure of financing;

S_2 — synthesis of the functional structure of financing with features of the aggregate parameters of the instruments;

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Table

Aggregated Tool Parameters

Parameters Tools	Application of the tool	Purpose of the tool	Asset of the tool	Mortgaging maintenance of the tool	Method of performance	Rights and obligations of parties
1. Environmental funding taxes	Taxes aimed at environmental remediation	Financing of environmental protection after negative effects	Taxes	Financial results of entities	Indisputable charging by law	Determined by federal and/or regional laws
2. Environmental regulatory taxes	Taxes to prevent environmentally damaging activities	Financing environmental protection before negative effects	Taxes	Financial results of entities	Indisputable charging by law	Determined by federal and/or regional laws
3. Carbon fee (carbon tax)	Fees to prevent environmental damage and/or remediation	Financing of various environmental protection activities	Carbon pricing	Financial results of entities	Indisputable charging by law	Determined by federal and/or regional laws
4. Emissions trading	Quotas with limits on greenhouse gas emissions	Financing of economic activities, including directly "green" projects	Planned carbon dioxide emissions	Expected results of entities	Placing through the exchange and/or auction	Determined by exchange and/or auction regulations
5. Subsidies/ subvention	Transfers to entities that have reduced harmful emissions and/or introduced environmental measures	Financing of economic activities, including directly "green" projects	Federal and/ or regional resources	Production results of entities	Direct financing of the recipient	Determined by federal and/or regional laws
6. "Green" public procurement	Contract purchase with environmental criteria of suppliers of goods, works or services	Financing of programs and projects aimed at development of "green" economy	Federal and/ or regional resources	Production results of entities	Competitive financing through auction	Determined by tender documents
7. "Green" bonds	Bonds issued to finance "green" projects	Financing of programs and projects aimed at development of "green" economy	Federal and/or regional and corporate resources	Financial results of issuers	Purchase contracts	Determined by purchase contracts
8. "Green" lending	Loans provided for "green" projects and/or environmental improvements in general	Financing of programs and projects aimed at development of "green" economy	Commercial bank resources	Financial results of borrowers	Credit agreement	Determined by credit agreement
9. "Green" mortgage	Low interest mortgage for implementing "green" projects and/ or for improving environmental conditions	Financing the construction and/or purchase of energy efficient homes, investment in the modernization of production and/or in the "green" energy sector	Commercial bank resources	Financial results of borrowers	Mortgage agreement	Determined by mortgage agreement

Table (continued)

Parameters Tools	Application of the tool	Purpose of the tool	Asset of the tool	Mortgaging maintenance of the tool	Method of performance	Rights and obligations of parties
10. "Green" car loans	Low interest loans for future car owners	Financing the acquisition of high fuel economy cars	Commercial bank resources	Financial results of borrowers	Credit agreement	Determined by credit agreement
11. "Green" insurance	Insurance products differentiating environmental contributions	Insurance financing of "green" projects	Insurance resources	Financial results of entities	Insurance contract	Determined by insurance contract
12. "Green" deposits	Specialized type of banking activity	"Green" financing the activities of subjects	Deposit resources	Financial results of entities	Deposit contract	Determined by deposit contract
13. "Green" leasing	Specialized activities of leasing companies	Acquisition of property necessary for the implementation of "green" projects	Leasing property	Financial results of entities	Leasing agreement	Determined by leasing agreement
14. Weather derivatives	Derivative instruments for stock speculation	Entity financing	Weather condition indicators	No	Purchase contract	Determined by purchase contract
15. Climate fund	Fund resources for environmental remediation and protection	"Green" financing the activities of subjects	Climate fund resources	Financial results of entities	Agreement for financing "green" projects	Determined by agreement for financing

Source: Compiled by the authors.

K_1 — optimization of the financing model;

P_3 — estimation of probability of development of the financing situation according to the studied model;

A_8 — analysis of the development of the financing situation over time;

P_4 — forecasting the development of the financing situation and assessing its impact on decision-making;

V_1 — assessment for compliance with forecasts of the development of the situation with explanations satisfying the expert;

C_1 — adjustment of the funding structure and model;

P_5 — verification of the result evaluation based on the principle of "how satisfied?";

Sh_1 — clarification (if necessary) of the financing model and its formalization;

E_1 — obtaining the values of the situation parameters and transferring the approved funding model to the management decision-making.

The data above the definition and classification of operators allows you to construct the U_1 model of the process of analysis and management of the funding situation of "green" projects with a specific tool on the following formula:

$$U_1 = In_1A_1A_2A_3A_4\downarrow_1F_1A_4A_5In_2P_1\downarrow_2St\ {}_1D_1D_2A_6A_7P_2\downarrow_3SmS_1S_2K_1P_3\uparrow^3 \downarrow_4A_8P_4\downarrow_5V_1\omega\downarrow_6C_1\uparrow^2\downarrow_7P_5\downarrow_7Sh_1D_1E_1Out.$$

In this formula, the arrows separate the analysis operations and their results from the aggregate parameters presented in the *Table*. The down-arrow denotes a straight sequence of operations, and the up-arrow denotes a return to the previous blocks to clarify the intermediate results.

It follows from the structure of the U_1 model that it allows not only to describe the analysis processes and the results of the choice of tools parameters, but also to change the range of input data, to optimize the output, and to predict the funding situation, perform step-by-step analysis of the tool using process automation.

In practice, the specification of the operators of the U_1 model should be carried out with the provisions set out in the previous sections of this paper with regard to the peculiarities of the development and implementation of "green" projects with climate and credit risks, as well as the composition of aggregate parameters of specific instruments.

Based on the operator model U_1 it is possible to create cognitive maps of tools [19, 20], which will allow by probability analysis of the influence of parameters on the results of the application of tools to assess their effectiveness in the changing business environment.[29]

CONCLUSION

In the article the authors consider the analysis and application of tools with features of development of "green" projects and specifics of climate and corporate credit risks, accompanying their implementation in practice. The informative analysis of these factors allowed the authors to identify the aggregate parameters of the tools and to develop their operator model, which:

- provides opportunities for detailed research of analytical processes and tool management;
- allows to evaluate the effectiveness of tools by assessing the impact of parameters on the final result;
- saves the labour time of experts on the study of the effectiveness of tools and their optimization (if necessary).

The main advantage of operator modelling is that it can be used to develop cognitive tool maps. As shown by numerous studies based on them, the maps will bring closer the results of modelling and analysis to the statistics of the tools management experiments in practice.

"Green" companies are invited to use tools with operator model and cognitive cards, which will, firstly, adapt tools to the changing business environment, secondly, minimize the risks of financing "green" projects, thirdly, implement "green" technologies of production of carbon-intensive products and, fourthly, reduce losses from carbon tax and increase the volume of export of their products.

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ABOUT THE AUTHORS

Elena V. Chaikina — Cand. Sci. (Econ.), Head of the Department of Finance and Credit, Sevastopol State University, Sevastopol, Russia
https://orcid.org/0000-0003-4413-3414
lena_chaykina@list.ru

Vladimir P. Bauer — Dr. Sci. (Econ.), Assoc. Prof., Chief Researcher, Institute of Regional Economic Research, Moscow, Russia
https://orcid.org/0000-0002-6612-3797
Corresponding author:
bvp09@mail.ru

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Features of Determining the Cost Indicators Through Forensic Examination During the Legal Proceedings in the Determination of the Amount of Losses

A.V. Shchepot'ev[a], **T.A. Fedorova**[b]
[a] Tula State University, Tula, Russia;
[b] Tula State Lev Tolstoy Pedagogical University, Tula, Russia

ABSTRACT

Cost indicators have been instrumental in highlighting the damage, in the qualification of crimes (large or especially large) and imposing punishment, as well as in conflict resolution between economic entities. **The aim of the research** is to identify the problems and conduct forensic examinations to determine the cost indicators and to formulate recommendations for improving this process. The research used such **methods** as content analysis of sources, normative and legal regulation, economic and mathematical methods, and analysis. Existing differences in individual concepts and types of values require uniformity in the justice system regarding their use. The authors recommend to adopt a list of issues and clarifications (explanations) to the issues in the determination of values on the basis of which the court will determine the amount of damage. The practice of forensic expert activity (at the legislative level, approved by norm) before the appointment of a forensic examination (in terms of determining the list of issues submitted for expert examination) was suggested, another proposal include implementation seminars with the participation of an expert (expert candidate) and detail of the cost indicators. Alternatively, this type of value can be represented as the term "market value with the restriction of free circulation". It was **concluded** that there is a need to develop unification and develop uniform principles for determining the cost of financial indicators in legal proceedings to determine the amount of losses.

Keywords: evaluation activity; forensic examination; expert; property value; business valuation; determination of damage; determination of loss; lost profit; investigation; legal proceedings

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INTRODUCTION

Legal proceedings evidence in Russia is based on results of forensic examinations. they are required in criminal proceedings, civil cases of general jurisdiction, and also used in arbitration proceedings.

Courts have to determine damages, determine their amount, decide on the reasonableness of damages and determine their amount. The determination of the value of the loss requires special knowledge in the economic sphere, so that courts often resort to the prescription of forensic examinations on relevant issues [1]. Expert skills are also required in criminal proceedings [2]. It should be noted that, on the basis of the results of the forensic examination as one of the relevant types of evidence (taking into account all other evidence available in the case file), the judicial authority makes the appropriate decision (verdict) [3].

The results of forensic examination or conclusion of a specialist (in addition to the consideration of the merits of the case) can be used to determine the amount of financial claims, i.e. to determine the amount of damage [4]. In the course of the forensic examination, valuation indicators are determined, including the value of the property, reconstruction or repair works, the amount of decrease in the value of the consumer properties of the property. In the current conditions of digitalization of society, questions of determining appropriate economic indicators of social and economic relations of economic entities are relevant [5].

The scientific and practical basis of the measured values is the evaluation activity, the results of which are present in various spheres of economic relations in society [6], including for the resolution of conflicts in court proceedings. The results of forensic examinations can also be used in the performance of State control functions [7].

Current judicial practice and existing legislation contain definitions of the notion of "market value". However, often the concepts of "actual value", "real value", "fair value", "intrinsic value", "reasonable value", "equivalent value" and other similar concepts can be used as synonyms.[1] Therefore, in judicial acts, legal sources and scientific literature are found as concepts-synonyms: "market value", "real value", "fair value", etc. [8]. Development of unification of terms and concepts will improve various areas of science, as well as contribute to the development of expert activities and court proceedings [9]. Unification of the terms used in the judicial process and in the judicial expert activity can be achieved through the compilation of judicial practice and relevant documents with recommendations on their use. Such generalizations should be made under the auspices and general control of the Supreme Court of the Russian Federation.

The values determined during forensic examination may have different names, nuances and features. That is why, when appointing forensic examination, it is necessary to clearly and unequivocally put relevant questions to the expert.

The aim of the study is to identify the problems of appointment and conduct of forensic examinations to determine the cost indicators and make recommendations to improve the process.

For achieving the set foal, the author solves the following **tasks**:

- identification of the main problems of the purpose and conduct of forensic examinations to determine the cost indicators;
- development of a recommendation on standardization of terminology used in judicial and expert activities;
- recommendation a list of questions and aspects to consider when appointing a forensic examination to determine the cost indicators.

[1] Article No. 7 of the Federal Law No.135 from 29.07.1998 "On estimated activity in the Russian Federation".

RESEARCH PART

On the basis of the results of the forensic examination, cost indicators are established, on the basis of which the judicial authorities determine the amount of real damage (in value) as well as loss of profit, i.e. the amount of damages.[2]

In the course of forensic examination, the cost indicators are determined on the basis of which the court determines the amount of damages.

It should be noted, however, that the draft questions on which cost indicators will be based, which will form the basis of the court's decision, are provided by the parties to the case, but the court determines the final version of the questions for forensic examination. The analysis of judicial practice revealed that the judicial system lacks uniform principles of asking questions for forensic examination.

According to the authors, it is necessary to introduce and actively use in the sphere of expert activity a mechanism of formation and preparation of questions (including clarification of the language and definition of types of value, taking into account all the different aspects of the defined cost indicators) for the purpose of the proposed forensic examination, taking into account the expert's opinion (expert candidate).

As an example, the process of developing, establishing and approving issues in the criminal proceedings No. 1.18.01700014.260176 may serve as an example for the formulation and agreement of the questions assigned for forensic examination with an expert (or candidate for expert) (was investigated by the investigation department of the Ministry of Internal Affairs of Russia in the Uzlovsky district of the Tula region on p. "b" part 2, art. 165 of the Russian Criminal Code; Uzlovsky City Court are convicted). In the course of the investigative actions before the appointment of the forensic examination by the investigative body with the candidate for judicial financial and economic examination, the relevant examinations were discussed, defined and established. Note that certain questions approved by the investigative body in cooperation with the candidate for experts have formed the basis of developed and implemented Methodical recommendations in determining the value of economic losses, arising from resource-supplying organizations during settlements of housing and communal services entities for the resources consumed [10]. In view of the above, it is advisable at the legislative level (with the introduction of appropriate additions to the legal acts governing the purpose of forensic examination) make explicit provisions for questions to be formulated before a forensic examination is appointed.

In the framework of this study, the authors analyzed the main types of cost indicators, proposed formulations of questions (detailing and clarifying cost indicators) that are advisable to make for forensic examination.

Consider the values that have the variability of the definition, taking into account the clarification and detail of the issues assigned to forensic examination.

1. What is the cost of materials and restoration of lost (damaged) property: including or excluding of physical deterioration of damaged property?

There is no unified position in judicial practice. In cases of recovery of real damage during the flooding of the apartment (compensation for repair of the apartment), repair of the vehicle after traffic accident (accident)In some cases, courts award the full market value of the repair and related materials as compensation to the injured party, in other cases — with depreciation. Depending on the questions posed to the expert by the judicial authorities, some value will be determined.

[2] Plenary Ruling of the Supreme Court of the Russian Federation No. 25 from 23.06.2015 "On Court Application of Certain Provisions of section I of the Civil Code of the Russian Federation", para. 13, 14.

2. Direct production cost, full cost or sales cost?

In determining the value of the property through a forensic examination, it is advisable for the court to specify what value the court wants to use. For trading activities, this variation may be as follows: the cost of purchase, the cost of purchase with cost of goods sold or the cost of selling the products.

It is advisable to determine the cost (purchase price) of the property when determining direct damages in criminal cases. And, in order to determine the loss of profits, it is useful to determine the market price of realization.

3. Wholesale or retail prices? If it is necessary to establish values, the court should provide appropriate clarifications on the issue of wholesale or retail prices: the difference for individual items can be very significant.

4. Price with or without VAT? Depending on the problem solved by the court, taking into account the specifics of the case, the court should indicate to the expert: with VAT or without VAT to determine the cost.

There is no unified judicial practice on this issue. There may be different questions about the value of property in criminal and arbitral proceedings, and therefore there may be variation in the question. In any case, however, the court must clarify the question: with or without VAT is taken into account, the values must be determined.

The VAT or no VAT valuation aspect should be based on the court's vision: what value (cost indicators) should be determined to resolve the substantive litigation.

5. The concept of "income" as "revenue" (excluding VAT) or "income" as "profit"?

In determining the loss of profits, it is necessary to determine the lost income that the injured person would have been able to obtain under normal conditions of civil turnover if his right had not been breached.[3]

There are a number of terms that have different interpretations in different directions of science [11]. The term "income" is one of them.

Accounting and tax legislation means revenue (without VAT).[4]

In the scientific economic literature [12] and a number of legal documents, the term "income" can be used synonymously with the term "profit": by income (profit) means the difference between revenue and cost, i.e. the profit of the entity.[5]

There are a number of different opinions that interpret in different ways the concepts of "income", "revenue", "profit". In judicial practice, there was no common understanding of what the cost of determining loss of profits should be: revenue or profit (the difference between revenue and cost).

That is why, when determining questions on valuation, the body that ordered the forensic examination should specify what was meant by income: revenue or profit?

6. Determination of market or liquidation value?

With regard to the property of business entities in bankruptcy proceedings, it may be necessary to determine not the market value but the liquidation value, i.e. in the event that the disposition of property is expected to take place within the time frame of the exposure of the property to the market, which is significantly lower than typical for this type of property. This aspect also needs

[3] Plenary Ruling of the Supreme Court of the Russian Federation No.25 from 23.06.2015 "On Court Application of Certain Provisions of section I of the Civil Code of the Russian Federation", para. 14.

[4] Order of the Russian Ministry of Finance No.32 from 06.05.1999 "On approval of Provision on accounting "Income of the organization" PBU 9/99» (registered in the Ministry of Justice of Russia No.1791 from 31.05.1999), para. 4, 5; Tax Code of the Russian Federation (part two) No.117 from 05.08.2000, art. 249.

[5] Order of the Ministry of Industry and Science of the Russian Federation No.2 from 04.01.2003 "On approval of the Methodical Regulations on planning, accounting of costs for production and sale of products (works, services) and calculation of the prime cost of output (works and services) at the enterprises of the chemical complex", para. 6.2.1; Guidelines for the development of accounting policies in agricultural organizations (approved by Ministry of Agriculture of the Russian Federation from 16.05.2005) etc. para. 29.

to be taken into account in the appointment of forensic examination (in the preparation of questions).

In the framework of this question can be relevant definition collateral value of the property [13].

7. Distinctions of determining values in respect of inseparable assets (in bankruptcy or liquidation of a legal entity).

If the court session needs to determine the actual value of a stake in a company in the process of bankruptcy or liquidation, the analysis and valuation of assets of an entity should take into account separately such a category of assets as inseparable assets.

Assets inseparable from an entity — assets for which the transfer to third parties is not (prohibited) by existing legislation or the acquisition of these assets by third parties is uneconomical [14].

As an example of inseparable assets can be considered deferred tax assets, written off uniformly organizational costs for the formation of a company, licenses, membership in a professional community (self-regulated organization), etc. Appropriate valuation and financial analysis procedures should be applied to these assets.

8. Features of determining the value of assets and liabilities during bankruptcy when establishing signs of deliberate or fictitious bankruptcy [15].

In this case, the expert may have before him materials (financial information) knowingly distorted by officials of the subject being analyzed (evaluated) [16].

9. Determination of the value of property not subject to accounting (including informal assets — is the accumulated stock of value, expressed in property or other rights, capable of bringing economic benefits or a number of economic benefits, but not meeting all formal criteria, the concept of "asset" in the formation of accounting (financial) reporting [17]). In the course of disputes between business entities, it may be necessary to identify values that are not subject to accounting rules. In this case, it is reasonable to use the professional skills of a forensic expert. At the same time, the expert who determines values can be both an appraiser defined by them according to the norms imposed on appraisers, such as real estate [18], and an expert with additional knowledge, such as in the field of audit, etc.

10. Features of the valuation of contraband.

Valuation of contraband is important in the investigation of illegal actions as well as in court proceedings. The definition of the crime itself will depend on the value of the contraband products. The value of the contraband will determine the size of the amounts of contraband: large or very large. This fact will influence the definition of the crime, the gravity of the punishment and the amount of damage caused.

With regard to property subject to smuggling in circumvention of customs duties, quotas or other legally prescribed restrictions on its movement across the border, the relevant issues should be taken into account in the appointment of forensic examination:

a) valuation with or without customs duties?

b) valuation of contraband products by market analysis in the exporting country or by market analysis in the importing country?

11. Distinctions of determining of the cost indicators in relation to counterfeit products.

Analysis of the value of counterfeit products (whether contraband or manufactured domestically) should determine the following value characteristic: determination of the value of this unoriginal (uncertified) product or original production, if the products submitted for research were original (brand)?

That is why, with regard to counterfeit products, it is advisable to ask for a forensic examination with the following wording: what would the cost of the original products if the counterfeit products being investigated were original?

12. Features of the definition of cost indicators in relation to property, prohibited or restricted (narcotic and psychotropic drugs, weapons and their elements, ammunition, State awards, etc.).

In relation to such property, it is advisable to use an independent concept of "market value when restricting free circulation" [19].

At the same time, the use of information from the "black" market can be considered admissible as evidence during the examination.

Suppose a civil servant was bribed with drugs. In addition to illicit drug trafficking, it is necessary to investigate the fact of bribery.[6]

As an alternative to the use of "black" market data during forensic examination, the standard price of the main types of property, prohibited or restricted in free circulation may be provided. Information about prices of "black market" initially can be obtained during the investigation in criminal cases, in which information on the value of the prohibited property in circulation appears.

At the same time, we note that for certain types of property limited or prohibited in circulation, there are legal acts that can serve as an information base for the determination of values.

In determining the values for animal products listed in the Red Book of the Russian Federation, the values indicated in the relevant document can be used.[7]

The values for firearms and ammunition can be determined on the basis of ransom (value compensation) norms for the population of arms and ammunition. Separate legal acts provide for the "reimbursement of the value of weapons and ammunition voluntarily surrendered by citizens of the Russian Federation, foreign citizens and stateless persons to the internal affairs bodies of the Russian Federation…".[8]

However, most of the instruments regulating the limited circulation of property (narcotics,[9] State awards[10] and other property) do not include any valuation.

According to the authors, the valuation of state awards cannot be adequate and fair, as many State awards are made of bronze or brass. The value of the metal from which they are made cannot be proportional to the fair value of the respective awards [19].

In order to carry out the investigative process, legal proceedings regarding various types of property, prohibited or restricted in circulation, the authors recommend the establishment of directories (price lists, regulations, etc.), which will indicate the value of the equipment concerned.

Another way to solve this problem may be to consolidate tools of property valuation, limited in circulation, for investigative and judicial purposes by including in the methodology of expert study right to use the value of non-expendable property according to data "black" market.

In doing so, the relevant clause on the principles of valuation, objectives of valuation and other relevant qualifications should be included in the methodological tools and expert studies undertaken.

CONCLUSION

Summing up the research, the author recommends:

[6] Order of Rosprirodnadzor No.317 from 30.06.2017 "On the approval of the List of Information Materials Required for Posting on the Information Stands "Anti-Corruption" in the Territorial Bodies of Rosprirodnadzor and Federal State Budgetary Institutions subordinate to Rosprirodnadzor".

[7] Order of the Russian Ministry of Natural Resources No. 107 from 28.04.2008 "On the approval of Method of calculating the amount of damage caused by animals listed in the Red Book of the Russian Federation, as well as other animals, not related to objects of hunting and fishing and their habitat" (registered in the Ministry of Justice of Russia No. 11775 from 29.05.2008).

[8] Federal Law No. 469 from 29.12.2014 "On the specific details of weapons in the Republic of Crimea and the Federal City of Sevastopol". Para. 10, art. 2.

[9] Resolution of the Government of the Russian Federation No. 681 from 30.06.1998 "On approval of the list of narcotic drugs, psychotropic substances and precursor, subject to control in the Russian Federation".

[10] Decree of the President of the Russian Federation No. 1099 from 07.09.2010 "On measures to improve the state award system of the Russian Federation".

I. To elaborate a list of questions and clarifications (explanations) to the questions on the determination of values on the basis of which the court will determine the amount of damage.

During the examination, it is necessary to clarify a number of aspects and nuances: the cost of restoration work with or without the deterioration of the facility itself; cost or value; wholesale or retail prices; with or without VAT etc.

The specifics of the questions and their clarifications are present when the experts are appointed to establish the value of contraband property, counterfeit products, property, limited and prohibited in circulation, as well as in relation to the company's assets, in liquidation or bankruptcy.

Competent authorities need to develop recommendations or rules for judicial and investigative authorities, expert organizations and other interested persons, which clearly indicate those values that should be determined during the determination of damages.

II. Given that the values determined by the forensic examination have many nuances, features and different interpretations, it is advisable to introduce into the practice of forensic expert work (at the level of a legislatively approved norm) prior to the appointment of the forensic examination (as part of the determination of the list of issues to be submitted for expert examination) to hold discussions with the expert (expert candidate) and refine the wording of the questions, detailing the cost indicators to be determined.

That was partly due to a lack of understanding among experts of what values (taking into account nuances, aspects and inconsistencies) should be determined, could lead to distorted and unreliable forensic examination.

The legal consequences of this fact may be an erroneous determination of the type and amount of punishment of the perpetrator in the course of an act in which the value of the damage is directly relevant, the value of the damage awarded to the victim may also be distorted.

That is why setting a clear task is so important when assigning examination.

III. At the legislative level, develop and establish guides (price lists, standards, etc.), which will indicate the value of property limited or prohibited in circulation. As an option, this type of value can be fixed in the form of the term "market value under restriction of free circulation".

An alternative solution to this problem can be the development of methodical recommendations for determining the market value when restricting the free circulation by providing the evaluator expert the right to use information on the value of the property according to "black" market.

There are still many outstanding issues and challenges in the expert activities [20]. Targeted steps to improve expert activity will contribute to the formation of a more civilized society of law, as well as the development of the judicial system in our country.

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ABOUT THE AUTHORS

Alexander V. Shchepot'ev — Cand. Sci. (Econ.), Assoc. Prof., Department of Finance and Management, Tula State University, Tula, Russia
https://orcid.org/0000-0003-3451-2947
Corresponding author:
shepotevsv@mail.ru

Tatyana A. Fedorova — Dr. Sci. (Econ.), Assoc. Prof., Director of the Department of Additional and Business Education, Tula State Lev Tolstoy Pedagogical University, Tula, Russia
https://orcid.org/ 0000-0002-1945-1835
tatiana75@mail.ru

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ORIGINAL PAPER

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Application of the Altman Z'' Score Model in Forecasting the Financial Position of BIST Companies

İ.E. Göktürk, H.S. Yalçinkaya
Necmettin Erbakan University, Konya, Turkiye

ABSTRACT

For measuring financial performances of companies and identifying financial failure, there are a lot of models in the literature. Among these models, Z Score model is of the most used in terms of its being an accounting-based model and simple applicability. The purpose of this paper is found out whether the Z'' Score model, which was revised by Altman, could be useful in making financial decisions about long-term firm value. For this purpose, panel cointegration analyzes were carried out among the variables, with the firm values of the publicly traded companies listed on the Turkish BIST (Istanbul Stock Exchange) as the independent variable and the Z'' Score values as the dependent variable. Although the research is specific to Turkey, the results of the research are considered to be applicable globally, as Altman states that the Z'' Score model can also be used by developing country companies. It has been proven that Altman Z'' Score Model, applied in public company, has a high prediction power directed to financial success of the firms. According to the results of the analysis, 1 unit increase in the Z'' Score values of the companies cause an increase of 0.353 units in the logarithmic return calculated over the firm value. Z'' Score Model can be a precious indicator for heads of companies, accounting and financial managers, auditors, creditors, investors to make accurate decisions directed to assessing financial structures of companies in advance.

Keywords: Accounting based prediction model; financial distress; Altman Z-Score; BIST

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INTRODUCTION

The firms, which cannot perform the requirements of market conditions, due to the fact that economic and financial troubles they face of, experience difficulties in sustaining their lives. The studies show that these problems that we can refer to business failure arise from bad management of firms [1].

Although there are many reasons for business failure, these reasons were classified in the literature as economic and financial failure in two main areas [2]. Economic failure emerges in case those firms cannot obtain income as much as it can meet costs forming in activity process [3, 4]. Economic failure may not create any problem for the business, which has a strong structure and paying power for their debts. Also, after the income generating activities, business can reach its profit targets in time.

Financial failure emerges in case of not being able to pay for debts in their due dates [5]. Financial failure is the insufficiency of the acts made directed to identifying financial performances of the firms [6–8]. Financial performance can be expressed as activity abilities of business managers for asset management and control [9]. Being able to take action by the managers can be possible by predicting financial failure in advance.

The use of an accounting-based structure in measuring fiscal performance and analysis of fiscal tables obtained from accounting data contribute performance measurement. The ratios that will be obtained from financial tables will provide information about the existing situation and future of the business. The analyses to be made will provide critical information for many parts such as company managers, investors, creditors and government while identifying possible problems to emerge in financial structures of companies provides for the in-business users to take necessary precautions from financial point of view, in viewpoint of out-business parts, it will be a guide in arranging the relationships with company [10].

Not being able to identify the problems occurring in financial structures of businesses and not being able to take the necessary actions in time are generally ended with bankrupt, and this case causes the formation of serious costs negatively affecting both companies

and all stakeholders related to the company [1, 11, 12]. In these stages, taking businesses to bankrupt, using certain methods for predicting failure will enable to take action with lower cost without facing to heavy cost of bankrupt [13, 14].

It is known that many prediction methods were developed for identifying the problems in financial structures of the businesses in advance [15–21].

One of the most encountered methods in the literature for testing financial structure and identifying bankrupt risk is Altman Z Score model. Besides that, Altman Z Score model is used in the areas such as merging and acquisition, credit risk analysis and return methods as danger measurement, this model has been begun to be used for the purpose of measuring performance [22]. The Altman Z Score model is a useful model not only for predicting bankruptcy, but also for measuring financial performance [23].

The most interesting study for identifying financial performances and successes via proportioning the variables taking place in financial tables was carried out by Beaver in 1966. In this study, used a univariate analysis as a traditional method [24]. After this study, Altman, using Multiple Discriminant Analysis (MDA), developed a new model in 1968. This model was broadly accepted besides that it had a high accuracy level, due to the fact that it could be used in assessing financial performances of firm managers, analyses of management accounting and presenting predictions in identification of fiscal structures as well as decision making processes of the various stakeholders such as investors, creditors, auditors, consultants [25, 26].

The study was divided into three sections, including introduction and conclusion sections. The first section theoretically describes Altman Z Score model and, the second section includes empirical examination of the literature about this method. The third section includes database and study method and, the last section presents a discussion about Turkey-specific results and their effects.

ALTMAN Z SCORE MODEL IN LITERATURE

Z Score Model, which is the first multiple variable model for measuring performances of financial structures and identifying financial failure, was developed by Altman Edward in 1968 [27]. Easily application of the method through accounting data and its success on performance results directed to identifying financial failure enabled the model to be used in a wide area and to be acceptable [28, 29].

The first Altman Score Model is based on the assumption that there is a linear relationship between financial failure and the ratios obtained from financial tables [30]. In the study, using 22 financial ratios, calculated through the values obtained from financial tables, were used. In the direction of the results obtained, 5 financial ratios, which is accepted that they identify financial failure, were reached [31].

Financial rates, accepted that they identify failure in Altman's original model, are [6]:

$X1$: Working capital/Total Assets;

$X2$: Retained earnings/Total assets;

$X3$: Earnings before interest and taxes/total assets;

$X4$: Market value of equity/Book value of total debt;

$X5$: Sales/Total assets.

Discriminant function, first developed by Altman and called Z Score, is as follows [15]:

$$Z = 0.012\ (X1) + 0.014\ (X2) + 0.033\ (X3) + 0.006\ X4 + + 0.999\ (X5).$$

The possible results of Z Score are determined according to the flowing limit values [15]:

- $Z \leqslant 1.80$: High Risk (Distress Zone);
- $1.81 \leqslant Z \leqslant 2.99$: Uncertain (Grey Zone);
- $Z > 2.99$: Low risk (Safe Zone).

It was identified by the researcher that the first model formed could predict accurately the financial successfulness of unsuccessfulness of the firms in the rate of 95% with the one year ago data and accurately in the rate of 72% with two years ago data [15].

The first Altman Z Score model was formed for public businesses. However, financial structures of non-public businesses differ from financial structures of public businesses. Especially, due to weakness in cash flows of non-public businesses, they face to more financial problems [32]. Altman noticing this problem updated model in the following years.

Discriminant function revised by Altman is as follows [33]:

$$Z': 0.717 * X1 + 0.847 * X2 + 3.107 * X3 + 0.420 * X4 + + 0.998 * X5$$

$X1$ = working capital / total assets;

$X2$ = retained earnings/ total assets;

$X3$ = earnings before interest and taxes / total assets;

$X4$ = book value of equity/ book value of total liabilities;

$X5$ = sales/ total assets.

After this modification, Z Score classification areas were also again determined,

- Z' < 1.23: High Risk (Distress Zone);
- 1.23 ⩽ Z' ⩽ 2.90: Uncertain (Grey Zone);
- Z' > 2.90: Low risk (Safe Zone).

Altman, for Z Score model to be able to be used except manufacturing businesses, revised the model once more. Altman, eliminating the variable of X5 sales/total assets, formed four variable Z" score model.

Four variable Z" Score model, is as follows [17, 33]:

Z" = 6.56 ($X1$) + 3.26 ($X2$) + 6.72 ($X3$) + 1.05 ($X4$).

After this modification, Z Score classification areas were also again determined. According to this:

Z" Score < 1,10: High Risk (Distress Zone)

1.10 ⩽ Z" Score ⩽ 2.60: Uncertain (Grey Zone)

Z" Score > 2.60: Low risk (Safe Zone)

Altman theory, for distinguishing whether or not quantitative models such as Multiple Discriminant Analysis (MDA) will show sufficient performance from financial point of view, is important in terms of that it shows that financial ratios can be used. Altman Z Score model, which has a scientific support and uses accounting data, is also continuously used at the present time by market markers both in academic studies and as an indicator of basic analysis.

Also, in this study carried out, it was focused on Altman Z" Score model, revised by Altman, that is highly acceptable in the literature [2, 15–17, 20, 24, 25, 33, 35–43].

METHODOLOGY

The Aim of the Study and Database

The last revised Altman Z" score is a model that can be applied in developing countries [44]. In the study, Altman Z" score success has been tested by using the financial statement data of publicly traded companies in Turkey, which is the developing country model.

When Altman Z Score coefficients are examined, Z" < 1.1 shows high bankrupt risk; 1.1 <= Z" < 2.60, grey zone and Z" >= 2.60, good condition of the firm [45, 46]. If there is a relationship between Z'' Score values and financial performance of firms, this relationship will have to effect market value of firms. In order to test hypothesis formed, Z" Score results of the firms recorded in Istanbul Stock Exchange (BIST) and market values of these firms were used in the study. In the hypothesis established, all companies registered in BIST were evaluated to obtain the most accurate result, and financial sector representatives from these companies were excluded because they had different balance sheet structures. By examining the data continuity of the companies registered in BIST, the longest possible period for the research was determined. According to this examination, it was decided that the most suitable study period for the study was 38 periods between 2nd quarter (six months) of 2012 and 3rd quarter (9 months) of 2021. As a result of all of these examinations, 111 firms and quarterly financial tables of 38 periods of these firms and market values of the firms were included as dataset in the study carried out. The firms being subject of the study were shown in *Table 1*.

Z" Score values of the companies were calculated as shown in the formula (1).

$$Z'' \text{ Score} = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4 \quad (1)$$

Firm value data, which is the independent variable of the research, is calculated from the market values of the companies shown in *Table 1*, reported in BIST. In the calculation of the firm value variable, the logarithmic return was calculated over the 3-month market values of the companies included in the analysis.

$$\text{Ln (return)} = \ln (P_{n+1}/P_n) \quad (2)$$

The purpose of using logarithmic return value instead of using firm value, is to avoid the stationary problem that may arise in the time series. As a result, the increase or decrease in the logarithmic return will not harm the basic question of the research, since it directly depends on the increase or decrease in the value of the firm.

In the dataset formed, due to the fact that it contains both time and cross-sectional vales, dataset turned into panel data set in the scale of 38×111.Although that analyses are made on the panel datasets is partly similar to time series, it also contains many differences. The most important one of these differences and element that is necessary to be studied is horizontal cross-sectional dependence. Other than cross-sectional dependence, additionally, studying homogeneity on

Table 1

BIST Firms Being the Study Subject

ADEL	ARMDA	BTCIM	DOKTA	GUBRF	KRSTL	PETKM	TKFEN
AEFES	ARSAN	BUCIM	ECILC	HATEK	KRTEK	PETUN	TOASO
AFYON	ASELS	CCOLA	EGGUB	HEKTS	KUTPO	PINSU	TTKOM
AKCNS	ATEKS	CELHA	EGPRO	INDES	LINK	PKART	TTRAK
AKENR	AVTUR	CEMTS	EGSER	IPEKE	LKMNH	PNSUT	TUPRS
AKSA	AYGAZ	CIMSA	ENKAI	KAREL	MNDRS	PRKAB	ULKER
AKSEN	BAGFS	CLEBI	ERBOS	KARTN	MRSHL	SARKY	USAK
ALARK	BAKAB	CMENT	EREGL	KENT	NETAS	SELEC	UTPYA
ALCAR	BIMAS	DERIM	ESCOM	KLMSN	NUHCM	SISE	VESBE
ALCTL	BIZIM	DESA	ETYAT	KNFRT	OLMK	TATGD	VESTL
ALKIM	BLCYT	DESPC	FROTO	KONYA	ORGE	TBORG	VKING
ALMAD	BRISA	DGATE	GENTS	KOZAA	OTKAR	TCELL	YAPRK
ANELE	BRSAN	DOAS	GOLTS	KOZAL	OYAKC	TGSAS	YATAS
ARCLK	BSOKE	DOBUR	GOODY	KRONT	PARSN	THYAO	

Source: Compiled by the author.

dataset is highly important for panel data analysis. Depending on analyzing these two elements, the analyses to be made will differ.

HORIZONTAL CROSS-SECTIONAL DEPENDENCE

Cross-sectional data exhibit a behavior in the direction of commonly moving, the correlation appears between cross-sectional data, and this state refers to horizontal cross-sectional dependence. Between cross-sectional data, the results of the analyses to be made without considering horizontal cross-sectional study are relatively different and can be misleading for the researcher [47–49].

For studying horizontal cross-sectional dependence, a lot of models were developed. These models are LM test [47], CD test [48] and NLM test [50]. The method to be used to select the most suitable one among these tests is basically is: if time series (T) is bigger than cross-sectional series (N), LM test should be chosen; if $N > T$, CD test; and if N and T reach big values, NLM test; CD calculates correlation between the residuals obtained as a result of ADF (Augmented Dickey-Fuller) in horizontal cross-sectional dependence test [51].

For being able to be calculated Pesaran CD test,

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \quad (3)$$

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t=1}^{T} e_{it}e_{jt}}{\left(\sum_{t=1}^{T} e_{it}^2\right)^{1/2}\left(\sum_{t=1}^{T} e_{ij}^2\right)^{1/2}} \quad (4)$$

e_{it} and e_{ij} are the residuals obtained as a result of regression, represent correlation and $\hat{\rho}_{ij}$ i and j. The hypotheses formed for the test made are [48]:

H_0: There is no correlation between cross-sections;

H_1: There is a correlation between cross-sections.

In this study carried out, in the size of $N = 111$ and $T = 38$, there are two variables as Z" and Ln (return). The results of Pesaran CD test and the other horizontal cross-sectional dependence test are presented in *Table 2*.

When the test results of three horizontal cross-sectional dependence, made on the variables of Z" Score and Ln (return) that are the subject of the study, are examined, depending on the result of $p < 0.05$ for each

Table 2

The Results of Horizontal Cross-Sectional Dependence Test

Test	Ln (return)			Z" Score		
	Statistic	d.f.	Prob.	Statistic	d.f.	Prob.
LM	229992.0	6216	0.00	242424.0	6216	0.00
CD	4.795,748		0.00	4.923.657		0.00
NLM	2.005,975		0.00	2.117.474		0.00

Source: Compiled by the author.

test and variable, H_1 is accepted, while H_0 is rejected. According to these acceptations, it is reached the conclusion that the variables have correlation on their own cross-sections and cross-sectional dependence cannot be rejected.

HOMOGENEITY TEST

If a variation in one of cross-sectional variables also shows similar effects on the other cross-sectional variables, we say that panel data structure is homogenous, otherwise, that it is heterogeneous [52]. In addition, whether or not panel data is homogenous play's important role in the preference of the analyses that will be made later.

In this study made, using Hsiao C. [53] homogeneity test, homogeneity of panel-data set was tested. In Hsiao Homogeneity Test, three hypotheses are formed as H_1, H_2 and H_3 are formed. While H_1 and H_2 hypotheses accept that model coefficients are homogeneous, H_3 hypothesis accepts that these coefficients are partly homogeneous [54]. The results of Hsiao Homogeneity Test are shown in *Table 3*.

In the results of Hsiao Homogeneity Test, since $p < 0.05$, homogeneity of panel-data set cannot be rejected. According to the results of horizontal cross-sectional dependence and homogeneity tests, it will be decided which test can be used for unit root tests, the next step.

In case that there is no horizontal sectional dependence, while 1st generation unit root tests can be applied, in case that there is horizontal cross-sectional dependence, 1st generation unit root tests give misleading results. In case that there is horizontal cross-sectional dependence, MADF [55], SURADF [56] and CADF (CIPS) [57] tests are recommended, which are among 2nd generation unit root tests. However, from among these tests, in the cases of $N > T$ and $T < N$, CIPS test gives the most reliable results [58]. Also, in this study carried out, CPS unit root test was chosen, depending on specified reasons.

CADF test, developed by Pesaran, was developed in terms of cross-section and while both $T > N$ and e $N > T$, it gives reliable results in panel data analyses under horizontal sectional dependence. The other feature of this test is that it is a heterogeneous test. Pesaran CADF is based on the model given below [58]. In case that there is no autocorrelation, panel data model is the same as that shown in formula (5).

$$Y_{it} = (1-\varnothing_i)\mu_i + \varnothing_i Y_{i,t-1} + u_{it}, \quad (5)$$

when f_t is accepted as unobserved factor and if u_{it} has a structure of single factor, u_{it} is expressed as shown in formula (6) [51]:

$$u_{it} = \gamma_i f_t + e_{it}, \quad (6)$$

when u_{it} is placed in the model, the new model will turn into the shape shown in the formula (7).

$$\Delta Y_{it} = \alpha_i + \rho_i Y_{i,t-1} + \gamma_i f_t + e_{it} \quad (7)$$

$$\Delta Y_{it} = Y_{it} - Y_{it-1},\ \alpha_i = (1-\varnothing_i)\mu_i \text{ and } \rho_i = (1-\varnothing_i) \quad (8)$$

Pesaran, taking arithmetic means of each series, H_0 and H_1 hypotheses through CIPS values.

$$CIPS(N,T) = \frac{\sum_{i=1}^{N} t_i(N,T)}{N} \quad (9)$$

Table 3

The Results of Hsiao Homogeneity Test

*H*1 = Null Hypothesis: panel is homogeneous Alternative Hyp.: *H*2		
*H*2 = Null Hypothesis: panel is heterogeneous Alternative Hyp.: *H*3		
*H*3 = Null Hypothesis: panel is homogeneous Alternative Hyp.: panel is partially homogeneous		
Hypothesis	***F*-Stat**	***P*-Value**
*H*1	0.00	1.00
*H*2	0.00	1.00
*H*3	0.00	1.00

Source: Compiled by the author.

Table 4

Pesaran CIPS Unit Root Test Results

Z" CIPS* = –2.219 *N, T* = (111.38)				**Ln (return) CIPS* = –4.730 *N, T* = (111,38)**		
	10%	5%	1%	10%	5%	1%
Critical values at	–2.01	–2.06	–2.14	–2.01	–2.06	–2.14

Source: Compiled by the author.

H_0: There is unit root;

H_1: There is no unit root.

Depending on the theoretical explanations, the results of unit root realized are shown in *Table 4*.

As shown in *Table 4*, since CIPS value for both variables is bigger than critical value of 1%, H_0 is rejected, and it is accepted that there is no unit root in the variables.

Since it was identified that both variables were stationary at the level, the presence of the relationship between both variables will be studied by Panel LS test.

PANEL LS TEST

The presence of correlations between horizontal cross-sections of the variables was identified in the previous sections. In addition, it was also identified that the coefficients of the variables exhibited a homogenous distribution. Depending on these identifications, on homogenous panel data that has horizontal cross-sectional dependence, PDOLS (Panel Dynamic Least Square) Model among second generation analyses can be used [51]. PDOLS analyses come to our face as long-term predictions and in order to eliminate the effect of intersectional correlation, add the premise and lagged value of the variables to model and internal feedback to independent variable disappears [59]. PDOLS analysis model are shown below [60];

$$Y_{it} = \alpha_i + x_{it}\beta + \sum_{j=-q}^{q} c_{ij}\Delta x_{it} + v_{it} \qquad (10)$$

c_{ij}, added to the model formed is the coefficient of premise and lagged values of explanatory variable, taken first difference.

For being able to be realized Panel LS test, it is necessary to study that model has to which of fixed effects, random effects or pooled effect. In order to be able to identify the existing effect in the model, it is necessary to make Hausman, Chow (F) and Breush-Pagan LM test. Without entering to the theoretical explanation of these tests, hypotheses of any test were shown in *Table 5*.

The hypotheses formed were tested on both horizontal cross-l sectional and time plane and test results were shown in *Table 6*.

When the results of the tests are examined, Hausman test accepts that the variables have the random effect, while F Test enables to be made preference between pooled effect and fixed effect for the variables. According to the results of F Test made, the variables have pooled effect. Breush-Pagan LM test enables to be made preference between random effect and pooled effect

Table 5

Effect Hypothesis

Hausman Test	Chow(F) Test	Breush-Pagan LM Test
H_0: random effect	H_0: pooled effect	H_0: pooled effect
H_1: fixed effect	H_1: fixed effect	H_1: random effect

Source: Compiled by the author.

Table 6

Effect Test Results

	P değeri	H_0	H_1	Etki
Hausman Test	0.9972	Ok	Reject	random effect
F Test	0.9998	Ok	Reject	pooled effect
B-P LM Test	1.0000	Ok	Reject	pooled effect

Source: Compiled by the author.

Table 7

PDOLS Test Results

Dependet Variable: Ln(return)				
Variable	**Coefficient**	**Std. Er.**	***t*-Stat.**	**Prob.**
Z"	0.353028*	0.004486	78.68831	0.00
R-squared	0.837398	Adjusted R-squared		0.759935
*$p < .01$				

Source: Compiled by the author.

and, according to the result of the test, identified that the variables have random effect.

As a result of all tests made, the following model is suggested, in which Ln (return) is dependent variable and Altman Z" Score value is independent variable.

$$Ln(return)_{it} = \alpha_i + Z''_{it}\,\beta + \sum_{j=-q}^{q} c_{ij}\Delta Z''_{it\,it} + v_{it} \qquad (11)$$

According to PDOLS analysis results (*Table 7*) since $P < 0.05$, Z'' affects the variable of Ln(return), hence, hypothesis is not rejected. In addition, in the analysis, when R^2 value is examined, significance level of the model formed was identified as 0.837 and this significance level can be accepted as relatively high. Lastly, it is understood that Altman's Z" model affects firm value in the rate of 0.35. Depending on all results obtained, although Altman Z" model is formed to measure financial failure of the firms, it is demonstrated that it can be also used to predict the increase or decrease in firm value in the long term.

CONCLUSION AND SUGGESTIONS

In Turkey, identifying the financial conditions of the companies recorded to BIST and, thanks to this, according to the results obtained in this study carried out to measure the success of the model in terms of decision makers, it was identified that there was a relationship between Altman Z" score value and firm value at high significance level.

According to the PDOLS model established between the dependent variable Ln (Return) and the independent

variable Z" value; A 1-unit increase in the Z" score value causes an increase of 0.353 units in the logarithmic return calculated over the firm value.

When the literature is examined, all of the studies on the Z" Score model have investigated the financial failures of the companies. In this study, it has been revealed that the Z Score model can be used not only to measure financial failure, but also to make firm value estimations in the future. From this point of view, this study has made an important contribution to the finance and accounting literature. Depending on this identification:

- Altman Z" score model is valid the other firms, recorded in Istanbul Stock Market, other than financial firms
- Increases in the value of Altman Z" score contribute to the increases of firm values.
- Following Altman Z" Score values will make contribution to long term investment.
- Since Altman Z Score values are calculated at the end of accounting records, especially in the period, in which financial tables are explained, that they also explain Z Score values will provide more prediction infrastructure for investors.
- Altman proposes the Z" Score model as a model that can be used by developing countries globally. Depending on this proposition, it is thought that the results of this study conducted in Turkey may be suitable for other developing country companies as well.

Depending on these results, in the next study, it will be suitable to prepare an index for investors through Altman Z Score value. In addition, the next studies can be focused on testing prediction accuracy of the models in sectorial basis. This study is focused on the companies, which are dealt in BIST. When considered that many small and medium –sized enterprises (SMSEs) in Turkey default due to cash flow problems, it will also be interesting accuracy of models to test on non-quotation SMSEs and service enterprises in stock market in Turkey.

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ABOUT THE AUTHORS

İbrahim Emre Göktürk — Assist. Prof., Faculty of Health Science, Department of Social Service, Necmettin Erbakan University, Konya, Turkiye
https://orcid.org/0000-0003-2881-1684
Corresponding author:
iegokturk@gmail.com

Hüseyin Serdar Yalçınkaya — Assist. Prof., Department of Accounting and Tax, Eregli Vocational School, Necmettin Erbakan University, Konya, Turkiye
https://orcid.org/0000-0002-5064-5144

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