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Editorial address:
53, Leningradsky prospekt, office 5.4
Moscow, 125167
tel.: **+7 (499) 553-10-71 (internal 10-79)**
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Subscription in editorial office
tel: **+7 (499) 553-10-71 (internal 10-80)**
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Prospects for the Incorporation of the Digital Ruble into Russia's Monetary Turnover: Attributes and Principles for Developing a Trusted Digital Environment

M.A. Abramova[a], **N.N. Kunitsyna**[b], **E.I. Dyudikova**[c]
[a] Financial University, Moscow, Russia;
[b, c] North-Caucasus Federal University, Stavropol, Russia

ABSTRACT

The rapid nature of the modernization of monetary turnover, accompanied by geopolitical risks against the background of post-pandemic economic recovery and the regionalization process, no longer just arouses the discursive interest of society, but becomes an indispensable condition of the new reality. The process of money turnover transformation by introducing digital currencies into circulation in the wave of digitalization among world powers lagging behind the evolving environment of the cryptocurrency industry is developing into a process of formalization of metaverses and penetrates deeper into the socio-economic reality. The **problem** of the Russian practice of developing the payment environment consists in its catching-up character, caused by the spontaneous formation of the digital society, resulting in the expansion of the scope of alternative finance outside the legal field. The **purpose** of the paper is to determine the inherent attributes of the digital trusted environment necessary to ensure digital ruble turnover, based on an empirical study of society's perceptions about the prospects for using the digital form of the national monetary unit by representatives of various generations. We used systematization, grouping, comparative and content analysis, surveys, and the quota **method** to achieve the paper's purpose. The survey involved 35,327 residents from different regions. As a **result**, the authors revealed the low level of readiness of society for the introduction of the digital ruble as a substitute for cash and cryptocurrency. The paper focuses on the need for an integrated approach to the disclosure of the digital ruble's value and benefits, which contributes to its successful launch and promotion in the market. The **results** of the research highlight the importance of correspondence in the digital ruble category "digital currencies", and also the impossibility of making incorrect decisions in the transformation of money turnover, which leads to the growth of risks of digital inequality, the clash of interests of certain groups of the population in the prevailing behavioral patterns in the form of a cautious attitude to digital finance with insufficient financial literacy.

Keywords: alternative finance; money turnover; cryptocurrency; digital currency; digital environment; digital ruble; trusted digital space; CBDC

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INTRODUCTION

The issues of sustainable development have significantly intensified in the modern world as a result of the pandemic's tragic repercussions and the impact of geopolitical elements of forced catastrophe. It is known that, in the context of the economy's digital revolution, society need a fundamentally different approach to its solution. This is supported by the continued popularization of countless inventions, which are characterized by spontaneous, "unobtrusive" advertising and widespread user coverage against the backdrop of a lack of actual regulatory oversight, control, and assurances by institutions of power. One such example is the so-called "ideal digital money", which evolved from public cryptocurrency to formal financial assets.

By early 2023, only Nigeria (eNaira based on DLT Hyperledger Fabric) and Cambodia (Bakong based on Hyperledger Iroha) had explicitly stated that they would realize the potential of cryptocurrency technology by making publicly available, but limited and specialized information on the underlying innovations.

The unprecedented statements of the Bank of Russia and the People's Bank of China on the Central bank digital currency (CBDC), available to the public for evaluation and analysis of pilot projects, are reflected in the report of the Bank of Russia for public consultations "Digital Ruble" concepts of digital ruble, "White Book" of the new digital currency of China E-CNY, the key provisions of which are duplicated in many aspects.

At the moment, Russia, such as the other countries that announced the active phase of CBDC pilot testing in 2021, has not specified the type of technological solutions used as the foundation of the platform being developed, making it impossible to check compliance with the developed monetary innovation criteria "digital currencies".

Moreover, indirect signs of announced projects [1] indicate that the Chinese government is promoting the creation of a national digital payment space based on distributed ledger technology (DLT). At the same time, reviews of the Russian blockchain platform "Masterchain",[2] and the analysis of open data on the pilot project of the Bank of Russia in terms of regulatory activity on the digital circulation of monetary value suggest the inability of the created digital ruble, integrated into the national payment system, realize the innovative nature and fundamental properties of digital assets, and translate into reality the potential of alternative finance. Skepticism intensifies both the insufficient informative potential of "digitization" of money turnover at the piloting stage of innovation, and the closed character of the tested project "Digital Ruble" at a time of increasing populist skepticism of new developments. These statements are based on the results of the conducted sociological research, the perspective of which allows to reveal the peculiarities of perception of CBDC by representatives of different generations, fundamentally different philosophy and worldview, transforming under the influence of the digital economy.

MATERIALS AND METHODS

A survey of residents of various age groups in various regions of the Russian Federation was conducted to assess the population's perception of the prospects for the introduction of the digital ruble into money circulation and to identify the problems of

[1] Red Date Technology launched the decentralized Spartan Network (an alternative non-cryptocurrency infrastructure that combines publicly available forks of Ethereum, Cosmos and Polygon Edge blockchains) and introduces a cross-border system for transferring stakeblocoins and CBDC Universal Digital Payments Network, claiming an initial common standard for a new generation of digital assets.

[2] Cnews. URL: https://www.cnews.ru/news/top/2019–07–03_sberbank_raskritikoval_ofitsialnyj_rossijskij (accessed on 22.12.2022).

its launch as a key direction of the digital transformation of the monetary sphere.[3]

The survey was conducted from August 2021 to December 2022. In the period for the study, 35 327 questionnaires were analyzed, and the condition of one response from one respondent was established. The basic selection of respondents was a targeted quota sample. The final set of respondents was formed with the following parameters: gender; territorial integrity; age.

The conditional grouping of respondents into four age categories allowed for the identification of generational differences in perception regarding technological digital developments[4]: The number of baby boomer generation respondents (born between 1946 and 1964) was 9.93% of the total number of respondents, generation X (born between 1965 and 1980) — 24.57%, millennial (Y, born between 1981 and 1996) — 30.35%, zoomers (Z, born between 1997 and 2012) — 35.14%.

Online questionnaire was divided into groups with consistent communication. If the primary question was answered negatively, the logically agreed on paragraphs would become inactive because the answers were evident and not required for the analysis. No additional explanations were given to respondents before the survey.

RESULTS OF THE STUDY

The results of analyzing a representative sample of surveys lead to several conclusions. As a result, the boundary between the "reality" (material) and the virtual world is being obliterated from generation to generation, resulting in the originality of modern society's perspective of the unpredictable expansion of the digital transformation of money turnover.

The baby boomer generation, on average, is an inactive Internet user (this fact confirms the senior generation's low share of "digitalized" clients in the banking sector, despite credit organizations' stated growth of the segment, which includes both active and passive[5] users). Respondents of this group pointed to superficial knowledge in the field of cryptocurrencies / stablecoins, lack of any value of digital ruble and understanding of the advisability of its development. Over 94% of respondents indicated that restrictive epidemiological measures and political tensions contributed to an increase in their share of cash payments. They are also not ready to give up the use of cash as a means of saving neither in favor of non-cash money (deposits) nor, especially, the "unknown" digital ruble. In the course of further analysis, the answers of representatives of the baby boomer's generation due to their resistance to radical innovation of money turnover are excluded.

Members of the X, Y and Z generations, totaling 31 819 people, are recognized as active Internet users, which confirms the relatively even distribution of survey participants' responses. All respondents confirmed their awareness of the existence of alternative finance and the intention of the Bank of Russia to issue a digital ruble. For 76% of them, the concepts of "cryptocurrency", "stablecoin/altcoin" and "CBDC" are not identical, respectively, 24%, including mainly the older generation, have some knowledge about them. In the total number of authentic "crypto-enthusiasts" who left a footprint in the

[3] Based on the representativeness, interrelationship and interrelationship of qualitative characteristics and features of social objects, as well as the legitimacy of conclusions about the whole on the basis of the study of its part, provided that this part is a micromodel of the whole, the sample was designed so that the distribution of the elements in the sample was the same as the distribution in the whole.

[4] Generational theory conventionally delineates age boundaries, providing an opportunity to understand typical characteristics of categories of people living at different stages of historical, political, economic and technological development. Different speed and characteristics of development of science and technology, modes of data transmission and trends are adding differences and misunderstandings between them. PROSTUDIO. URL: https://prostudio.ru/journal/generation-x-y-z/ (accessed on 08.02.2023).

[5] Users who do not work independently in the personal account of "online bank": the client comes to the bank personally, the consultant logs in and performs all operations on behalf of the client in his presence in order to achieve the targets.

Table

Structure of the Respondents Sample who Confirmed Practical Experience in the Digital Field of Alternative Finance

Generation	Number of respondents participation in the survey	Number of respondents who confirmed practical experience in the cryptocurrency industry		
		people	share in the total number of digital users, percent	share in the respondents of the appropriate generation, percent (column 3 / column 2)
1	2	3	4	5
X	8681	776	9.59	8.94
Y	10723	4166	51.49	38.85
Z	12415	3149	38.92	25.36
Total	31819	8091	100.00	–

Source: Compiled by the authors.

digital world (8091 people), members of the X generation have little practical experience[6] outside the legal field (*Table 1*).

Analysis of the answers shows that millennials (Y) have the most active behavior in the digital space — more than 50% of them are participants in the digital transformation. At the same time, 38.85% of them received practical experience in the cryptocurrency industry. This is not accidental: the rapid backstage digitization of finance initiated by the representatives of the Y generation, most of them at the time interested in the possibility of quickly speculative income. At the same time, the prolonged period of "crypto winter" did not have a negative impact on the popularity of the crypto industry and the dynamism of the digital space. In the new realities, the millennials and zoomers unanimously recognize the value of philosophy and the boundless potential of innovation, the primary importance of which is also emphasized by respondents in the questionnaire responses (*Fig. 1*). It should be noted that the Z-generation has not experienced a period of rapid earnings on exchange rates and are not mass clients of banks; they have no experience with financial crises, which either leads to underestimation or revaluation of risk, despite the fact that their fourth part (25.36%) has already joined the informal digital environment.

Another important trend confirmed by the results of the study — is the public's sustained interest in a high-tech optional metaverse with a built-in mechanism for the circulation of digital currencies, allowing to eliminate the function of intermediation in the transmission of information, but giving the right of full access and control to the personal account in which all information about the owner of personal data is stored.

According to the interviewees, the digital platform model on the scale of industrial operation, preserving the ideology of DLT with built-in derivatives of centralization and regulation as the basis of the new economic order is quite acceptable for the formation of the Russian metaverse, which could become a reality in the foreseeable

[6] As part of the study of practical work experience, we consider activity of any type in the DLT system: from opening a crypto wallet to actions with units of alternative finance / smart contracts.

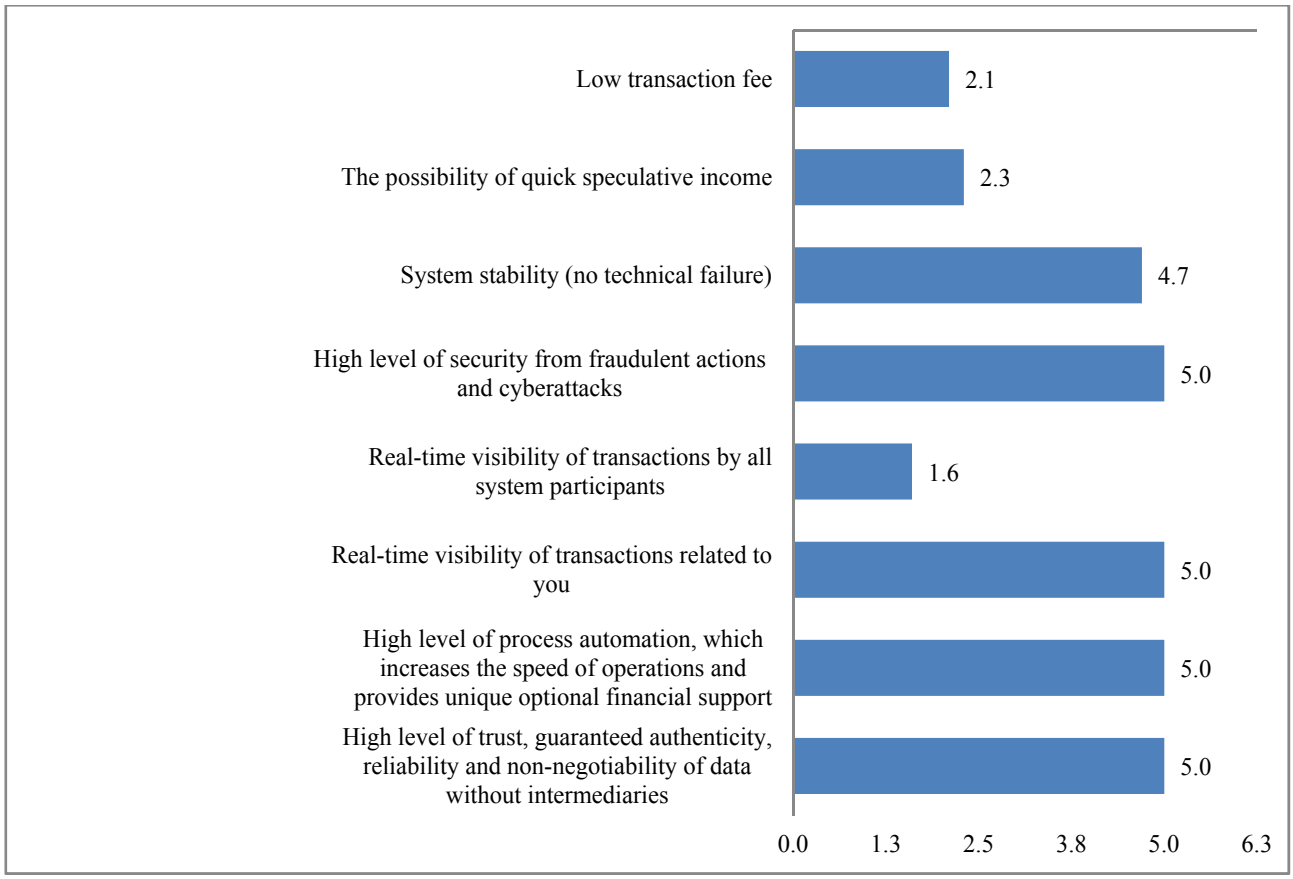

Fig. 1. **Attractiveness of Trusted Digital Environment Attributes, Average Score**

Source: Author's calculations.

Note: The average values of the received responses were assessed on a five-point Likert scale: the lowest significant attribute was assessed at 1 point; the highest one was assessed at 5 points. The answer fields were active in all options for answering other questions except for awareness of alternative finances.

future. At the same time, respondents agreed on the impossibility of its compliance on the basis of the classical banking infrastructure, so the digital ruble circulation platform, in their opinion, most likely will not embody the attributes of the trusted digital environment and will not provide a legitimate solution to the opposition to alternative finance (*Fig. 2*).

Along with this, respondents observe the main reason for deliberate evasion of constructive digital transformation of money turnover in the reluctance of representatives of the upper and middle stratification levels of society in terms of attitude to power to disclose their personal financial flow (in acceptable openness for tracking), property position, and business interests, which is underpinned, inter alia, by contradictory legislative activities[7] and has only increased the mistrust for new digital development.

The results of the research allowed to predict the absence of spontaneous demand for the use of digital ruble by users. However, in case of extreme necessity[8] or significant economic attractiveness due to the implementation of loyalty programs Russians will not reject this opportunity, adhering to the principle of "single use" (*Fig. 3*).

[7] Technology Law Source WEB. URL: http://publication.pravo.gov.ru/Document/View/0001202302060005?index=0&rangeSize=1 (accessed on 12.02.2023).

[8] Introduction of digital ruble into monetary circulation is compulsory, comparable with the introduction of the card payment system MIR.

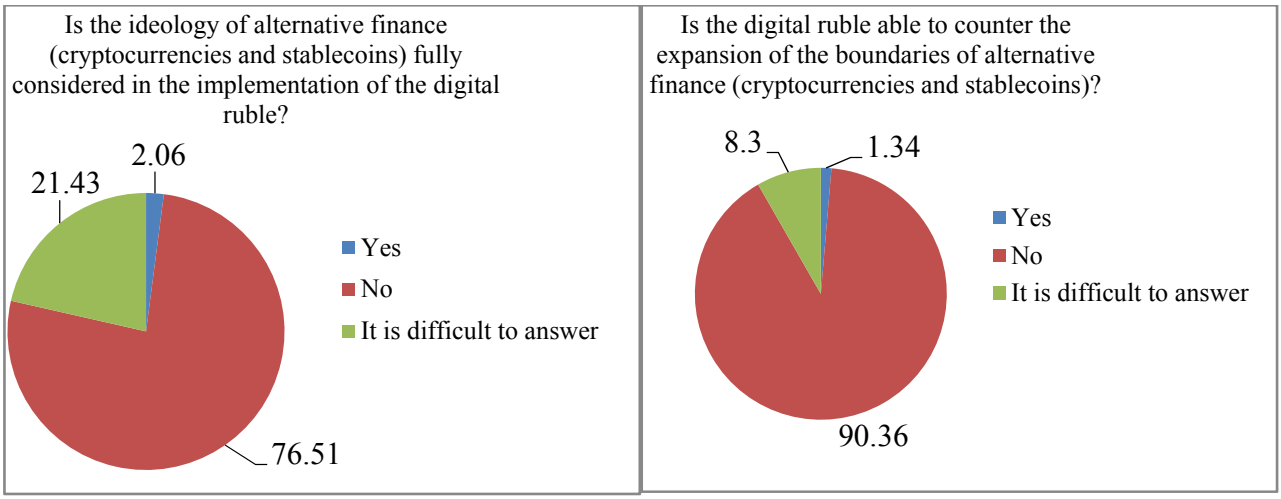

Fig. 2. **Compliance of the New Form of the Ruble with the Digital Currency Required by the Information Society: Respondents Perception, % of the Total Number of Respondents**

Source: Author's calculations.

* It is assumed that the digital ruble is seamlessly embedded in the general system of non-cash transfers, but the declared seamless payment space is not provided due to the lack of a bundle in transferring from one form to another "digital ruble – cash ruble".

Of course, respondents consider the digital ruble as a feasible alternative to non-cash money, but not cash and DeFi cash surrogates, as the Bank of Russia expects (*Fig. 4*).

Unpreparedness of Russians to recognize the role of digital ruble and the prevailing rejection of classic forms of money (all indicated only partial substitution) is by bias about the authorities' intention to control the financial flows of the population to the detriment of its interests.

Thus, under the influence of spontaneous negative public opinion, potential users do not understand the unique benefits of the digital ruble (provided it is actually implemented as a variety of "ideal digital currencies" or no such in an alternative development of events) may lead to a serious problem that Nigeria once faced with the introduction of the eNaira digital platform. The Central Bank launched eNaira as a national digital currency, presenting it as an improved analogue of Bitcoin and focusing on the benefits of the secondary type: low transaction costs, high transfer speed and universal availability. However, Nigerians did not meet the expected demand for CBDC, ignored the proposed innovation, which became a symbol of distrust to the ruling elite due to non-compliance with user requirements focused on the slogan "honest currency on DLT".

DISCUSSION OF PROSPECTS FOR DIGITALIZATION OF MONEY TURNOVER

In Russia, the current monetary innovation is focused mainly on the generation NEXT (millennials and zoomers), but the older generation, which is difficult to perceive innovative solutions, ignores the fundamental differences between "digital currencies" and "non-cash / electronic money" [1, p. 60, 61].

As a result, the population associatively perceives this monetary innovation as a limitation of human rights by controlling its behavior through the digitization of the money turnover, in other words, as a measure to deprive the DeFi environment of universal observability and accessibility of information. It is difficult to disagree with this, as the authorities in the media claim the advantages of the digital ruble, beneficial only to the state: the ability to directly track all cash flows, addresses by coloring accounting units, making instant blocking of accounts, the implementation of the automatic element of deflation / inflation,

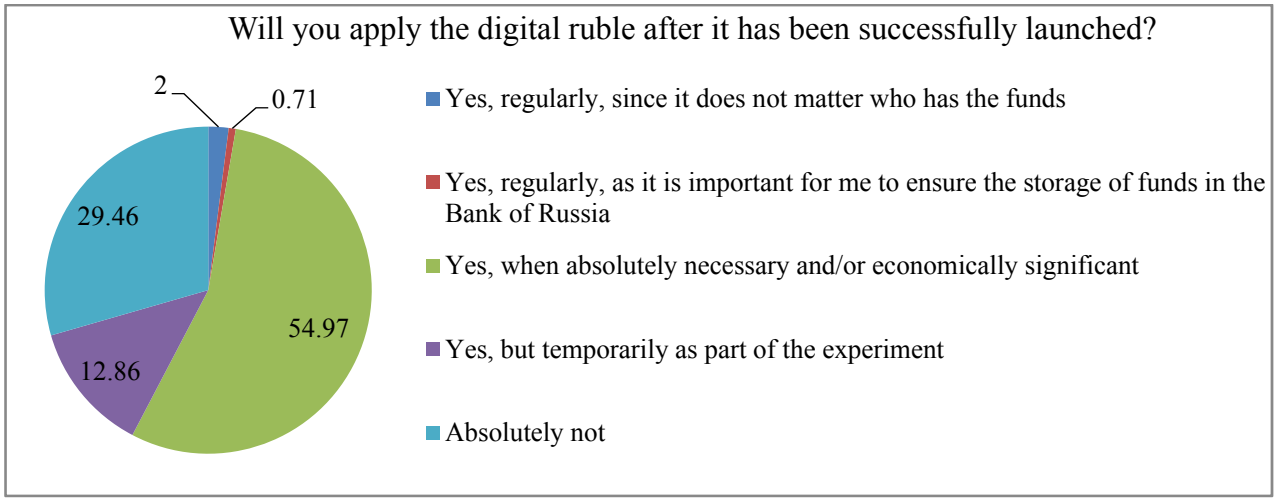

Fig. 3. **The Degree of Readiness of Russian Society to Accept the Digital Ruble of the Bank of Russia, % of the Total Number of Respondents from Generations X, Y, Z**

Source: Author's calculations.

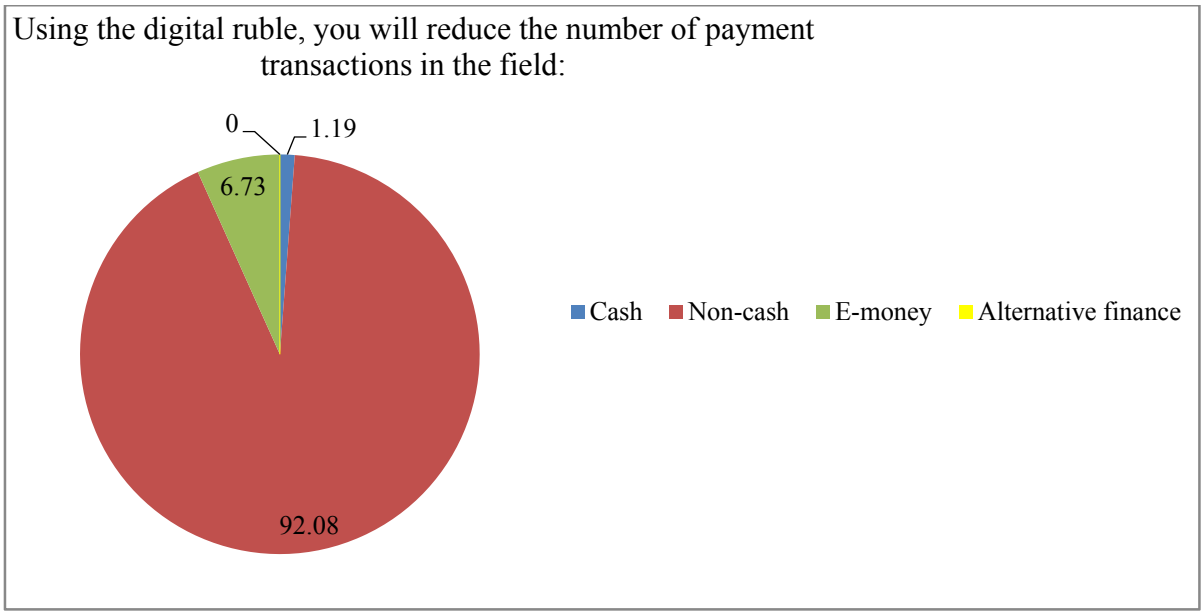

Fig. 4. **Respondents' Perception of the Role of the Digital Ruble as an Alternative Method of Settlement and Payment Transactions, % of the Total Number of Respondents From Generations X, Y, Z**

Source: Author's calculations.

etc. At the same time, the weighty arguments in favor of public acceptance of the digital ruble are not disclosed, which is unacceptable in the context of the perception of the monetary innovation by different generations[9] who make up the economically active population. As a result, all State measures may not be effective in achieving the goal of digital transformation, namely — task of development and sustainability of a national payment system capable of resisting the expanding informal

[9] Members of generations X, Y, Z make positive decisions in the event of an accurate understanding of the benefits of the product and the personal benefits of its use. Generation Y is distinguished by the fact that their environment from childhood listens to their demands and desires, so it is important that the proposed innovation fully meet their expectations. As part of the research presented above only they have given a response-consent to the temporary use of digital ruble in the experiment, which demonstrates their willingness to dialogue.

sector of alternative finance. One of the reasons, in our opinion, is not quite correctly formulated the main goal of the project "Digital Ruble", implemented in a certain rush: synchronization of the financial system of the country with the modern flow of digitalization. Ideally, the result of the project is not intended to be an impulse for synchronization, but a restructuring of the world order, lifestyle and behavior of the population as stakeholders of innovations in the financial market. So, regulators, understanding the hopelessness of the situation, are faced with a dilemma: maintaining the usual way or building a digital economy that requires inevitable radical changes in the fundamental, organizational, and regulatory fundamentals of the monetary system. All kinds of attempts to introduce the digital ruble, capable of competing with the sidelines alternative finance, and at the same time to maintain the traditional monetary system, just formed a negative public opinion. In today's realities, neither the investment experience [2], nor the financial literacy [3], nor the social factors [4, 5] that determine the commitment to alternative finance are key in the event of a distortion of the digital transformation of money turnover. That component of which is the multifarious chain of changes in the many dimensions of social reality in the complex, which will ultimately result in a conflict of interest between generations as a result of the imbalance of the basic foundations of digital literacy in theory and practice.

Since the transformation of the monetary system is unavoidable, we should talk about the evident benefits of the digital ruble as a digital currency. According to O.T. Evtukh, "the genesis of money indicates that it is a socio-economic tool of information exchange" [6, p. 44]. The information function does not duplicate recognized monetary functions [7–12].

Of course, the digital currency as a driving force and promising weapon of transformational warfare is intended to trigger "not only fundamental changes in the world order and the world economy, but also radical changes in social attitudes and beliefs that will eventually pave the way for radical new policies and social contract provisions" [13].

At the same time, describing a monetary innovation that does not include a complex of features of the digital environment, "digital currency" is irrational, as this interpretation permits mutual substitution of concepts "digital currencies", "electronic money", "non-cash money". The conclusion about non-conformity of digital ruble category "digital currencies" is explained not only by categorical differences, but also attempts to deflect the unique benefits of innovation for users due to the possibility of local realization of existing traditional technological solutions, including coloring procedures and accessibility.

Digital information and communication environment provides an exclusive format of interaction of economic subjects, in which the importance of information function and role of money increases. At the same time, the "abstract" monetary value can both directly (in the role of a "universal product") and indirectly provide the execution of optional financial support of legally significant actions (accounting in the transaction of utilitarian digital rights on the type of barter exchange). Skepticism about the innovation will gradually disappear after potential users realize and accept the unique utility and consumer value of the digital ruble as an integral element of the national digital ecosystem (metaverse), rather than an input-output monetary value from outside.

The attractiveness of the advance trusted digital reality technology rests not in the capacity to perform anonymous transactions and eliminate a centralized operator, but in a great unique potential. At the same time "currency — only one of the applications of technology, perhaps not even the most popular" [14; 15, p. 119] in an adapted digital environment, but mandatory and

indispensable. Functionality and inclusiveness of the national digital ruble circulation platform can become the basis of an eventual ecosystem (metaverse) capable of solving a number of problems of the shadow economy and the labor market. In particular, curb the expansion of informal employment and promote the social well-being of the Russian population.

CONCLUSION

The state and development of the financial system and the economy as a whole in the new reality reflect not so much a decline in the share of cash in the money supply, How much of the trusted digital environment is developed with technically inextricably linked flows of information [16–19], excluding developmental characteristics of the information (network) society (features of "transition" automation process of multiplicity, isolation, fragmentation, volatility, hidden and variability of electronic space formed by a set of autonomous information systems). Digital society as a new formation with extraordinary views and a new philosophy requires a fundamentally different information and communication environment of interaction, allowing to recreate "digital counterparts" with full immersion in Noonomy [20]. The grand transformation must take place in an orderly manner, starting with monetary circulation, the priority of which is due to the primary role of the institution of money as a value in ensuring continuous renewal (reproduction) of economic activity and recognition of the payment system as a critically important segment "to create the customer path of the "full cycle" within the ecosystem" [21, p. 38].

The successful launch of CBDC as an alternative to DeFi depends solely on the readiness, initiative and will of economic actors to accept it as the apotheosis of the new economic paradigm. The results of the study pointed out the characteristics of Russian perception of the digital ruble at the current stage and pointed to the need of disclosure of information that provides mental accessibility. In the current circumstances, the significance of matching the digital ruble to the rapidly advancing innovation category "digital currencies" as a collective image of alternative finance and the inadmissibility of distorting the national digital system, having the potential to develop into a fully functional, comprehensive metaverse for the new economy.

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ABOUT THE AUTHORS

Marina A. Abramova — Dr. Sci. (Econ.), Prof., Head of the Department of Banking and Monetary Regulation of the Faculty of Finance, Chief Researcher of the Institute of Financial Research of the Faculty of Finance, Financial University, Moscow, Russia
https://orcid.org/0000-0001-9338-8478
Corresponding author:
MAbramova@fa.ru

Natalia N. Kunitsyna — Dr. Sci. (Econ.), Prof., Head of the Finance and Credit Department, North-Caucasus Federal University, Stavropol, Russia
https://orcid.org/0000-0001-9336-8100
nkunitcyna@ncfu.ru

Ekaterina I. Dyudikova — Dr. Sci. (Econ.), Jun. Researcher of the Scientific and Educational Center "Innovative development of the credit and financial sphere", North-Caucasus Federal University, Stavropol, Russia
https://orcid.org/0000-0001-8126-6529
dudikova.e@gmail.com

Authors' declared contribution:
M.A. Abramova — problem statement, literature review, statistical data collection, conclusions.
N.N. Kunitsyna — paper concept development, literature review, statistical data collection, data analysis, results description, conclusions.
E.I. Dyudikova — literature review, statistical data collection, graphical representation of results, data analysis, results description, conclusions.

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Formation of Pension Savings from Pension Insurers: Comparative Analysis and Efficiency Assessment

I.V. Terentieva, A.V. Svistunov
Murom Institute (branch) of the Vladimir State University named after A.G. and N.G. Stoletovs, Murom, Russia

ABSTRACT

The subject of the research is the formation of pension savings on compulsory pension insurance by public and private pension insurers. The paper's **relevance** comes from the lack of a conclusive solution in contemporary research to the dilemma of selecting between maintaining competition in the pension market and centralizing pension savings. **The purpose of the research** is to assess the effectiveness of the formation of pension savings for mandatory pension insurance in private pension funds in comparison with the Pension Fund of Russia, both from the point of view of the interests of insured persons and society as a whole. Research **methods** include comparative analysis and logical generalization, economic-mathematical and statistical methods, methods of financial mathematics. The information base of the study is data from the official websites of the Pension Fund of Russia, the Central Bank of Russia, the Federal State Statistics Service, the Deposit Insurance Agency, the Moscow Stock Exchange, VEB.RF, etc. The effectiveness of the formation of pension savings from public and private pension insurers was assessed by a number of criteria: from the standpoint of the interests of insured persons — these include the profitability of pension savings the reliability of the pension insurer, the possibility of choosing investment strategies; from the standpoint of the interests of society — the evaluation criterion is the use of pension savings as a long-term investment resource for economic development. As a result, it is **concluded** that the Pension Fund of Russia manages the pension savings of citizens more effectively than private pension funds. This raises the question of whether private pension funds should participate in compulsory pension insurance.
Keywords: pension savings; pension insurers; state pension fund; private pension funds

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INTRODUCTION

Despite the fact that since 2014 pension savings are not replenished with insurance contributions, their total amount is about 5 trn rubles. Based on the dynamics of savings and the number of insured persons among pension insurers, the population prefers Non-State Pension Funds (further — NPF) rather than the Pension Fund of the Russian Federation (further — PFR), hoping for higher returns. Does the public insurer really give way to private funds in terms of the efficiency of management of pension savings?

There are a number of studies in the scientific literature devoted to this issue. The papers [1, 2] notes the increasing role of state pension funds in the formation of pension savings. In other papers [3, 4], private funds are seen as a viable alternative to the public pension system. However, the paper [5] notes that this requires fully formed financial markets, adequate knowledge of and confidence in these markets.

Domestic studies compared the effectiveness of the formation of pension savings in NPFs and management companies that entered into contracts with the PFR. The cumulative return on investment of pension savings is used as a criterion for comparative analysis [6, 7]. In some papers [8, 9], the Sharpe ratio or the return/risk ratio is used. The paper [10] uses a criterion such as the reliability of management of pension savings.

However, the NPF — is a pension insurer whose activities are more logical to compare with other insurers — PFR. At the same time, it is advisable to expand the criteria for comparative analysis of pension insurers. It is also necessary to improve the validity of the findings on the return on pension savings by covering all savings intervals for the maximum possible period of analysis. All this determines the relevance and practical significance of further research in the specified subject area.

The purpose of the research — is to determine the effectiveness of formation of pension savings on compulsory pension insurance (further — CPI) in the NPF compared to the state insurer (PFR).

As assessment criteria reflecting the interests of the insured person, the following are defined:

- return on pension savings;
- reliability of the pension insurer;
- selection of investment strategies.

The evaluation criterion that reflects the interests of society — is the use of pension savings as a long-term investment resource for the development of the economy.

PENSION INCOME

Return — is the most important indicator of the effectiveness of the formation of pension savings from the point of view of the insured person, because it shows the relative increase of pension funds of citizens.

Compare the return on pension savings of PFR [pension investors — State management company "Vnesheconombank" (VEB), as well as private management companies (PMC)] and NPF.

Consider the return on investment of pension savings (return before deduction of fund management remuneration, contributions to the CPI reserve and to the pension savings guarantee fund) starting in 2008 due to the lack of data on the NPF for earlier years. The yields of the NPF and PMC were calculated as weighted averages, i.e. taking into account the amount of pension savings. 100% NPF and PMC are covered.

The accumulated return on investment for all pension investors exceeds inflation (see Fig. 1) with the exception of NPF since 2008 (at 98.62% by the end of 2020, while accrued inflation was 147.08%). In all periods of savings, NPFs are inferior in yield, both VEB and PMC. In certain periods, their accumulated returns are slightly higher than inflation. The best indicators are shown by PMC.

Return on pension investors is often compared with such benchmarks as the asset indices of pension savings of the Moscow Stock

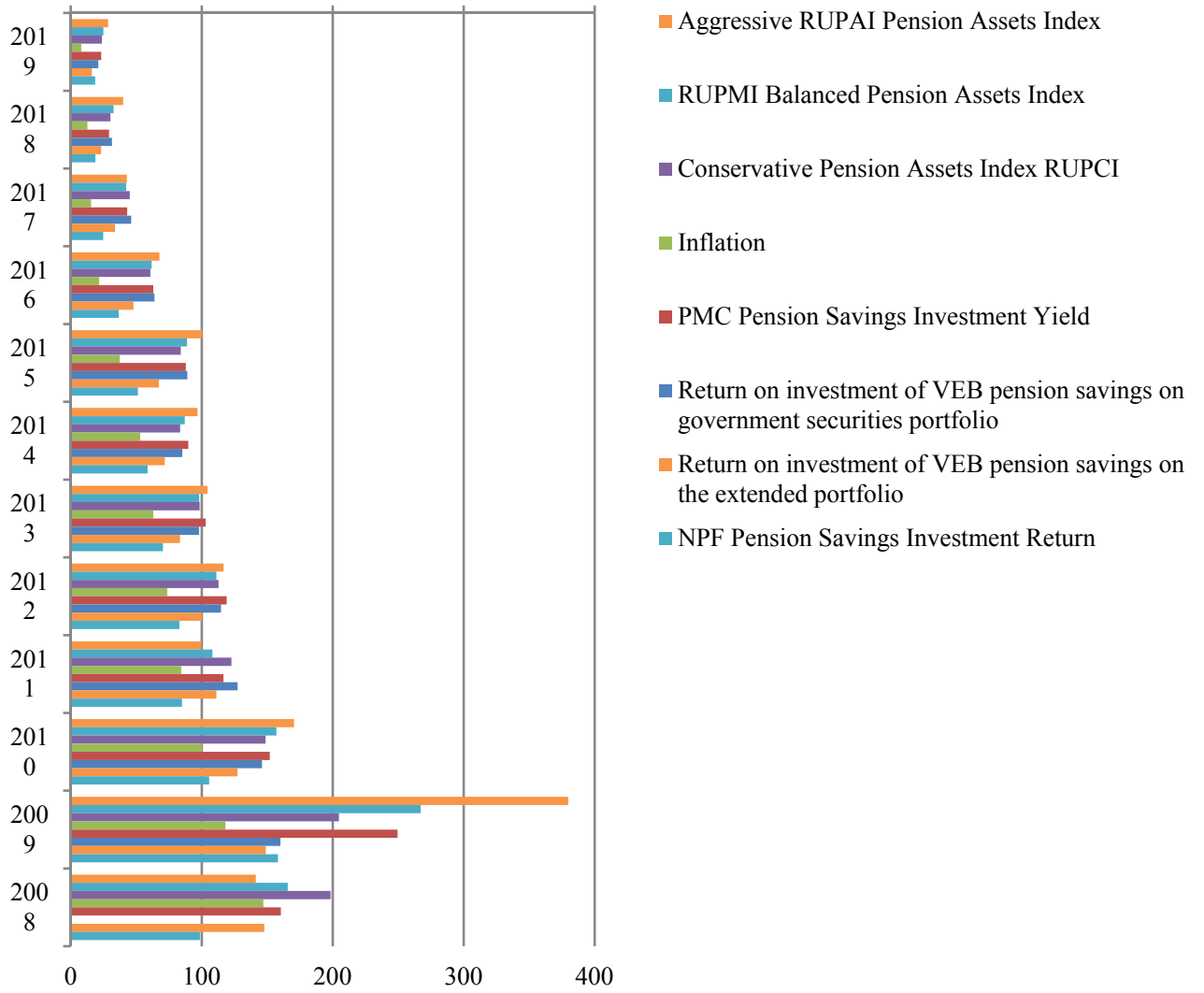

Fig. 1. **Accumulated Investment Return on Pension Savings by the End of 2020, %**

Source: The author's calculations are based on data from the Pension Fund of Russia, the Bank of Russia, the Federal State Statistics Service, the Moscow Stock Exchange, and the Investfunds information portal.

Exchange. The analysis presented in *Table 1* showed that VEB implements a conservative investment strategy in both portfolios (funds are invested in bonds, including Federal Loan Bonds (further — FLB), and PMC and NPF — are a balanced investment strategy (along with bonds funds are investment in shares, but their share is about 10%). At the same time, NPF is significantly lower for all savings periods to the balanced RUPMI index, and the expanded VEB portfolio to the conservative RUPCI index. PMC and the portfolio of government securities show accumulated returns at the level of the indices, RUPMI and RUPCI, respectively, in individual periods exceeding their values. The aggressive strategy of increasing the share in the investment portfolio (up to 40%) is not implemented either by PMC or NPF, we consider due to its increased risk.

Consider the accrued effectiveness of pension savings (return after deduction of fund management remuneration, contributions to the CPI reserve and to the pension guarantee fund), which is of greatest interest to insured persons, since it shows the relative increase of pension saving directly on pension accounts.

NPF and PMC returns were calculated as weighted averages. PMCs are fully covered.

Table 1

Correlation Coefficient Between the Accumulated Returns of Pension Investors and Pension Indexes

Accumulated return on investment of pension funds	RUPCI	RUPMI	RUPAI
NPF	0.951	**0.982**	0.926
VEB by expanded portfolio	**0.985**	0.919	0.782
VEB on the portfolio of state-owned securities	**0.973**	0.902	0.807
PMC	0.960	**0.996**	0.946

Source: Authors' calculations.

The average NPF coverage of the share of total pension savings was 97% (the minimum was 92% in 2005).

The accumulated accrued return of all pension investors exceeds inflation in savings periods from 2009 and 2015–2019 (*Fig. 2*). At the same time, the maximum values are shown by PMC (except for the periods from 2017 and 2018, when VEB led), and the minimum values — NPF (excluding the period from 2009). In the savings period from 2010–2014, only NPF's accrued returns were inferior to inflation, i.e. the increase in pension savings on the accounts of insured persons did not even compensate for the inflationary depreciation of money.

In the savings period from 2005–2008, not all pension investors were able to cover inflation through accrued returns (except for PMC in the periods from 2005 and from 2008). In other words, almost all citizens who have formed pension savings over the past 12 to 15 years have not generated any investment income on their pension accounts. Moreover, by the end of 2020, annual accrued returns could not even cover the inflationary depreciation of pension savings.

NFPs, behind PRFs in yields, still have a high cost of managing pension savings. There is no remuneration for the fund for the management of pension savings for the PRF. In NPF, remuneration exists even with negative outcomes of investment of pension savings. *Table 2* shows the costs of the insured persons of both insurers, which are further increased by contributions to the CPI reserve fund, and contributions in the pension savings guarantee fund.

Analysis of reports on investment results of pension savings funds presented on the website of the Bank of Russia shows that VEB remuneration is less than 1% of the investment return on the expanded portfolio and less than 3% on the portfolio of government securities (at the threshold value of 10%). PMC remuneration — is from 0 to 10%, and there is no excess of the standard. At the same time, the variable part of the remuneration in 2019–2020 exceeded the threshold level of 15% of the investment income, for example, in 2019 in NPF "MIF named by V. V. Livanova" (18.12%), NPF "Rostech" (19.98%), in 2020 in NPF "GAZFOND pension saving" (19.63%), INPF "Bolshoi" (20.89%), NPF "Professional" (25.64%).[1] The updated standard of remuneration exceeded a number of NPFs and until 2018,[2] for example, NPF "Education" (28.66% in 2012), NFP "SAFMAR" (25.86% in 2017). In the case of individual NPFs, remuneration standards for management companies were exceeded almost

[1] Calculated by authors according to the Bank of Russia. URL: https://cbr.ru/finmarket/supervision/sv_coll/ops_npf/2020y/ (accessed on 05.12.2021).

[2] By 2018, the system of remuneration of NFPs was different — not more than 15% of investment income after deduction of reward to managing companies (up to 10% of the investment income) and payment of special depository services (up to 0.1% of the value of net assets).

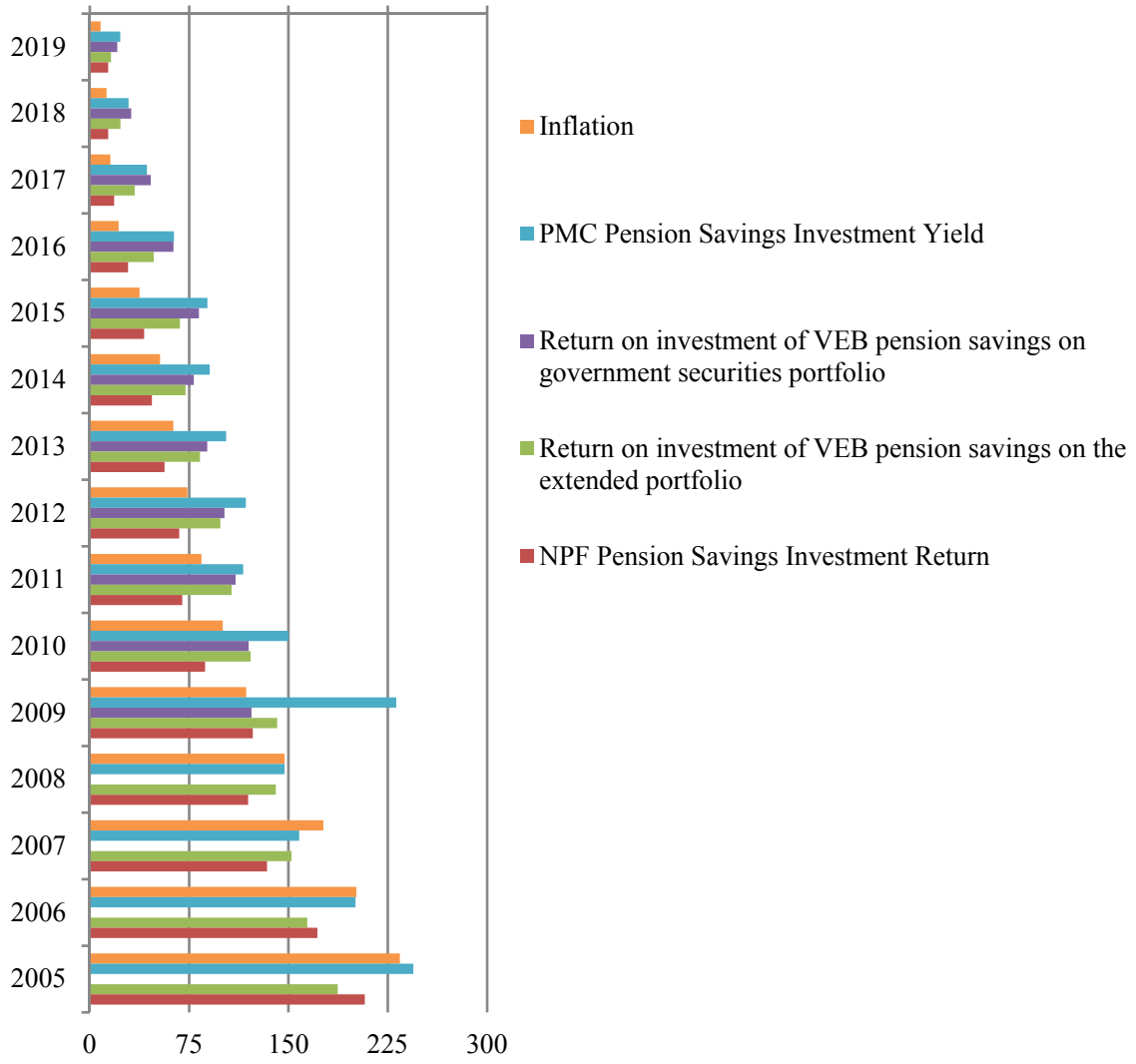

Fig. 2. **Accumulated Net Return on Pension Savings by the End of 2020, %**

Source: The authors' calculations are based on data from the Pension Fund of Russia, the Bank of Russia, the Federal State Statistics Service, Vnesheconombank, publications of Pension and Actuarial consultations, NPF sites, information portals "NPF-Broker.RU" and "PensiaMarket".

annually. Thus, in 2012 the remuneration of managing companies NPF KIT Finance was 100%, NPF "ZERICH" — 111.4% (!) of investment income received in the reporting year. Payment of special depository services for some NPFs exceeded the standard by 2–3 times.

The indicator of costs of insured persons is the difference between investment and calculated return on pension savings. *Table 3* shows that the relative level of costs in the NPF is tens of times higher than the level of expenses in the PFR, and the amount of accrued return of the NPF is lower than that of the state insurer.

PROPERTY OF PENSION INSURANCE

In accordance with the Federal Law No. 167 from 15.12.2001, PFR is the state insurer for PFR in Russia, and the state bears subsidiary responsibility for the obligations of PFR to insured persons, which is understood as "the obligation of the State to ensure the fulfilment of social-insurance obligations by transferring to the budget of the insurer the necessary funds" [11].

NPF — these are commercial organizations that operate in the form of joint-stock companies and operate under CPI on the basis of a license. The participation of the NFP contributed to

Table 2

Costs of Insured Persons in the Compulsory Pension Insurance System

<table>
<tr><th>Pension Fund of Russia</th><th>NPFs</th></tr>
<tr><td rowspan="2">Fund remuneration not provided</td><td>Fixed part of remuneration – not more than 0.75% of the value of net assets</td></tr>
<tr><td>Variable part of remuneration – not more than 15% of investment income</td></tr>
<tr><td>Payment of management company expenses – not more than 1.1% of the value of net assets under management</td><td rowspan="2">From these funds, NFPs pay remuneration to management companies and the special depository, and also pay the costs of management companies</td></tr>
<tr><td>The remuneration of the managing companies is not more than 10% of the investment income (not paid if losses have been received)</td></tr>
</table>

Source: Federal Law No. 111 from 24 July 2002, Federal Law No. 75 from 7 May 1998.

Table 3

The Relative Level of Costs of Insured Persons from Pension Insurers

Indicators	2016	2018	2019	2020
NPF				
Investment capacity, %	9.55	0.11	10.70	7.20
Calculated returns, %	8.81	0.07	8.22	5.20
Costs of insured persons, %	0.74	0.04	2.48	2.00
PFR				
Expanded VEB portfolio				
Investment capacity, %	10.53	6.07	8.7	6.87
Calculated returns,%	10.74	6.14	8.63	6.77
Costs of insured persons, %	–0.21	–0.07	0.07	0.10
VEB State Securities Portfolio				
Investment capacity, %	12.20	8.65	12.14	7.95
Calculated returns, %	11.69	8.74	12.08	7.77
Costs of insured persons, %	0.51	–0.09	0.06	0.18
PMC				
Investment capacity, %	13.94	4.90	13.93	8.18
Calculated returns, %	14.21	5.01	13.91	8.06
Costs of insured persons, %	–0.27	–0.11	0.02	0.12

Source: Authors"calculations. The analysis period corresponds to 100% coverage of NPFs.

increased transparency of the funds, in particular obliging them to disclose the structure of fund owners. Furthermore, the Bank of Russia was entrusted with regulating the activities of the NFP, which has tightened the requirements for NFP in terms of the capital size of the funds, the quality of their assets and the risk assessment system. At the same time, a system of guaranteeing the rights of insured persons has been established, providing for the possibility to carry out CPI only to NFPs — members of the system that meet certain criteria. This suggests that the reliability of NFPs in the field of COI has improved. However, the commercial nature of the activities of the NFP, which is focused on "earning" profit for shareholders and paying them dividends, is generally in conflict with the interests of insured citizens.

The safety of pension savings of citizens of Russia is guaranteed by the Federal Law No. 422 from 28.12.2013. The rights of insured persons in the CPI system are protected at two levels: 1) PFR or NPF at the expense of the CPI reserve; 2) Deposit Insurance Agency (further — DIA) at the expense of the pension savings guarantee fund.

In the event of the withdrawal of the license and (or) bankruptcy of the NPF, the guarantee compensation only compensates the nominal amount of the contributions for the funded pension, and the investment income is not guaranteed (to those who have not yet received the pension). Investment income is included in the register of creditor claims and is replenished by the sale of the assets of the fund included in the insolvency estate to insured persons after the claims of the DIA are satisfied.

As at 31.12.2020, liquidation proceedings were conducted by DIA for 28 NFPs not included in the insured rights guarantee scheme and were fully completed in 6 NPFs.[3]

The average duration of liquidation procedures is 5.3 years, although according to the requirements of the Bank of Russia should not exceed 3 years.

According to DIA, the estimated value of assets of liquidated NFPs, which constitute funds of pension savings, is 31.9 bln rubles, which corresponds to only 36% of their book value.[4] This is due to the poor quality of the assets liquidated by NFPs and the write-off of assets that are not realizable and recoverable. Taking into account another 1 bln rubles of the estimated value of the competitive mass, which can be used to cover liabilities in the absence of funds of pension savings and reserves, 32.9 bln is the maximum that insured persons of liquidated NFPs can count on to reimburse investment income, and after meeting the requirements of the Bank of Russia.[5]

The main settlements with creditors were made in 2016–2018, but the amounts of satisfied claims are insignificant and are predominantly directed to settlement with the Bank of Russia (the main lender, whose share in aggregate claims is 70–80%) (*Fig. 3*). In total, as at 31.12.2020, 27.89 billion rubles were allocated to settlements with creditors at the expense of pension savings. Thus, the amount of creditors' claims significantly (approximately 2.5 times) exceeds both actual and potential cash revenues from the assets of the liquidated NFPs, which constitute pension savings.

According to the DIA data in NFPs where liquidation procedures have been completed,

[3] DIA website. URL: https://www.asv.org.ru/pension-funds?category=npf-liquidation-in-process (accessed on 10.12.2021).

[4] According to DIA's annual reports. URL: https://www.asv.org.ru (accessed on 10.12.2021).

[5] In accordance with the Federal Law No. 422 from 28.12.2013 "On guaranteeing the rights of insured persons in the system of compulsory pension insurance of the Russian Federation in the formation and investment of funds of pension savings, establishment and implementation of payments at the expense of pensions savings" in the case of enforced liquidation of NPF, which is not a fund — a participant in the insurance system of guarantees of rights of persons, the reimbursement of retirement savings in the amount of contributions made is carried out by the Bank of Russia and is transferred to the PF. In accordance with the Federal Law No. 127 from 26.10.2002 "On Insolvency (Bankruptcy)", the insured person's claim shall not be satisfied until the Bank of Russia's claims in respect of the insurance person have been fully satisfied.

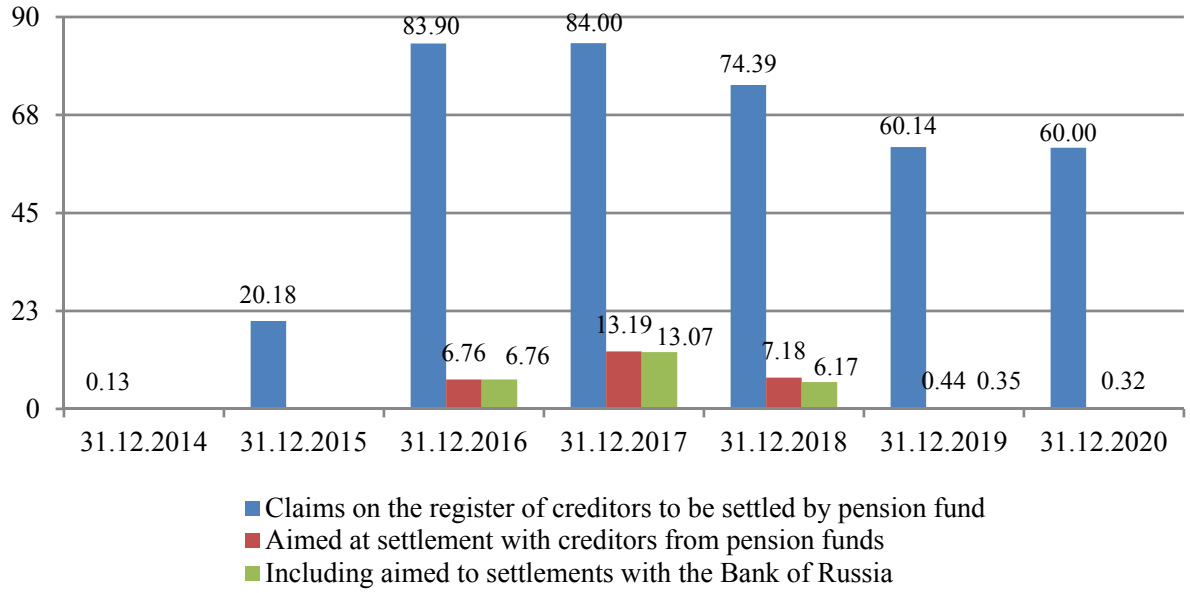

Fig. 3. **Creditors' Claims to be Satisfied at the Expense of Pension Savings, and Settlements on them, Billion Rubles**

Source: Compiled by the authors on the basis of the annual reports of the Deposit Insurance Agency.

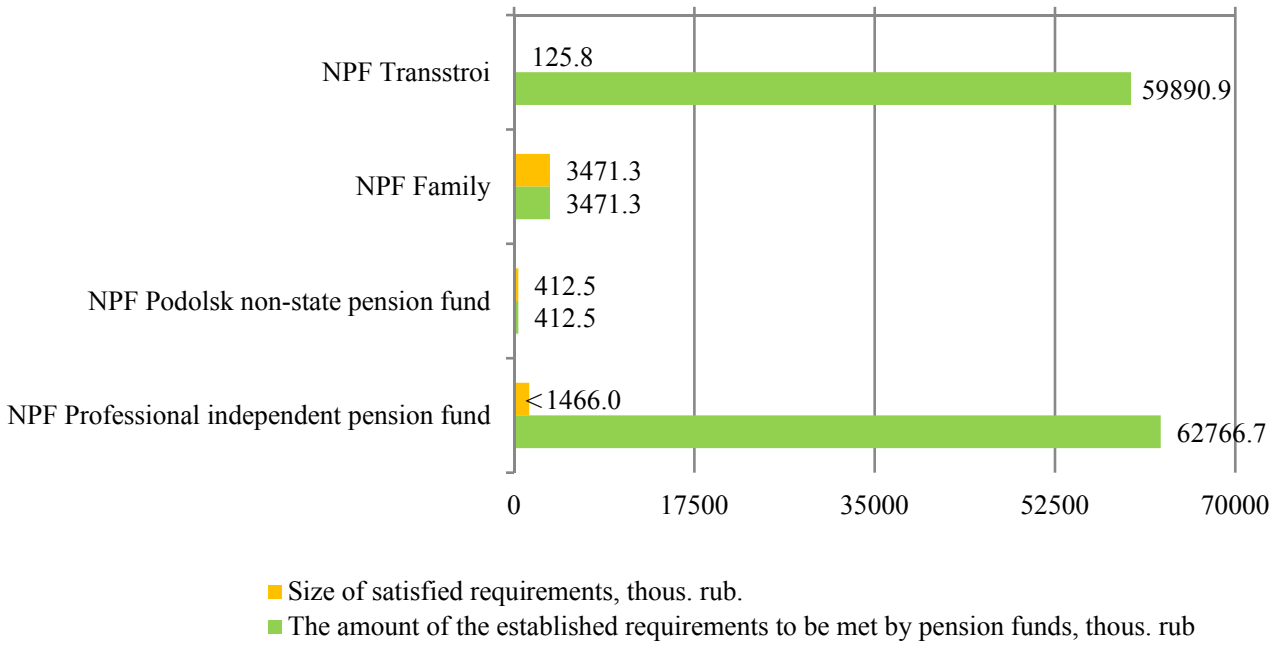

Fig. 4. **Satisfaction of Creditors' Claims of NPFs in which Bankruptcy Proceedings Have Been Completed**

Source: Compiled by the authors on the basis of reports on the results of bankruptcy proceedings for funds.

creditors' claims to be satisfied from pension savings funds have been satisfied by only 4% (*Fig. 4*).[6]

It follows that, most likely, more than 90% of the investment income will not be reimbursed to insured persons who have formed their pension savings in liquid able NFPs. They are reimbursed only the number of contributions to accumulative pensions,

[6] DIA Annual Report for 2020. URL: https://www.asv.org.ru/upload/agency/annual/2020/page5_4.html (accessed on 20.01.2022).

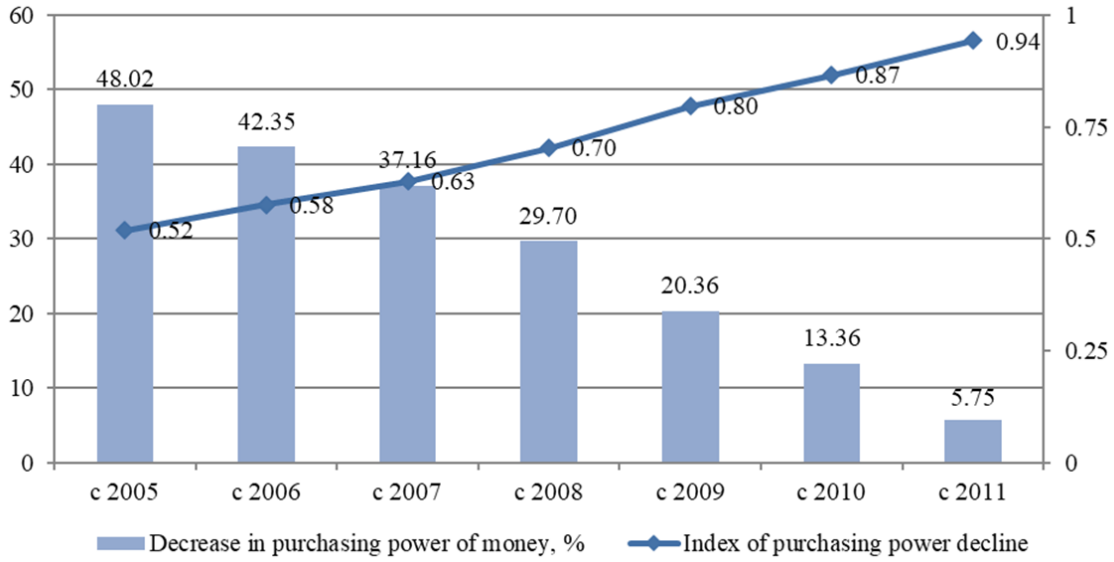

Fig. 5. **The Change in the Purchasing Power of Money from the Beginning of the Formation of Pension Savings Until the Revocation of the License from the NPF "Semeinyi"**

Source: Compiled by the authors on the basis of data from the Federal State Statistics Service and the Deposit Insurance Agency.

and in nominal terms, excluding inflation. However, the decline in the purchasing power of money can be very significant, as illustrated in *Fig. 5* on the example of the family fund. Pension savings in it were formed since 2005, and the license was revoked 02.08.2012. The Bank of Russia is obliged to transfer the nominal of contributions under the CPI to the PFR, i.e. in 2012 in the formation of pension savings, for example, from 2005 until the revocation of the license, the index of purchasing power decline was 0.52, i.e. by 2012 every 100 thous. rubles. pensions savings became equivalent to 52 thous. rubles. The decrease in the purchasing power of money was 48%. Given the high level of inflation for the entire savings period prior to the massive withdrawal of NFP licenses in 2015–2016, the losses from the inflationary depreciation of pension savings in insured persons may be significant and are not compensable. Thus, those who have formed pension savings in liquidated NFPs are unlikely to receive neither investment income nor the real equivalent of their insurance contributions.

Despite the higher reliability of the NFPs included in the system of guaranteeing the rights of insured persons, in case of deprivation of the fund of the license DIA will compensate also only the nominal contributions to the accumulative pension.

CHOICE OF INVESTMENT STRATEGIES

Investment of pension savings is carried out by management companies with which pension insurers enter into trust management agreements of savings funds. An investment declaration is an integral part of the contract, which must comply with the legislative requirements for the assets in which pension savings may be placed, as well as the structure of the investment portfolio.

In NPF, insured persons do not have the possibility to choose the strategy of investment of pension savings, it is possible to change it only by switching to another NPF. However, this can be done without loss of investment income not earlier than after five years of formation of savings in this NPF.

The PFR has entered into a trust agreement with VEB for the funds of pension savings selected by the PMC competition. VEB can invest pension savings in an expanded portfolio and a portfolio of government securities. Both portfolios reflect a conservative approach to investment, as they

mainly include government securities and bonds of reliable issuers. A wider list of assets for investment, including shares of Russian issuers, is included in PMC investment declarations, in which the maximum shares for individual asset types differ. Moreover, some management companies offer the option of selecting a specific portfolio. For example, "AGANA" offers "Balanced" and "Conservative" portfolios, while "BCS" offers the "Profitable" and the "Balanced". Thus, if the insurer is PFR, the insured persons have the option of choosing the strategy of investing their pension savings, which are offered by VEB and PMC. At the same time, you can change the management company or investment portfolio annually without losing investment income.

USE OF PENSION SAVINGS FOR THE DEVELOPMENT OF THE ECONOMY

The needs of the Russian economy for long-term sources of financing cannot be met by bank loans alone. Collective investors, including pension funds, also have significant investment potential. They are capable of transforming citizens' pension savings into an investment resource necessary for the development of the real economy. This demonstrates the socially beneficial effect of the formation of pension savings.

Analysis of the structure of investment of pension savings in pension insurers does not give an opportunity to assess their contribution to the development of the real sector of the economy (*Fig. 6*). Investments in public securities are not considered a source of financing for the real economy, as public loans are used to finance budget deficits, repay debt liabilities and replenish budget balances. Cash and deposits can be seen as investments in the financial sector rather than in the real sector of the economy. Of course, financial institutions lend real-sector enterprises, but their use as an intermediary in the investment process leads to an increase in the financial resources needed for the development of enterprises. Thus, equity investments and corporate bonds may be indicators of investment of pension savings in the real economy. By the end of 2020, their total share in the investment portfolio of PFR was 44%, or 0.9 trn rubles, and NPF was 59.1%, or 1.8 trn rubles. It should be noted that the management company with which PFR works, VEB, is not entitled to invest pension savings in shares and could not invest in corporate bonds until 2009. But even these figures do not give an idea of the scale of investment by pension insurers in the real sector of the economy, as some of them are invested in shares and bonds of credit institutions.

According to the Bank of Russia, the investment of NPF pension savings in the real sector of the economy amounted to 39% on 31.12.2020 (public sector — 33%, financial sector — 22%, others — 6%).[7] Unfortunately, no such statistics are provided for the PFR. The Bank of Russia only points out that the real sector dominates the VEB portfolio, ahead of the public sector, while the financial sector accounted for 9.4% of the portfolio.

The industrial structure of NPF investments in the real sector of economy is dominated by the oil and gas industry, engineering and transport,[8] and the VEB — transport, road construction, oil and gas industry, electricity.[9]

The economy needs long-term investments. And pension savings, which involve a long period of formation, obviously should be the source of such investments. However, in NPF bond sub-portfolios, long-term debt securities with a duration (effective before maturity) of more than 5 years are less than 11%, including longer than 10 years — 1.7%. At the same time,

[7] Review of key indicators of the NPF. Information and analytical material No. 4, 2020. URL: http://www.all-pf.com/upload/iblock/e32/Klyuchevye-pokazateli-NPF-za-2020-god.pdf (accessed on 27.02.2022).

[8] NPF Market Trends. Quarter 3 of 2020. URL: https://cbr.ru/Collection/Collection/File/31565/NPF_market_trends_2020-q3.pdf (accessed on 27.02.2022).

[9] Kuznetsov E. Silence of Money: Where the VEB invested the pension savings of Russians. URL: https://iz.ru/1280719/evgenii-kuznetcov/molchanie-denzhat-kuda-veb-vlozhil-pensionnye-nakopleniia-rossiian (accessed on 27.02.2022).

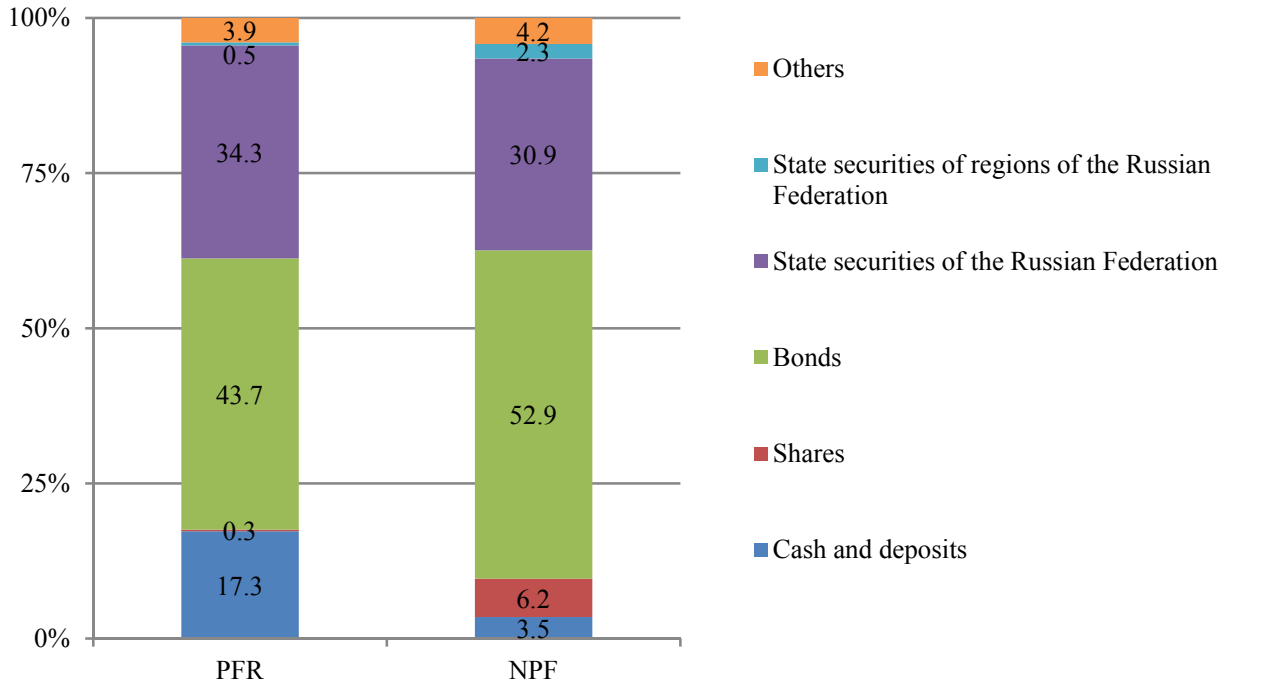

Fig. 6. **Structure of the Investment Portfolio of Pension Savings as of 31.12.2020**

Source: Compiled by the authors on the basis of data from the Bank of Russia.

the share of bonds with duration from one to 3 years prevails.[10] Experts associate this with the market deficit of long-term financial instruments of reliable issuers and the high risk of long investments in the conditions of volatility of the Russian market. Regarding the PFR, this information was unfortunately not found.

It is also known that VEB invests pension savings in long-term bonds of the largest Russian companies with state participation, for example, Russian Railway with a term of 20 years, Russian Post — 15 years, PJSC "ROSSETI" — 30 years, PJSC "KAMAZ" — 15 years,[11] as well as in non-permanent bonds Russian railway.

Prospective investments for pension funds are investments in infrastructure bonds that provide future pensioners with incomes that exceed inflation, while at the same time providing a source of financing for the construction of roads, stations, airports, railway infrastructure, social facilities, urban infrastructure and ecology. Not all of the NPFs are going to be on the spot yet. The largest interest in infrastructure investments is shown by NPF "Gazfond pension savings", NFP "VTB Pension Fund", NPF "Open", NPF "Future". Pension savings of the NFP are invested in such projects as: part of the motorway Moscow — St. Petersburg, section of the Moscow — Minsk route by passing Odintsovo, three fitness and wellness complexes, municipal solid waste processing facilities in the Nizhny Novgorod region, etc.[12] VEB, as a state development agency, actively invests pension savings in infrastructure projects related to the construction of affordable housing, roads in cities and regions of Russia, the development of the Moscow

[10] Pronin K.V. State of the NPF market. 20.08.2020. URL: http://pensionobserver.ru/files/213559/%D 0%9F%D 1%80%D 0%BE%D 0%BD%D 0%B 8%D 0%BD.pdf (accessed on 27.02.2022).

[11] VEB clarified the structure of investment in pension savings bonds. URL: https://ria.ru/20150528/1067015275.html (accessed on 27.02.2022).

[12] The future of the pension market: pension funds have become strategic investors. URL: http://pensionreform.ru/files/111993/823191c5afd669a18e16bc5.pdf (accessed on 01.03.2022).

transport hub, the energy infrastructure of the Far East and Siberia, the renewal of railway infrastructure, etc.[13] Since a number of infrastructure bonds are not allocated to a separate asset class and are not reflected in the accounts of funds, it is difficult to estimate the value of investment of pension savings in infrastructure.

CONCLUSION

In general, it can be concluded that PFR is more efficient in saving citizens' pension savings than private pension funds. It is therefore logical to raise the question of the continued feasibility of NPF participation in the CPI system. After all, "the participation of a financial intermediary is economically justified if it creates added value, i.e. increases profitability or reduces costs" [9]. But, as the research shows, this is not observed. Furthermore, the status of the CPI insurer in relation to NPF is questionable in the scientific community [12].

Similar conclusions have been described in a number of other researches. For example, in the paper [8] based on a comparison of investment results of public and private pension funds in six countries, the authors come to the conclusion about the feasibility of transferring compulsory pension savings in Russia to a single state fund. The paper [13], which included 10 sovereign, 11 public and 73 private pension funds and plans, concluded that, in terms of real yields, private funds ceded to sovereign and public funds over the nine-year period of analysis, with private-owned funds at higher risk levels than government funds. The papers [14, 15], as well as a report prepared by a group of IMF staff,[14] on the example of Russia, Hungary and Poland, found that competition in the pension market does not lead to an improvement in the quality of investment of pension savings.

In a number of states, centralization of pension savings has already been implemented at the state level, for example in Singapore, Malaysia, Kazakhstan. In our view, it is advisable to study their experience and determine the conditions for the effective management of pension savings by the State.

[13] How Savings «Silent» Work in the Real Economy. URL: https://pensiya.veb.ru/pensija-v-jekonomike/kak-nakoplenija-molchunov-rabotajut-v-realnoj-jekonomike/ (accessed on 01.03.2022).

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ABOUT THE AUTHORS

Irina V. Terentieva — Cand. Sci. (Econ.), Assoc. Prof., Department of Economics, Tourism and Mass Communications, Murom Institute (branch), Vladimir State University named after A.G. and N.G. Stoletovs, Murom, Russia
https://orcid.org/0000-0002-8541-9411
Corresponding author:
terentieva-murom@yandex.ru

Andrey V. Svistunov — Cand. Sci. (Econ.), Assoc. Prof., Department of Economics, Tourism and Mass Communications, Murom Institute (branch), Vladimir State University named after A.G. and N.G. Stoletovs, Murom, Russia
https://orcid.org/0000-0003-1592-5703
svistunov-murom@yandex.ru

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ORIGINAL PAPER

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Retirement Wealth Adequacy Estimation Based on Income Group Classification: A Case Study in Malaysia

A.A. Adnan[a], R.I. Alaudin[b], A.M. Yaakob[c], N. Ismail[d]
[a, b, c] Universiti Utara Malaysia, 06010 UUM Sintok, Kedah, Malaysia;
[d] Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

ABSTRACT

The inadequacy of retirement wealth can significantly impact a country's social support system. The increase of the size of the elderly population in line with the constant growth of life expectancy among Malaysians has triggered a question, are there enough resources to cover needs in retirement years? The main **objective** of this study is to estimate the retirement income adequacy of future retirees under a defined contribution (DC) plan, which is the Employee Provident Fund (EPF). The projection of retirement income adequacy uses cross-sectional data from the Malaysian Household Income Survey (HIS) 2014, based on 14,169 sample households. The households are categorized according to three different income groups, including Top 20% (T20), Middle 40% (M40) and Bottom 40% (B40). In addition, this research also investigates the demographic and socio-economic determinants of retirement wealth adequacy using OLS and logistic regression. The result shows that 26% of households in the sample have inadequate retirement income, especially households in the B40 group.

Keywords: welfare; retirement; income; regression; income group

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INTRODUCTION

Malaysia is predicted to become an Aging Nation prior to 2030, by which 14% of the population will be aged 60 and above.[1] This scenario has triggered our consciousness of having enough resources to support living expenses during retirement, especially in terms of wealth and income. Adequate retirement wealth is imperative to maintain the standard of living after retirement, or else the individual is forced to return to their labour force to provide a living.

The emergence of an aging population is closely associated with the mortality rate. The average mortality rate of the Malaysian population is 75 years old, according to the World Health Organization (WHO).[2] Therefore, individuals have to save enough wealth until they reach 75 years old. As for the case in Malaysia, the maximum working service in the government sector is until reaching the age of 60. In general, retirees have to survive for 15 years without their monthly salary during the working period.

Concerning the retirement system, every nation has a Multi-Pillar Pension System. It commonly includes social security, pension benefits and personal savings, and the Malaysian pension scheme is placed under Pillar 2 of the mandatory contributory component. The idea of the Multi-Pillar system is to ensure income security for older people, preventing poverty and reducing inequality.

The main objective of this study is to estimate the retirement income adequacy of future retirees under a defined contribution (DC) plan, which is the Employee Provident Fund (EPF). The projection of retirement income adequacy uses cross-sectional data from the Malaysian Household Income Survey (HIS) 2014, based on 14,169 sample households. The households are categorized according to three different income groups, including Top 20% (T20), Middle 40% (M40) and Bottom 40% (B 40). In addition, this research also investigates the demographic and

[1] KWSP. (2016). Achieving a Better Future. URL: https://www.kwsp.gov.my/documents/20126/144342/Facts_at_a_Glance_2016.pdf (accessed on 27.06.2023).
[2] WHO. (2018). Mortality Rate in Malaysia. URL: https://www.who.int/ (accessed on 27.06.2023).

socio-economic determinants of retirement wealth adequacy using Ordinary Least Square (OLS) and logistic regression.

LITERATURE REVIEW

Literature-related topics are discussed next in this section. The consumption of an individual determines retirement income adequacy after retirement. The consumption during retirement can be estimated in numerous approaches based on the previous finding by the researchers [1–5]. A number of researchers [1–3] applied the Consumer Expenditure Survey to forecast the spending for households where the dataset was used as the measure of retirement consumption. Consumption (needs) is a big part of this research since we used the wealth-needs ratio to determine retirement wealth adequacy.

According to the life cycle model, savings and assets accumulate during work-life to finance retirement needs [4]. The wealth-needs ratio is explained by the fact that wealth is the accumulated fund projected from individual work-life income divided by needs, which is the consumption of individuals after they retire. The ratio value indicates the level of adequacy of retirement wealth. If the value is equal to or greater than one, it means adequate wealth; otherwise, it is inadequate wealth if the ratio is less than one.

According to the life cycle hypothesis, individuals desire to maintain consumption over their entire lives [5]. Economic theory suggests that consumer behaviour remains the same at retirement age. Then, consumption needs can be estimated. Concerning adequate retirement wealth, the life cycle model infers that the accumulated financial resources pre-retirement is equal to or greater than the financial requirements at the point of retirement [4]. Nevertheless, the expenditure pattern might be different before and after the retirement age.

There are several approaches to estimating future retirement wealth. One of the common approaches is the replacement rate (RR). RR is derived from the pre-retirement income percentage, representing the desired consumption level during retirement. Few kinds of research have highlighted the notable set of the replacement rate range. For example, Palmer [6] suggested an adequate range ranging from 65–85% of income level, while Duncan et al. [7] proposed an adequate replacement rate between 70–90%. Unfortunately, there is no standard RR outlined to indicate the Malaysian population. A replacement rate is convenient in approximating the life cycle model's predictions for how households wish to prepare for retirement [8].

Apart from RR, another approach to estimating the retirement consumption pattern proposed by Yuh [9] used the Consumer Expenditure Survey to predict consumption among the retired individuals. On top of that, most literature used a life-cycle framework to explain the issue concerning retirement.

However, the expenditures at and in retirement are distinct prior to the retirement age [4, 10]. A summary of finding suggests that consumption in retirement is lower compared to before the retirement, thus an extensive study by Alaudin [11] which considers both optimistic and pessimistic scenarios give an inclusive measure of two different scenarios. While Caliendo and Findley [12] demonstrated the optimal level of retirement saving and other dynamic scenarios, they expressed regret for having saved too little for retirement.

METHODOLOGY

Data & Method

Cross-sectional data of Household Income Survey (HIS) 2014 was used in this study. The Department of Statistics Malaysia (DOSM) conducts HIS every five years. The HIS 2014 data is the prevailing data for this research, as HIS 2019 data has not been released until the second half of 2020. The HIS 2014 data contains 24 463 households, comprising information of demographic and socio-economic characteristics. However, the selected sample consists of 14,157 household data that satisfy the following conditions. First, working full-time provides the annual salary data with an increment rate is 6%. Second, households

with members between the ages of 30 and 59 presume that those people have stable jobs. Finally, this study considers only workers paid above the poverty line (RM 11,760).

Nonetheless, the data only discloses the proportion of income for EPF contributors. The ratio of wealth from social security and other financial assets will be a limitation because of the shortage of information available. This study defines the projection of accumulated retirement wealth and retirement needs in the same model as in Alaudin et al. [13, 14].

The projection of accumulated fund (EPF) at retirement age can be calculated as follows:

$$C * S * (1+i)^n * \left(\frac{r^{n+1} - 1}{r - 1} \right), \quad (1)$$

where C is the joint contribution rates of employer and employee, S is the first annual salary, i is salary increment rate, n is future service year at the start of the working year and r is calculated as follows:

$$r = (1+d)/(1+i) \text{ and } d = i/(1+i). \quad (2)$$

The salary increment rate is reported at 6% by Bank Negara Malaysia.[3] Meanwhile, the contribution rate of EPF is assumed to be fixed at 23% as it has been used for the past ten years. An average of the past ten years' dividend rate is considered in the calculation, 6.03%, because of fluctuating dividend rate every year.

In contrast to the contribution rate and dividend rate that have set a fixed value, the withdrawal fund from EFP Account 1 and Account 2 varies, respectively, from EPF members. EPF offers up to 18 types of different withdrawals.

The chosen significant and typical withdrawal schemes are; First, withdrawal for purchasing or building the first house. Second, withdrawal for educational purposes. Third, withdrawal for medical expenses and hospital bills. Fourth, pre-withdrawal at age 50. Based on realistic assumptions and EPF annual report 2019,[4] this research focuses on the scenario of an individual withdrawing 30% from EPF Account 2 at age 31 to purchase the first house. At age 45, withdrawing another 30% for education or medical bills, and finally involving pre-withdrawal at age 50.

Alaudin et al. [14] implied two types of withdrawals: purchasing the first house at 31 and pre-withdrawing at the age of 50. However, this research includes one more realistic scenario, comprising 30% of education withdrawal at age 45. This extension seems more practical, as most parents send their children to pursue studies in higher education. With the continuous increase in education, parents indeed wish to spend more on tuition fees to ensure their children's success [15]. Malaysia and Singapore are among the countries that provide this privilege. Notwithstanding the European countries that barred education withdrawal, fast-developing Singapore also allows for education-purpose withdrawal [16].

In addition, this research also considers the i-Lestari withdrawal program introduced by the government in April 2020 due to the Covid-19 pandemic. The i-Lestari withdrawal program allows contributors to withdraw from RM50 to a maximum of RM 500 per month between 1 April 2020 and 31 March 2021 based on the amount of savings available in the Member's Account 2.[5] However, the i-Lestari withdrawal facility may also affect the adequacy of the retirement wealth of Malaysians since it reduces retirement savings.

For salary projection, all EPF members are assumed to start working at age 19 for high school graduates and at age 24 for college graduates, first degree or advanced diploma. The accumulated wealth is estimated at age 60 and the total needs during retirement are discounted at age 60, as per the retirement age suggested by the Malaysian Government amendment of December 2012. According to the life cycle model postulate, an individual desires to maintain a standard of living;

[3] Bank Negara Malaysia. (2019). Bank Negara Malaysia 2018 Annual Report & Amp; Financial Stability And Payment Systems Report (Issue March).

[4] Employees Provident Fund Board. Annual Report 2018. URL: https://www.kwsp.gov.my/documents/20126/974925/6 (accessed on 27.06.2023).

[5] EPF (2020). Frequently Ask Questions. i-Lestari. URL: https://www.kwsp.gov.my/faq-i-lestari (accessed on 27.06.2023).

hence, the retirement needs can be defined as follows:

$$W = T * RR * \left[\frac{\left[1-(1+r)^{-m} \right]}{r} \right], \quad (3)$$

where W represents retirement needs, T is the expected annual salary prior to retirement, RR is replacement rate, r is estimated real interest rate from retirement age to death, m is the retirement period until death, calculated as 75 minus 60 equals 15.

The annual income of household survey 2014 is used to predict consumption during retirement. The replacement rate used is 70% which is a valued place in the range of the suggested RR by previous researchers. The real interest rate, r, is estimated using the real interest rate of 2.75%.

The wealth-to-needs ratio is defined by the following equation:

$$\frac{\text{Projection of Retirement Wealth}}{\text{Total of Retirement Needs}}. \quad (4)$$

Regression Model Specification

This paper highlights the use of the ordinary least squares OLS and Logistic Regression models to identify demographic and socio-economic determinants of retirement wealth adequacy. This research's demographic and socio-economic factors are state, sex, strata, marital status, ethnicity, education level, occupation group, employment type, income group, age, and household size. The models adopted from the general linear model [17], demonstrated as follows:

OLS regression model

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i + \varepsilon, \quad (5)$$

where y is the percentage of wealth-needs ratio, X is determinants, and β is the parameter that indicates the average change in Y that is associated with a unit change in X while controlling for other explanatory variables in the model.

Logistic regression model

$$y_i \sim B(n_i, \pi_i), \quad (6)$$

where Y is a binary variable equal to one if the household has adequate retirement wealth and zero otherwise, n_i is the binomial denominator, and π_i is the probability. The maximum likelihood estimation is used to obtain the regression estimators.

RESULTS AND DISCUSSIONS

The data profile for HIS 2014 data is shown in *Table 1*. The dispersion of samples in regions of Region 1, Region 2 and Region 3 is almost equal, while slightly higher in Region 4 and Region 5, since both regions have wide-scale areas and dense population distributions. Most of the households are male, with 88.2% who act as the family's breadwinner. Strata urban dominates by 76.6% compared to 23.4% in rural areas. A significant majority (84.8%) are married, and more than half (69.1%) are Bumiputera. For education proportion, 55% of the sample are high school graduates (SPM, SPMV, PMR/SRP), college graduates are 16.5. In comparison, higher-level education (degree and advanced diploma) is 14.1% and 14.4% of households with no certificate, respectively.

A large portion of the B 40 group represents 55.9% of the total sample, indicating that more than half of Malaysians people earn less than RM 52,320 annually, followed by the M40 (33.1%) and a few samples of the T20 group of 11.1%. *Table 2* highlights the proportion of households according to different income groups for region, strata and education level. The determinants of the region, strata and education level are significant in explaining retirement wealth adequacy [14]. Moreover, the data distribution by income group provides a clear picture of the income groups divisions.

Table 2 shows that most B 40 comes from Region 5 (Sabah & Sarawak). This situation is reasonable since Region 5 is a less developed region than other regions. Meanwhile, most M40 and T20 income groups are from Region 4

(P. Pinang, Selangor, K. Lumpur, Putrajaya). The households in Region 4 generate higher income than other regions, as the primary economic sector is manufacturing industries that offer higher salaries. In addition, the administration centre is located in this region.

Furthermore, the percentage of households living in urban areas is greater for all income groups. Besides the strata, education level also plays an essential role in earning a higher salary. As shown in *Table 2*, the largest portion of the B 40 income group is made up of households that complete their high school education only. On the contrary, the households of the T20 income group are mostly graduates with a degree or at least an advanced diploma. The main findings of this research are discussed in the following section.

Results of the projected wealth-needs ratio indicate that 26% of households in the sample data do not have adequate retirement wealth to finance their consumption during retirement. The percentage of inadequacy represents 3,723 households. In comparison with the previous study by Alaudin et al. [14]. The result shows a slight decrease with 26% of households having inadequate retirement wealth, compared to the result of Alaudin et al. [14] showed that 31% of households have inadequate retirement wealth.

The withdrawal from the i-Lestari scheme does not affect much the inadequacy of retirement wealth, since the wealth-needs ratio shows the same result as before, taking into account that 26% of sample households do not have enough wealth during their retirement. This situation might happen because the withdrawal duration is short, only within one year, according to the available amount in Account 2.

Table 3 shows the results of analysis of variance from multivariate OLS regression. The response variable for OLS is the measure of retirement wealth adequacy represented by the wealth-needs ratio, where a ratio greater than one is considered adequate and a ratio less than one is inadequate. All variables are statistically and significantly associated with the wealth-needs ratio at a 95% confidence level, except for household size.

Table 1

Data Profile for HIS Sample 2014

Variables	The proportion of households (%)
Region	
1 (Kelantan, Pahang, Terengganu)	13.8
2 (Johor, Melaka, Negeri Sembilan)	17.1
3 (Kedah, Perak, Perlis)	14.2
4 (P. Pinang, Selangor, K. Lumpur, Putrajaya)	28.5
5 (Sabah, Sarawak)	26.4
Sex	
Male	88.2
Female	11.8
Income Group	
B 40	55.9
M40	33.1
T20	11.1
Strata	
Urban	76.6
Rural	23.4
Marital Status	
Single	9.6
Married	84.8
Separated	5.7
Ethnic	
Bumiputera	69.1
Non-Bumiputera	30.9
Education Level	
Degree/Advance Diploma	14.1
Collage Graduate	16.5
High School Graduate	55.0
No. Certificate	14.4
Occupation Group	
1 (Professional)	7.5
2 (Administrative)	6.8
3 (Associates and Higher Technician)	29.8
4 (Agriculture and Aquaculture)	16.5
5 (Craft and Repair)	14.7
6 (Elementary Occupation)	24.7
Employment Class	
Civil Servant	1.9
Private Sector	21.8
Employer	66.7
Self Employed	9.0
Others (Pensioner & Family Business)	0.5
Age Group	
Less Than 34	16.5
35 ⩽ Age ⩽ 44	31.6
45 ⩽ Age ⩽ 54	39.5
54 and above	12.4
Total	100

Source: Author's calculation, Microsoft Excel 2016.

Table 2

Data Distribution by Income Group

B 40 55.9%	M40 33.1%	T20 11.1%
Region 1 9.34% 2 9.30% 3 9.67% 4 11.41% 5 16.15%	**Region** 1 3.55% 2 6.65% 3 3.64% 4 11.40% 5 7.81%	**Region** 1 0.90% 2 1.19% 3 0.88% 4 5.65% 5 2.46%
Strata Rural 17.69% Urban 38.17%	**Strata** Rural 4.75% Urban 28.30%	**Strata** Rural 0.93% Urban 10.15%
Education Degree/Adv Dip 1.37% College Graduate 4.43% No Cert 11.98% High School Grad. 38.09%	**Education** Degree/Adv Dip 6.12% College Graduate 6.85% No Cert 2.26% High School Grad. 17.82%	**Education** Degree/Adv Dip 6.58% College Graduate 2.02% No Cert 0.19% High School Grad. 2.29%

Source: Author's calculation, Microsoft Excel 2016.

Table 3

Analysis of Variance

Variable	Wealth-Need Ratio	*P*-Value
Region	70.8	0.0000
Strata	15.7	0.0000
Sex	1.5	0.0000
Marital status	514.4	0.0000
Ethnicity	95.0	0.0000
Education level	317.2	0.0000
Occupational group	62.6	0.0000
Employment class	157.6	0.0000
Age	6194.9	0.0000
Income group	146.6	0.0000
Household size	0.2	0.2100

Source: Author's calculation, R-studio Programming Language.

Table 4 provides the estimates, standard errors and *p*-values of the covariates. The results indicate that States, urban strata, male respondents, some occupation groups and employment classes are positively associated with adequate retirement wealth. Correspondingly, married status, non-Bumiputera, education, income group, age and number of household members negatively correlate with the response variable (wealth-need ratio). However, the results show an unexpected situation for higher-income groups (M40 and T20). The M40 income group has inadequate retirement wealth, while the T20 income group has a worse situation. The summary analysis of the OLS model is shown in *Table 5*.

The result of the highest annual income households (T20) who are more likely to experience inadequate retirement wealth, is rather unexpected. However, since the RR is used as a proxy for consumption level and is assumed to

Table 4

OLS of Retirement Wealth Adequacy Regression Coefficients

Variable	Estimate	Standard Error	*P*-Value
Intercept	2.9637	0.0189	0.0000
Region 1: reference			
Region 2	0.0163	0.0073	0.0256
Region 3	0.0042	0.0075	0.5746
Region 4	0.0209	0.0069	0.0026
Region 5	0.0171	0.0066	0.0092
Rural: reference			
Urban	0.0109	0.0051	0.0316
Female: reference			
Male	0.0106	0.0073	0.1478
Single: reference			
Married	−0.0518	0.0074	0.0000
Separated	−0.0716	0.0109	0.0000
Bumiputera: reference			
Non-Bumiputera	−0.0209	0.0047	0.0000
College Grad: reference			
Degree/Adv. Diploma	−0.0035	0.0076	0.6502
High School Grad	−0.0328	0.0062	0.0000
No. Cert	−0.0215	0..0084	0.0105
Income Group B 40: reference			
M40	−0.0143	0.0049	0.0034
T20	−0.0357	0.0082	0.0000
Occupation Group Professional: reference			
Administrative	0.0083	0.0115	0.4711
Associates and Higher Technician	0.0004	0.0087	0.9644
Agriculture and Aquaculture	0.0191	0.0099	0.0535
Craft and Repair	0.0060	0.0102	0.5525
Elementary Occupation	−0.0040	0.0098	0.6782
Employment Class Civil Servant: reference			
Private Sector	0.0057	0.0162	0.7211
Employer	0.0205	0.0154	0.1844
Self Employed	−0.0044	0.0164	0.7852
Others –Pensioner & Family Business	−0.0502	0.0324	0.1216
Age Group Less than 34: reference			
35 ⩽ Age ⩽ 44	−0.9602	0.0061	0.0000
45 ⩽ Age ⩽ 54	−1.8084	0.0061	0.0000
54 and Above	−2.2146	0.0079	0.0000
Household Size 1–3: reference			
4–6	−0.0056	0.0048	0.2451
7–9	−0.0138	0.0070	0.0497
10 and above	−0.0168	0.0144	0.2404

Source: Author's calculation, R-studio Programming Language.

Table 5

Summary Analysis of OLS Model

Explanatory Variable	Linkage	Influence
Region 4 (P. Pinang, Selangor, K. Lumpur, Putrajaya)	People living in Region 4 are likely to have adequate retirement wealth, which may be influenced by good job opportunities with a higher salary in developed states. Kuala Lumpur and Putrajaya are the capital cities and centers of administration of Malaysia, offering many job opportunities. The sample of households in Region 4 is mainly from the B 40 and M40 groups	Positive
Region 5 (Sabah, Sarawak)	The source of income is mainly from traditional economic activities (sea-produce, logging). The sample of households in Region 5 consists of B 40 groups, and the result might be influenced by the higher percentage of respondents from East Malaysia	Positive
Strata Urban	The urban area is influenced by 0.0109 of the adequate ratios. Living in an urban area provides many facilities and opportunities to better live Over 75% of the households live in the urban area, comprising a higher percentage of M40 and T20 groups	Positive
Married	Every married household will lose 0.0518 of the wealth-to-needs ratios. Married heads of households have less adequate wealth since the consumption is more significant with the family's commitment. The spending is multiplying with the addition of new family members	Negative
Non-Bumiputera	Non-Bumiputera influence wealth-needs ratio by reducing 2.09%	Negative
Degree/Advanced Diploma	Higher education levels will have more accumulated income resulting from higher salaries Education level is highly associated with the income group of the sample. B 40 households with lower education levels (primarily high school graduates) have lower retirement wealth adequacy. In contrast, M40 and T20 households with higher education backgrounds (Degree or Advance Diploma graduates) have higher retirement wealth adequacy	Negative
Income group	Households with higher income accumulate more assets, and higher-income groups M40 & T20 have lower adequate retirement wealth, which is unexpected. The evidence suggests that T20 possess other assets (financial and non-financial) besides EPF savings	Negative
Age group	Households with a later retirement age have a longer period to accumulate retirement wealth	Negative
Household size: More than ten members	A larger number of households have lower retirement adequacy as spending increases, and savings for retirement decrease	Negative

Source: Author's explanation.

be directly proportional to the annual income, it is expected that households with higher incomes will have higher consumption, thus, reducing the adequacy of retirement wealth. The unexpected situation also happens for the determinant of age, where older households tend to face inadequacy in retirement although they are from the T20 income group compared to younger households. The older households probably have larger commitments to their children or spend more on health and medical expenses.

Table 6 shows the analysis of variance from the logistic regression model. The response variable for the logistic regression model is expressed as a binary variable that is equal to one, if the households have adequate retirement wealth

Table 6

Analysis of Variance from Logistic Regression

Variable	Deviance	*P*-Value
Region	66.7	0.0000
Strata	9.4	0.0022
Sex	7.7	0.0055
Marital status	278.8	0.0000
Ethnicity	69.6	0.0000
Education level	399.5	0.0000
Occupational group	73.7	0.0000
Employment class	406.9	0.0000
Income group	186.7	0.0000
Age	7620.0	0.0000
Household size	32.5	0.0000

Source: Author's calculation, R-studio Programming Language.

(or the projected wealth-need ratio is equal to or greater than one) and zero otherwise.

Table 7 provides the results for the logistic regression model at the 5% significant level. Significant variables are higher education (degrees and advanced diplomas) and a medium number of household members. The probability of adequate retirement wealth increases if sample respondents have higher education.

CONCLUSIONS

In conclusion, this study has found the adequacy of retirement wealth in Malaysian society as a whole using the wealth-need ratio indicator. The estimation of adequacy is based on the panel data that cover all regions across Malaysia, including peninsular and east Malaysia, of which the most concentrated region is placed in the capital of Malaysia. More than half of Malaysian citizens are classified as low-income (B 40), accounting for 55.9% of the data. It indicates that more than half of Malaysians earn less than RM 52,320 annually.

The estimated wealth-need ratio shows that 74% of the households from the sample of 14,157 respondents have adequate retirement income. In contrast, more than a quarter of the total samples are unable to maintain their level of consumption in retirement years. A slight improvement in the percentage of the sample having adequate retirement income compared to the previous study. The percentage of households with adequate retirement wealth is 74% in this study, compared to 69% found in Alaudin et al. [14]. This situation may happen because of a marginal improvement of income earned in recent years and economic stability.

Besides the wealth-need ratio indicator, this study has investigated other determinants of adequate retirement wealth through multivariate OLS and logistic regression models.

Variables of state region, strata, sex, marital status, ages, ethnicity, education, occupational group, employment class and income group are statistically and significantly associated with the wealth-needs ratio at a 95% confidence level. The effects of demographic and socio-economic factors are also investigated.

According to the findings, States, urban strata, male respondents, some occupation groups, and employment classes are all positively associated with adequate retirement wealth. While married status, non-Bumiputera, education, income group, age, and number of household members have a negative correlation with the response variable (wealth-need ratio). The outcome of the highest annual income households (T20) group being more likely to have insufficient retirement money

Table 7

Logistic Regression of Probability of Adequate retirement wealth

Variable	Estimate	Standard Error	*P*-Value
Intercept	7.3893	1.0359	0.0000
Region 1: reference			
Region 2	0.0534	0.1028	0.6038
Region 3	0.0242	0.1032	0.8148
Region 4	0.1224	0.1006	0.2239
Region 5	0.1893	0.0932	0.0423
Rural: reference			
Urban	0.0121	0.0716	0.8654
Female: reference			
Male	0.2138	0.1099	0.0516
Single: reference			
Married	−0.3583	0.1540	0.0199
Separated	−0.2987	0.1807	0.0984
Bumiputera: reference			
Non-Bumiputera	−0.1532	0.0688	0.0259
College Grad: reference			
Degree/Adv. Diploma	0.3967	0.1220	0.0011
High School Grad	−0.2548	0.0986	0.0097
No. Cert	−0.3881	0.1223	0.0015
Income Group B 40: reference			
M40	−0.3081	0.0704	0.0000
T20	−0.5015	0.1181	0.0000
Occupation Group Professional: reference			
Administrative	0.0071	0.1666	0.9662
Associates and Higher Technician	0.0727	0.1209	0.5477
Agriculture and Aquaculture	0.1408	0.1370	0.3039
Craft and Repair	0.0299	0.1389	0.8294
Elementary Occupation	−0.0042	0.1339	0.9751
Employment Class Civil Servant: reference			
Private Sector	0.1503	0.2214	0.4973
Employer	0.4875	0.2092	0.0198
Self Employed	0.0051	0.2205	0.9814
Others -Pensioner & Family Business	−0.9616	0.5528	0.0819
Age Group Less than 34: reference			
35 ⩽ Age ⩽ 44	0.6775	1.4146	0.6320
45 ⩽ Age ⩽ 54	−7.0390	1.0011	0.0000
54 and Above	−26.0830	154.5127	0.8660
Household Size 1–3: reference			
4–6	0.3759	0.0724	0.0000
7–9	0.4445	0.0985	0.0000
10 and above	0.0695	0.1892	0.7134

Source: Author's calculation, R-studio Programming Language.

is relatively unexpected. The rationale that can be pictured is that high-income Malaysians have higher spending behaviour.

For future studies, the projection of the wealth-needs ratio can be improved by including other accessible assets such as financial assets (stocks, equities, bonds) and non-financial assets (gold and real estate). Meanwhile, consumption patterns in retirement age should be considered since consumption affects the adequacy level of retirement wealth. In addition, the possible consumption can be included, such as the cost of digital technology, since this element is a necessity at the moment. As for the model scoring, it can be further revised with a comparison to other established actuarial models for retirement.

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ABOUT THE AUTHORS

Afnan Aizzat Adnan — PhD in Mathematics, Research Scholar at School of Quantitative Sciences, College of Arts and Sciences, Universiti Utara, Sintok, Malaysia
https://orcid.org/0000-0002-5853-8060
Corresponding Author:
afnan.sqs@gmail.com

Ros Idayuwati Alaudin — PhD in Statistics, Senior Lecturer at the School of Quantitative Sciences, College of Arts and Sciences, Universiti Utara, Sintok, Malaysia
https://orcid.org/0000-0002-6555-0834
idayuwati@uum.edu.my

Abdul Malek Yaakob — PhD in Computational Intelligence, Senior Lecturer at the School of Quantitative Sciences, College of Arts and Sciences, Universiti Utara, Sintok, Malaysia
https://orcid.org/0000-0002-9394-6393
abd.malek@uum.edu.my

Noriszura Ismail — PhD, Prof. at the School of Mathematical Sciences, Faculty of Science and Technology, Universiti Kebangsaan, Malaysia
https://orcid.org/0000-0001-9546-952X
ni@ukm.edu.my

Authors' declared contribution:
A.A. Adnan — identified the problem, reviewed of literature, collected data, performed analysis and wrote the conclusions.
R.I. Alaudin — discussed the variables, techniques and framework of research
A.M. Yaakob — reviewed the article and conclusion of the study.
N.I. Ismail — defined the concept of research, reviewed the overall of the article.

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ORIGINAL PAPER

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The Interdependence of Environmental Activities and Investment Attractiveness: Finances of Russian Metallurgy

L.I. Chernikova, D.A. Egorova, K.S. Melikhov, A.I. Yashchenko
Financial University, Moscow, Russia

ABSTRACT

All countries now share a long-term vision of the importance of implementing technology development and transfer to improve climate resilience and reduce greenhouse gas emissions. Metallurgical enterprises play a significant role in achieving this goal, since they produce a large amount of carbon dioxide emissions into the atmosphere. In connection with the changing operating conditions and changing markets of presence, the issues of ensuring their investment attractiveness are acquiring obvious importance in the framework of the finances of Russian metallurgical companies. **The object of the study** is an assessment of the investment attractiveness of Russian metallurgical companies. **The subject of the study** is the relationship between the investment attractiveness of metallurgical companies and the results of their environmental protection activities. **The purpose of this study** is to identify the interdependence of environmental metrics and the investment attractiveness of steel companies. **The methodological basis** is a regression analysis of the impact of environmental metrics on the investment attractiveness of metallurgical companies. The authors chose the following indicators of environmental performance: CO_2 emissions, energy consumption, water recycling, waste. To assess the investment attractiveness of metallurgical companies, the following indicators were used: revenue, EBITDA, investment in R&D. The authors **concluded** that the environmental activities of companies have a significant impact on their investment attractiveness. **The scientific novelty of the study** lies in identifying the interdependence of environmental protection activities and the investment attractiveness of Russian metallurgy companies. **The results of the study can be used** by both Russian steel companies and institutional investors as part of the development of an investment strategy.

Keywords: environmental metrics; environmental protection; investments; corporations; strategic advantages; sustainable development; non-ferrous metallurgy

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INTRODUCTION

The practice of environmental activity of economic entities has been actively developing since the 1980s. Initially, the main focus of all investigations of EGS was on the definition of a business condition that allows for the maintenance aspects of sustainable development in ecological, social and governance matters [1].

For a long time, economic entities considered environmental investment projects only as attempts to gain some additional profit and were usually disappointed. It's important to note that in case of social or governance initiatives, we can trace a direct connection between the Key Performance Indicators (KPI) of a company and the results of such ESG-projects, thus, we can truly state that a company could be interested in them. But in case of environmental investment projects, the initiative usually comes from third parties and for a company, such projects could be too expensive and intensive to implement [1].

This led to a lag in the development of environmental investment projects, whose rapid growth occurred at the end of the 20th century. The current stage of environmental activities in the corporate sector is characterized by the formation of environmental analysis and audits. One of the main driving forces for companies' investment attractiveness is their reputation in terms of environmental impact. Thus, nowadays, we are speaking about so-called "exclusion policy", which is held by institutional investors and based on the carbon footprint of whole industries and distinct companies.

It would be fair in this case to refer to such industries: chemical and gas, pulp and paper and metallurgical. The world policy of minimizing the carbon footprint is aimed at reducing the negative consequences of enterprises' performance in these segments. For the chemical-gas and pulp-and-paper industries, models for replacing of the current principles of performance have already been determined. However, they are not

applicable for the metallurgical industry. This could be explained by the limited nature of materials capable of replacing metal-containing products.[1]

That is why the authors decided to focus on the metallurgical industry and find out the interdependence of environmental metrics and metallurgical companies' investment attractiveness. Since, environmental investment projects are mostly considered in terms of their effectiveness and investment attractiveness is based on both on the effectiveness and profitability of their performance, we would like to identify the key environmental metrics that could describe and prove their effectiveness, and explore the connection between them and profitability indicators.

LITERATURE REVIEW

In the research literature, this direction was more distinguished as an independent one, and gained its significant influence after 1972, when the program of the UN General Assembly for the protection of the environment was established [2]. Since that period, research approaches have systematically moved from assessing the full impact on the ecological system at the level of specific states and nations to the level of specific economic industries and companies. This became one of the primary reasons for including of environmental aspect in the assessment of the investment attractiveness of companies [3].

Speaking about the metallurgical industry, we should mention the following fundamental studies dedicated to investment attractiveness assessment in the environmental context:

- A. Galant and D. Kvek, who assessed the investment attractiveness in the regional context of a separate developing country — Croatia and identified directions for improving the existing methodology of such an assessment under the assumption of limited data [4];
- A. Akbar, H. Jiang, A.M. Qureshi, M. Akbar, who explored Chinese metallurgical companies in the context of emissions and identified the main features of government regulation of such companies' performance [5];
- M.B. Fakoya and K.T. Chitepo, who focused on metallurgical and mining companies that guarantee compliance with ESG-principles as a condition of their inclusion in the exchange index. The authors assessed the impact only through a narrow analysis of two fundamental indicators of emissions into the environment — the volume of carbon dioxide and the size of municipal solid waste generated. At the same time, the researchers found a relationship between the volume of industrial investments in environmental activities and the attractiveness of companies within the framework of the stock index [6];
- M. Sh. Shabbir and O. Wisdom, who assessed the relationship between the volume of investments in environmental projects and the KPI of companies in the manufacturing sector. The determining role for researchers was assigned to the assessment of standardized financial indicators within the pool of companies of related economic sectors [7];
- K. Theo, Y.B. Hutomo, G. Monroe, who considered the theory of stakeholders in relation to the performance of Australian mining and steel companies. The researchers determined that regulators and business entities are required to take environmental activities into account when planning to attract investment financing [3].

A number of works by Russian authors are also devoted to the issues of developing a financial mechanism for attracting investments in environmental projects, as well as determining the most significant tools for stimulating environmental activities. The most significant research results are presented by the following authors: E.B. Tyutyukina [8–12]; T.N. Sedash [8, 9, 11, 12]; D.A. Egorova [8, 13].

It's fair to say that research materials allow the authors to take into account an extensive methodological base and make some important notes and corrections of inaccuracies and assumptions established by other authors, to develop conclusions about the significance of environmental activities in the assessment of the metallurgical companies' investment attractiveness.

METHODOLOGY

Data

To confirm the relevance of this study and clarify the empirical basis of our calculations, we analyzed the metallurgical industry in Russia and abroad.

[1] Cross-border carbon regulation in the EU: how to prevent discrimination against Russian exporters. Analytical Report: Institute for Natural Monopoly Problems. Moscow; 2021:12.

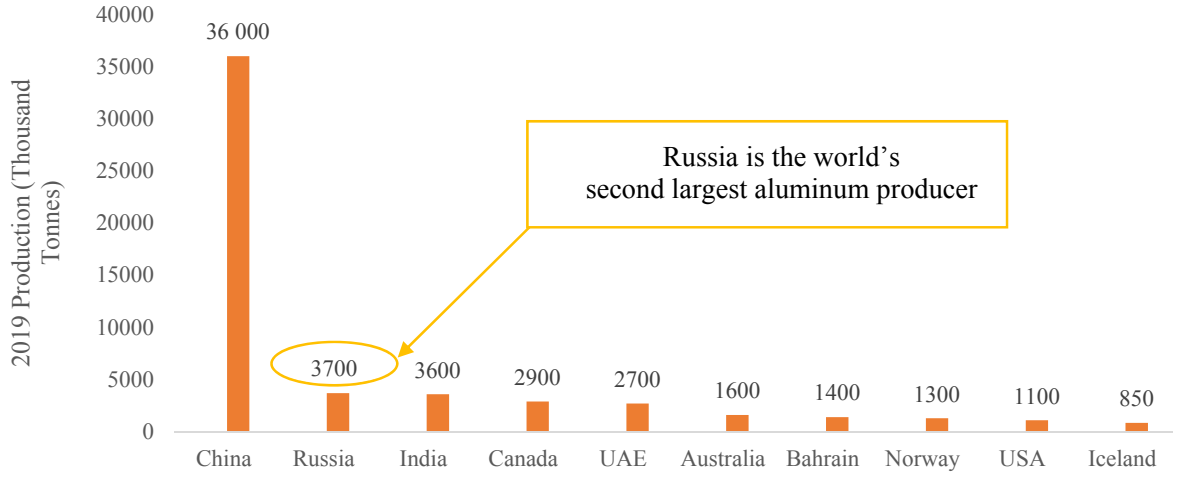

Fig. 1. **Top 10 Largest Aluminum Producing Countries in the World**

Source: Compiled by the authors on the basis of data from the annual publication "WORLD MINING DATA". URL: https://www.world-mining-data.info/ (accessed on 21.11.2022).

It should be noted that non-ferrous metal metallurgy's volumes of production are significantly lower than those of ferrous [14]. But the price of its products is much higher. Among them are heavy non-ferrous metals (copper, zinc, lead, nickel, chromium), lightweight (aluminum, magnesium, titanium), alloys (used as an additive to steel — tungsten, molybdenum, vanadium), and precious (gold, silver, platinum).

Let's take a look at the analysis of the main countries, that produce aluminum and compare them, in order to highlight the place of Russia in this ranking (*Fig. 1*).

Russia ranked as the world's second largest aluminum producer with around 3.6 million metric tons of aluminum produced, which is much lower than China's output in first place. The aluminum production in Russia is mostly dominated by RUSAL — one of the world's largest aluminums producing companies based in Moscow.[2]

In 2020, Russia exported $ 5,21B in Raw Aluminum, making it the 2nd largest exporter of Raw Aluminum in the world. In the same year, Raw Aluminum was the 10th most exported product in Russia. The main destination of Raw Aluminum exports from Russia are: Turkey ($ 793M), Netherlands ($ 618M), Japan ($ 565M), South Korea ($ 318M), and Italy ($ 251M). Russia Aluminum Exports was reported at 8042247,604 USD thousand in Dec 2021. *Figure 2* shows the dynamics of aluminum export value in Russian Federation from 2010 to 2021.[3]

Let's compare main Russian aluminum producers by the amount of their revenue to highlight the role of RUSAL in the metallurgy industry in Russia (*Table 1*).

Speaking about environmental activities, we should note, that RUSAL was the first Russian company to join the UN Development Program (UNDP) to participate in the international initiative for minimizing climate change which assumed voluntary commitments to reduce greenhouse gas emissions. The Company introduced an internal assessment of the environmental impact of all new investment projects. By 2025, carbon dioxide emissions (in equivalent) at RUSAL aluminum smelters are forecast to have decreased by 15%, and at alumina refineries — by 10% (vs 2014).

About 90% of RUSAL aluminum is produced using electricity from renewable sources, which is supplied by hydraulic power plants in Siberia. The Company's production facilities adhere to the requirements of international environmental management system standard ISO 14001.[4]

[2] URL: https://www.aluminiumleader.com/economics/world_market/ (accessed on 21.11.2022).

[3] URL: https://www.aluminiumleader.com/economics/world_market/ (accessed on 21.11.2022).

[4] National standard of the Russian Federation GOST R ISO 14001–2016 "Environmental management systems. Requirements and guidelines for use" (approved by order of the Federal Agency for Technical Regulation and Metrology dated April 29, 2016 No. 285-st). URL: https://docs.cntd.ru/document/1200134681 (accessed on 21.01.2021).

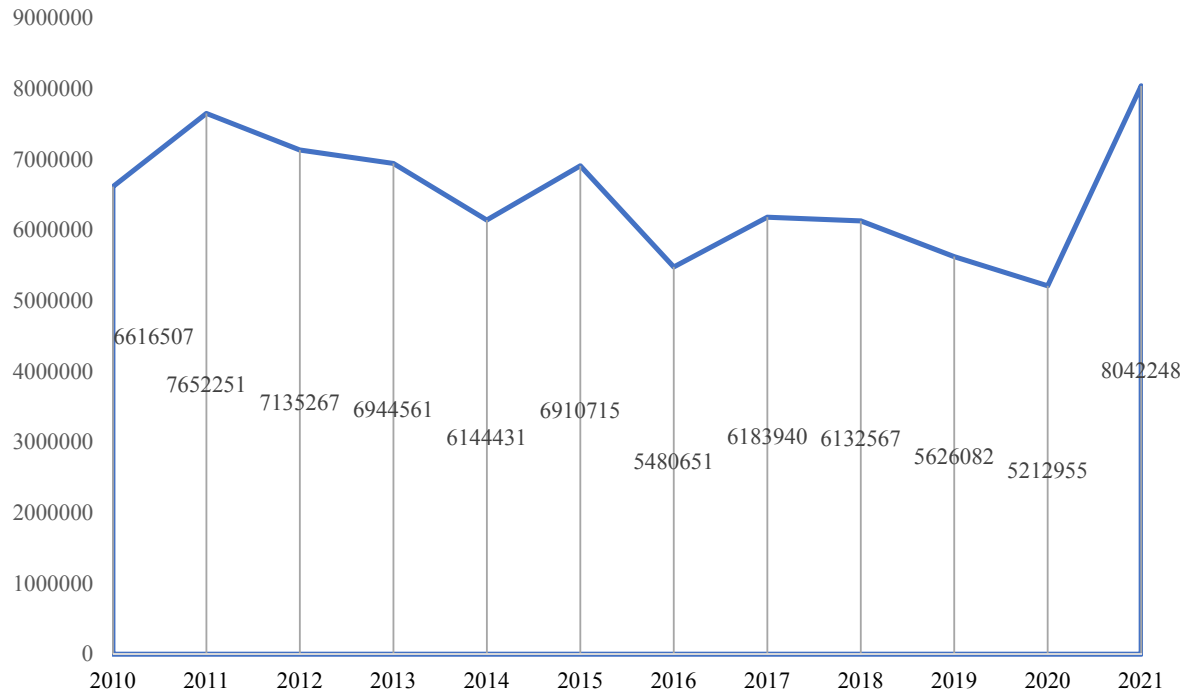

Fig. 2. **Export Value: Aluminum (Russian Federation), Thousand USD**

Source: Compiled by the authors on the basis of data from "All about Aluminium". URL: https://www.aluminiumleader.com/economics/world_market/ (accessed on 21.11.2022).

Thus, we are going to focus on PJSC RUSAL's financial and non-financial information as the empirical basis for all our further calculations, measurements and conclusions to be able to extrapolate the results to other non-ferrous metallurgical companies in Russia. All the data is taken from official sources (official website of PJSC RUSAL, Bloomberg Finance L.P.).

Indicators

The environmental activity of any company proceeds from the intention to maintain a balance between the actual costs of innovation, the commercial benefits from its implementation and the change of the company's role in the eyes of stakeholders [15].

In this case, it is important to detect so-called imaginary environmental innovations aimed at one-time compliance with the ecological standards of functioning and positions of sustainable development [16, 17]. The authors presented a scheme of this correspondence in terms of interactions within the framework of the behavioral models of the organization's management in the figure (*Fig. 3*).

The authors' conclusions shown in *Fig. 3* establish under which behavior model the company receives the greatest benefits from its economic activities. In this regard, it is appropriate to consider that when focusing on long-term investments and operations to maintain environmental friendliness, companies gain a greater number of final benefits than with short-term (non-systemic) business models. This conclusion allows us to focus on the strategic model of organizing activities oriented toward sustainable development.

The system of indicators for evaluating environmental performance is rather poorly developed [18]. There is the international environmental assessment standard ISO 14031:2021 "Environmental management",[5] on the national level there is the National Standard.[6] The system of indicators has been developed, but the conditions and practice of their application have not been defined. In this work, we will be guided by our own scorecard developed on the basis

[5] ISO 14031:2021 Environmental management — Environmental performance evaluation — Guidelines. 2021. 44 P.

[6] National standard of the Russian Federation GOST R ISO 14001–2016 "Environmental management systems. Requirements and guidelines for use" (approved by order of the Federal Agency for Technical Regulation and Metrology dated April 29, 2016 No. 285-st). URL: https://docs.cntd.ru/document/1200134681 (accessed on 21.01.2021).

Table 1

Rating of Organizations (Aluminum Producers) by Revenue

Rank	Name	Indicators, million rubles		Region
		Revenue	Assets	
1	PJSC RUSAL Bratsky Aluminum Plant	114 123	115 435	Irkutsk region
2	JSC RUSAL Krasnoyarsk Aluminum Smelter	82 404	71 426	Krasnoyarsk region
3	JSC RUSAL Sayanogorsk Aluminum Plant	77 644	42 758	The Republic of Khakassia
4	JSC Arkonik SMZ	73 285	30 414	Samara Region
5	JSC RUSAL Ural	64 667	70 841	Sverdlovsk region
6	JSC Boguchansky Aluminum Plant	52 400	112 365	Krasnoyarsk region
7	JSC RUSAL Achinsk Alumina Refinery	33 671	25 908	Krasnoyarsk region
8	LLC Ural Plant of Non-Ferrous Casting	19 929	534	Sverdlovsk region
9	LLC Krasnoyarsk Metallurgical Plant	19 828	9 382	Krasnoyarsk region
10	JSC RUSAL Novokuznetsk Aluminum Plant	19 706	10 116	Kemerovo region

Source: Compiled by the authors on the basis of data from "Investing Port". URL: https://porti.ru/company/analysis/compare/MOEX:RUAL (accessed on 21.11.2022).

of ISO 14031:2021 "Environmental management". The indicators are divided into two groups — A and B (*Fig. 4*).

Due to the fact that environmental activities require additional costs, the effectiveness of corporations that have included elements aimed at improving and preserving the environment in their business processes remains questionable. In this connection, a hypothesis was put forward: *Environmental activities to reduce emissions do not positively affect the economic efficiency of the company.*

This hypothesis will be tested during the study of group B indicators, which are calculated indicators usually applicable in the framework of financial analysis, for example, gross margin.

Group A indicators are divided into four subgroups. The first describes the change in the performance of the corporation over time. The general calculation formula has the form (1). Any indicator can be subjected to such an analysis.

$$\Delta A = A_i - A_j, \mathrm{i} > j, \quad (1)$$

where ΔA — is the absolute change of the indicator; $A_{i,j}$ — is the value of the indicator at the moments of time i and j.

The second subgroup describes the growth rates of indicators, the nature of mutual changes and their unidirectionality. Formulas for calculation and their description are presented in *Table 2*.

Indicators from different areas can be, for example, revenue and emissions, so using formula (3) we can determine the quantity of emissions per ruble of revenue. Hypothetically interrelated indicators can be research and development costs (R&D) and emissions, so using formula (4) we can explore the degree of increase or reduction in emissions achieved through investments in R&D.

The breadth of research on these indicators is usually underestimated, so, for example, in formulas (3, 5) it is permissible to use $i, j_A \neq i, j_B$, which allows you to determine the effects with a time lag. So, for example, the hypothesis about the effect of R&D spending in the period i on the quantity of emissions in the period $i+3$ can be tested, which is fair since it's impossible to obtain "instant" results from investments.

The third subgroup, indicators of elasticity, characterizes the degree of sensitivity of indicators, their ability to adapt to changes in each other. Formulas for calculation and their descriptions are presented in *Table 3*.

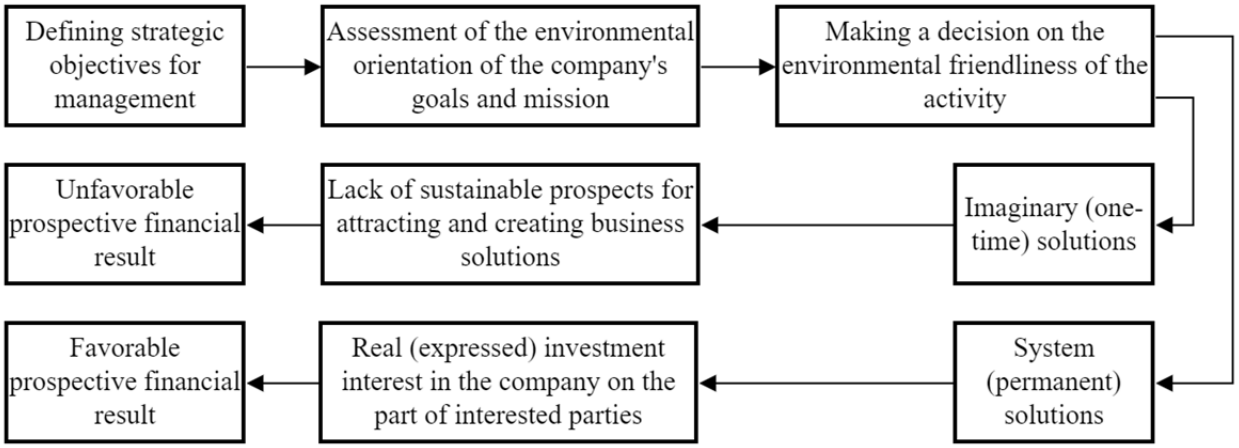

Fig. 3. **Models of the Organization's Management Behavior During the Implementation of Environmental Decisions**

Source: Compiled by the authors.

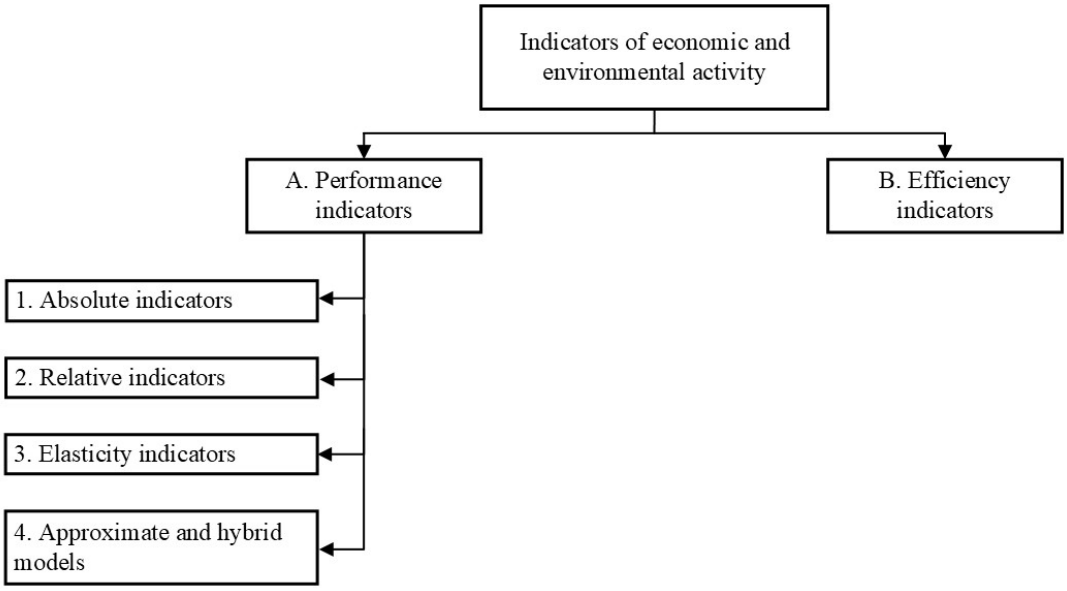

Fig. 4. **The System of the Economic and Environmental Performance Indicators of the Company**

Source: Compiled by the authors.

Any indicator, preferably hypothetically related, can be investigated this way. A significant advantage of the study of elasticity is its versatility and ability to combine indicators, due to the fact that $E_{B(A)} = \frac{\partial \ln A}{\partial \ln B}$, you can get the elasticity of the combined indicator $A_i \times A_j$ for B as $E_{B(A_i \times A_j)} = E_{B(A_i)} + E_{B(A_j)}$ regardless of the values of A and B, which allows you to expand the ongoing research.

The last, fourth group — approximate and hybrid models, can characterize both the measure of sensitivity and the mutual direction of changes in indicators. These models are represented, in particular, by various types of regression models, stochastic and differential models, their configurations (e.g., inverse differential equations) and their combinations with each other, and other models.

The simplest regression model is a linear one, represented by formula (2).

$$y = \beta_0 + \sum_{i=1}^{n} \beta_i x_i + \xi, \quad (2)$$

Table 2

Indicators of the B-2 Group of Economic and Environmental Activities of the Company

Formula number, name	Formula	Characteristic
(2) growth rate	$T_A^{'} = \sqrt[i-j]{\frac{A_i}{A_j}} - 1, i > j$	Characterizes the change in the indicator in fractions of its own initial value for a period of time $i - j$, any indicator can be studied
(3) direct effect	$p_{A,B} = \frac{A_i}{B_i}$	Characterizes how many units of indicator A fall on one unit of indicator B at time i, can describe any indicators, it is preferable to explore indicators from different areas
(4) average direct effect	$\overline{p_{A,B}} = \frac{\overline{A}}{\overline{B}}$	Similar to the direct effect, but characterizes how many units of indicator A fall on one unit of indicator B on average
(5) marginal effect	$\beta_{A,B} = \frac{\Delta A}{\Delta B}$	Characterizes the increase in indicator A when indicator B changes by one, can describe the relationship of any indicators, it is preferable to investigate hypothetically related indicators

Source: Compiled by the authors.

where y — the dependent variable; x_i — the regressors that hypothetically affect the value of y; β_0, β_i — the model coefficients; ξ — and is the model error.

It is still necessary to carry out an assessment for each indicator separately, and then combine the results using elasticity. The adequacy of such measurements is achieved by the absence of dimension of the elasticity indicator.

RESULTS

We have calculated the indicators for the metallurgical holding PJSC RUSAL. The sources of information were the holdings reports, press releases and data from the Bloomberg news agency. The results are reflected in *Table 4*.

Since the Bloomberg platform was the only source of non-financial information for analysis, the authors were limited to a sample of data for the period 2018–2020. It was for this period that data on CO_2 emissions, energy consumption, secondary use of water, and waste were disclosed in the Bloomberg Finance L.P.

An analysis of the change in indicators over time was directly carried out: absolute growth and growth rate for the entire period were calculated (*Table 5*).

No decrease in emissions is observed over the entire period of time, the amount of water reused has increased, relatively to the total consumed (~3%[7]), which is negligible.

Let's calculate the direct effect and the marginal effect for all pairs of financial indicators with environmental ones. Thus, according to the authors' calculations, in 2020, 1$ of revenue accounted for 4.62 kg of CO_2 emissions, 20.4 kWh of electricity consumed, 3.54 liters of reused water (which is only 3% of water consumption), 13.7 kg solid waste. For $ 1 of EBITDA in 2020, these figures are 10 times higher, and for $ 1 of investment in R&D — 526 times higher.

In 2020, direct effects will be greater than the average effects over the past three years, which, against the backdrop of a decrease in revenue, indicates a negative trend in environmental performance. Given the lockdown caused by the COVID-19 pandemic, there was no need to increase production due to the presence of large stocks. However, RUSAL's figures are 45% better than the industry average.[8]

It is noteworthy that the changes in the volume of waste, electricity consumption and EBITDA within the study period are unidirectional, so it's necessary to pay attention to these indicators when calculating elasticity (*Table 6*).

[7] Bloomberg Finance L.P. URL: https://www.bloomberg.com/europe (accessed on 25.01.2022).

[8] Bloomberg Finance L.P. URL: https://www.bloomberg.com/europe (accessed on 25.01.2022).

Table 3

Indicators of the B-3 Group of Economic and Environmental Activities of the Company

Formula number, name	Formula	Characteristic
(6) simple elasticity	$E_{B(A)} = \beta_{A,B} \times p_{A,B}^{-1}$, $i_A = i_B, j_A = j_B$	Characterizes the sensitivity of indicator A to changes in indicator B at the moment i
(7) medium (arc) elasticity	$\widetilde{E_{B(A)}} = \beta_{A,B} \times \overline{p_{A,B}}^{-1}$, $i_A = i_B, j_A = j_B$	Characterizes the sensitivity of indicator A to changes in indicator B on average over time interval *i – j*

Source: Compiled by the authors.

Table 4

Performance indicators of PJSC RUSAL

Index	The source of information
CO_2 emissions, tons	Bloomberg Finance L.P.
Energy consumption, MW/h	Bloomberg Finance L.P.
Secondary use of water, m^3	Bloomberg Finance L.P.
Waste, tons	Bloomberg Finance L.P.
Revenue, thousand $	Annual reports of PJSC RUSAL
EBITDA, thousand $	Authors' calculations
Investments in R&D, thousand $	Bloomberg Finance L.P., PJSC RUSAL Sustainability Reports

Source: Compiled by the authors.

It can be seen that according to data, with an increase in energy consumption by 1%, the volume of solid waste increases by 1.1%. With a 1% increase in EBITDA, electricity and solid waste consumption increases by 1.7 and 1.8%, respectively.

The results of the study of the elasticity of emissions for investment in R&D are also interesting. Thus, in 2020 with a change of 1%, they decreased: CO_2 emissions by 3.6%, electricity consumption by 3.7%, solid waste by 4%. It can be concluded that the investments are effective and this is reflected in the reduction of emissions by 3–4%. The reduction in revenue in 2020 due to the pandemic made it impossible to adequately interpret the results of elasticity with this indicator.

Let's calculate the elasticity of the total environmental damage with respect to EBIT and investments in R&D. As described, for elasticity in this case, the summation of indicators is sufficient, without entailing the appearance of uninterpretable data. In 2020, with an increase in EBIT by 1%, the total environmental damage increased by 5.1%; with an increase in investment in R&D by 1%, the total environmental damage decreased by 11.3%. In the case of arc elasticity, due to the decline in financial performance from 2018 to 2020, the elasticity values are meaningless.

As a study of the A-4 group indicators "Approximate and hybrid models" we used a simple pairwise regression (including non-linear). EBIT (EBIT) and R & D investment (RD) acted as regressors in different models, as they did not give pandemic-related distortion in 2020. The dependent variable was the amount of solid waste (W). To improve the quality of the model, we took quarterly figures from 2014, the data source was Bloomberg Terminal.

The models look like this:

$$W = \beta_0 + \beta_1 EBIT + \xi, \qquad \text{(Model 1)}$$

Table 5

Analysis of performance indicators of PJSC RUSAL over time

Index	2020	2019	2018	Average for 2018–2020
CO_2 emissions, tons	39 532 299.58	24 799 322.95	24 428 359.41	29 586 660.65
Δ, tons	+14 732 976.63	+370 963.54		
T', %	+27.2			
Energy consumption, MW/h	175 020 833.63	106 733 188.33	137 191 488.27	139 648 503.41
Δ, MW/h	+68 287 645.29	–30 458 299.94		
T', %	+12.9			
Secondary use of water, m^3	30 334 092.81	18 784 653.24	18 045 049.91	22 387 931.99
Δ, m^3	+11 549 439.57	+739 603.33		
T', %	+29.6			
Waste, tons	117 750 264.81	69 067 842.17	73 871 614.87	86 896 573.95
Δ, tons	+48 682 422.64	–4 803 772.70		
T', %	+26.3			
Revenue, thousand $	8 566 000.00	9 711 000.00	10 280 000.00	9 519 000.00
Δ, thousand $	–1 145 000.00	+569 000.00		
T', %	–8.7			
EBITDA, thousand $	849 000.00	653 000.00	1 994 000.00	1 165 333.33
Δ, thousand $	+196 000.00	– 1 341 000.00		
T', %	–34.7			
Investments in R&D, thousand $	16 300.00	18 000.00	14 700.00	16 333.33
Δ, thousand $	–1 700.00	+3 300.00		
T', %	+5.3			

Source: Compiled by the authors based on Bloomberg materials Finance L.P., PJSC RUSAL Annual Reports, PJSC RUSAL Sustainability Reports; authors' calculations.

$$W = \beta_0 + \beta_1 RD + \xi, \quad \text{(Model 2)}$$

$$W = \beta_0 EBIT^{\beta_1} + \xi, \quad \text{(Model 3)}$$

$$W = \beta_0 RD^{\beta_1} + \xi. \quad \text{(Model 4)}$$

The interpretation of all these models was questioned since the results were inconsistent. In an attempt to specify a meaningful model, Model 5 was compiled with a time lag of three years, by successively eliminating regressors.

$$W_t = \beta_0 + \beta_1 RD_{t-5} + \xi. \quad \text{(Model 5)}$$

The simulation results are as follows: $W_t = 14804 - 0,42 * \mathrm{RD}_{t-5}$, this suggests that R&D investment yields results (negative impact on emissions) only in the fifth year. The model and its coefficients are statistically significant at a significance level of 0.05. The coefficient of determination is 0.51.

Using regression, we tested the previously set hypothesis that "Environmental activities to reduce emissions do not have a positive effect on the economic efficiency of the enterprise", for which we use the volume of emissions as a regressor, and return on equity (ROE) as a dependent variable. Data source: Bloomberg Terminal.

$$ROE = \beta_0 + \beta_1 W + \xi. \quad \text{(Model 6)}$$

The simulation results are as follows: $ROE = 46.8 + 0.33W$, this suggests that with an increase in emissions by 1 million tons, ROE grows by 0.33%, thus, our initial hypothesis is accepted: environmental activities to reduce emissions do not have a positive effect on economic efficiency. The model and its coefficients are statistically significant at a

Table 6

Matrix of Positive Simple Elasticity of the Chosen Indicators

	Energy consumption, MW/h	Waste, tons	EBITDA, thousand $
Energy consumption, MW/h	–	1.1	0.59
Waste, tons	0.4	–	0.56
EBITDA, thousand $	1.7	1.8	–

Source: Authors' calculations.

significance level of 0.05. The coefficient of determination is 0.48.

So, we can conclude that in 2020, RUSAL's environmental performance showed worse results than the average for the last three years, but better than those of industry peers. For sustainable development purposes, in particular the environmental aspect, RUSAL needs to focus on a commensurate increase in EBITDA and investment in R&D, then, based on our forecast, there will be a net reduction in emissions of 4–5% per year. However, it is worth considering that the environmental return on investment in R&D occurs around the fifth year. In addition, the activity of the company to reduce emissions affects the return on equity negatively.

CONCLUSION

The authors in the first sample received a 9 by 9 matrix with marginal effect coefficients, and this is far from the limit of the variety of combinations. The algorithm for calculating and interpreting indicators, whose "financial" component has undergone negative changes, is subject to improvement, since the meaningfulness of the values calculated under this condition is doubtful. In addition, the linear nature of these indicators can be considered a disadvantage.

Approximate and hybrid models, such as regression, can be used to address the linearity issue. However, in this case, the process of calculating elasticity indicators becomes more complicated, especially when using multiple regression models. The undoubted advantage of regression is the calculation of all coefficients (except for the total elasticity) "in one iteration", without the need to recalculate the coefficients separately for each indicator.

In the future, it will be relevant to adapt stochastic models to the needs of environmental assessment in order to take into account the probabilities that describe the degree of success of ongoing environmental activities, determine the significance and weights of certain environmental indicators. Modeling based on differential equations will allow taking into account not only the temporal change of variables, but also their relationship with each other in time. Fuzzy modeling can solve the problem of linking the space of prerequisites in stochastic modeling with the space of conclusions, which are the consequences of the occurrence of certain events in terms of probability.

The need for these models draws our attention to the creation of a software package for analyzing and modeling the environmental activities of an enterprise, with the aim of automating calculations, using machine learning models, stochastic, differential modeling and fuzzy logic models.

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ABOUT THE AUTHORS

Lyudmila I. Chernikova — Dr. Sci. (Econ.), Prof., Department of Corporate Finance and Corporate Governance, Financial University, Moscow, Russia
https://orcid.org/0000-0003-4743-5506
LIChernikova@fa.ru

Daria A. Egorova — Cand. Sci. (Econ.), Assoc. Prof., Department of Corporate Finance and Corporate Governance, Financial University, Moscow, Russia
https://orcid.org/0000-0002-7981-2583
Corresponding author:
DAEgorova@fa.ru

Kirill S. Melikhov — student, Faculty of Economics and Business, Financial University, Moscow, Russia
https://orcid.org/0000-0001-5964-8029
ks.melichov@gmail.com

Alexander I. Yashchenko — student, Faculty of Economics and Business, Financial University, Moscow, Russia
https://orcid.org/ 0000-0002-9042-6077
AIYashchenko@fa.ru

Authors' declared contributions:
L.I. Chernikova — statement of the problem, development of the concept of the article, critical analysis of the literature.
D.A. Egorova — collection of statistical data, tabular and graphical presentation of the results.
K.S. Melikhov — conducting data analysis, describing the results and forming the conclusions of the study.
A.I. Yashchenko — conducting data analysis, describing the results and forming the conclusions of the study.

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Development of the Methodology for Comprehensive Analysis of the Efficiency of the State Financial and Investment Model of Population Social Security Using the Example of Russian Regional Finance

M.L. Dorofeev
Financial University, Moscow, Russia

ABSTRACT

The effectiveness of financing the social security system is one of the key conditions for sustaining sustainable economic growth. The global economic crisis of 2020 associated with the coronavirus pandemic, and the subsequent crisis of 2022, due to the urgent need to carry out a structural transformation of the Russian economy in the context of large-scale international sanctions, emphasized the **relevance** of the problem of increasing the efficiency of budget expenditures on social policy. The **purpose** of the study is to develop methodological approaches to the comprehensive analysis of the effectiveness of the State financial and investment model of social security of the population (further – SFIMSS) using the example of data on the socio-economic development of the regions of Russia. The following **methods** were used: coefficient analysis, ranking, construction of heat maps and regression analysis. The coefficient of efficiency of budget expenditures at the regional level makes it possible to have fairly comprehensive assessments of the regions. The application of the regression analysis methodology makes it possible to expand its effectiveness and identify important dependencies and relationships on the basis of which it is able to establish the policy of state financial regulation. This study evaluated the effectiveness of 85 regions for the period from 2017 to 2021. The most and least effective regions were identified. The construction and interpretation of the regression model made it possible to identify a number of significant exogenous factors such as GRP, GRP per capita, volume indices of GRP, that positively impact the effectiveness of SFIMSS. At the same time, the public debt on loans in rubles, the volume of budget expenditures on social support measures for certain categories, and the proportion of the population older and younger than working age have a negative impact. In the article, recommendations are given on the development of mechanisms for increasing the efficiency and targeting of budget expenditures, as well as the creation of conditions to accelerate economic growth in regions, which will increase the effectiveness of SFIMSS.

Keywords: poverty; income inequality; social policy; regional finance; regional budget; efficiency of budget expenditures; state financial and investment model of social security

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INTRODUCTION

One of the most important systemic objectives of social and economic policy within the framework of Russia's national development goals is to reduce poverty by half (to the level of 6.45% of the total population) compared to 2017. Regional poverty indicators are directly related to Russia's average poverty rate. As a result, the strategy for halving poverty in Russia should be based primarily on the use of effective budgetary instruments, provided that the targeted impact on socio-economic indicators of regional development is achieved.

The effectiveness of the use of budget money is assessed in two aspects, according to the principles of budget system design: (1) economy, i.e. using the fewest budget money to achieve a comparable socioeconomic effect, and (2) effectiveness — achieving the highest socioeconomic impact feasible with the limited budgetary resources available.

According to Rosstat, five regions were numbered in Russia with poverty levels below 6.45% in 2021 (Moscow, Moscow region, St. Petersburg, Republic of Tatarstan, Yamalo-Nenets autonomous district). In nine regions of Russia (Belgorod, Voronezh, Lipetsk, Leningrad, Nizhny Novgorod, Sakhalin, Magadan districts, Khanty-Mansiysk and Chukotka AD), the poverty level of the population exceeded the target of 6.75% by no more than 2 p.p. All other things being equal, the greatest impact on poverty indicators in Russia will come from the medium- and high-poverty regions and the population.

The calculation methodology certainly also has an impact on poverty indicators. The changes in the methodology for determining the poverty line in 2021 were received by the scientific community with a certain amount of criticism and fear, that such reform could result in a sharp rise in regional income inequality, while formally reducing poverty in some regions. The reform of the subsistence minimum (hereinafter — SM) for regions with relatively low SM, for example, Moscow, is likely to increase poverty and increase the burden on the regional budget to finance social expenditures.

Regions with low levels of poverty (Moscow, St. Petersburg, Republic of Tatarstan, etc.) are characterized by a high concentration of the population with incomes between the current poverty level calculated as the SM (in the future — 42.5% of the median per capita income) 50% of median per capita income. A full-price increase of the poverty line to at least 42.5% by 2025 will lead to increased poverty in high per capita income and population regions. In the future, such regions could lead to a deterioration of the national poverty rate.

The purpose of this research is to develop the methodology for assessing the effectiveness of budget expenditures within the current financial and investment model of social security of the population of Russia. This methodology should be used as an additional instrument for effective financial management over the problem of poverty reduction in order to successfully achieve Russia's national development goals.

REVIEW OF THE LITERATURE

The principal approach to estimation of efficiency of budget expenditures is the so-called methodology "cost-efficiency" [1–6]. On the principle of correlation of achieved indicators of socio-economic efficiency with costs or resources spent from the budget, most models and methods of assessment of efficiency of budgetary expenditures on social policy are based [7–14].

Simple methods are useful in the preliminary analysis of the efficiency of budget expenditures, while more complex and integrated methodologies are useful in intercountry and interregional comparisons.

The idea of efficiency analysis based on data with lagged input and output information (cost and socio-economic efficiency indicators) is considered in a number of scientific papers [8, 15]. Current level of some socio-economic indicators such as life expectancy, health indicators, financial literacy, etc. depend on

the accumulated base effect. They can be used as output parameters for budget efficiency analysis, taking into account time lags. However, the scientific literature does not meet enough compelling research from this field. Most socio-economic development indicators, such as a country's degree of poverty, are thought to be impacted by budget expenditures during the period of direct implementation [4–7].

The current financial and investment model of state regulation of poverty in most countries, especially in Russia, is mainly based on budget financing of social policy. Policy on poverty alleviation influences income inequality [11]. Analysis of poverty and income inequality before and after taxes and transfers in OECD countries in a long-term perspective shows that an effective social security system reduces poverty from 15 to 60%.

MATERIALS AND METHODS

By State financial and investment model of social security of the population (hereinafter — SFIMSS) we mean the form of organization of the system of economic relations regarding the interaction of socio-economic institutions, providers and consumers of social services, as well as the mechanism of financing, investment and management of financial resources for the implementation of the State's social guarantees.

The efficiency of the public financial and investment model of social security will be evaluated in this study using indices of regional poverty and expenditures on its alleviation from regional budgets.

The research information base — The research information base — balanced panel data of socio-economic development of 85 regions of Russia and expenditures of the budget system for the period from 2017 to 2021. The main sources of information were Rosstat's open data from the single portal of the budget system of the Russian Federation (portal Electronic Budget).

Methods of the study are coefficient analysis of efficiency of expenditures on social policy of regions, method of construction the heat maps and regression analysis of efficiency indicators with the involvement of an extended set of exogenous factors.

A heat map of efficiency indicators was built on the principle of automatic selection of cells of the table containing high indicators using MS Excel tools. Construction and testing of the regression model results was carried out in RStudio.

Efficiency analysis of budget expenditures on social security, aimed at overcoming poverty, was carried out according to the formula (1).

$$\text{CeffB} = \frac{\left(100\% - \text{C}_{\text{Poverty}}\%\right)}{\text{Social security expenditure, \% of GRP}}, (1)$$

where CeffB — coefficient of efficiency of state financial regulation of poverty, reflecting the share of citizens living above the poverty line, through budget expenditures on social security at 1% of GRP; $C_{Poverty}\%$ — share of population with incomes below the poverty line or the subsistence minimum of 42.5%; Social security expenditure, % of GRP— the value of expenditures on social policy as% of GRP in the consolidated budget of the Russian Federation'.

Regression analysis of efficiency indicators and a set of 38 exogenous variables of socio-economic development of the regions of Russia, available in the Rosstat database at the beginning of 2023, was conducted using the standard model of panel regression according to the formula (2).

$$y_{i,t} = \alpha + x_{i,t}^{'}\beta + z_{i}^{'}\gamma + c_i + u_{i,t}, \qquad (2)$$

where $z_i^{'}$ — vector of characteristics that do not change over time; c_i and $u_{i,t}$ — random elements; $E(c_i) = 0$, $E(u_{i,t}) = 0$; random effects (RE) models assume that $E(c_i \mid z_i^{'}, x_i) = 0$; fixed effects models (FE) allow that $E(c_i \mid x_i) = 0$; depends on x_i; fixed effects model does not allow estimating α and γ; through pooling regression assumes that $c_i = 0$.

Exogenous factors were pre-tested for stationarity. Dickey-Fuller test showed that

they are stationary. To improve the quality of the regression model, where possible, data in relative units of measurement were used and absolute values were scaled up (variables *x*9 — *x*14; *x*27 — *x*28; *x*35 — *x*37).

RESULTS

In the first stage of the study, a simple coefficient of efficiency of budget expenditures for social policy of 85 regions of the Russian Federation was calculated. Based on the data obtained, a heat map is built, and regions are ranked in terms of dynamics for the period 2017–2021 (see *Appendix 1*).

The construction of a regression model, in addition to a number of associated tests of the obtained results, particular to the regression analysis method, were carried out in the second stage of the major section of the study.

Testing of regression coefficients using the Lagrange test, the fixed effects F-test, and the Hausmann Test have shown that of the five options for evaluating regression coefficients, the most effective is the fixed effects evaluation option (see *Appendix 2*). Coefficients of determination R2 and corrected R2 for fixed effects are high enough to explain the efficiency factor of budget expenditures.

DISCUSSION

Data from *Appendix 1* show that with budgetary expenditures from the regional budget for social policy at 1% of GRP in the period 2017–2021, the Government of the Republic of Ingushetia provided incomes above the regional subsistence level only 4.96–6.09% of the region's population. This is the worst indicator in Russia (average — from 21.94 to 28.01%), which indicates inefficiency of the social support system in the region.

The top 5 regions in terms of efficiency of budget expenditures on social policy include: (1) Yamal-Nenets AD; (2) Khanty-Mansiysky AD; (3) Nenets AD; (4) Republic of Tatarstan and Magadan district (5). The evident competitive advantages of the first three regions have to do to their obvious advantages: the commodity and export-oriented type of economy, the comparatively small population, and the low share of the population over the working age. Existing regional labour market opportunities and government-business policies keep poverty levels low in these regions.

Separately, attention was paid to the efficiency indicators of the Magadan region in dynamics. The region, such as the top three, has a rich raw material base and a small population. In 2017, the region was ranked 23rd (see *Appendix 1*), and after 5 years it was ranked 5th in Russia, which is a huge progress in improving the efficiency rate (a smaller share of spending with simultaneous progress in poverty reduction). Further factor analysis of the efficiency factor is required to explain this phenomenon, and in some ways, this is a disadvantage of simple coefficient analysis. In five years, the age structure of the population of Magadan district has changed in favor of an increase in the proportion of the working-age population as the total population of the region has declined. By the end of 2021, the population of the Magadan district had decreased to 137.8 thous. people (–5.4%), due to a roughly proportional reduction in both the working-age population and children and pensioner. At the beginning of 2017, 145.6 thous. people lived in the region, of these 18.7% — are under working age, 60.4% — are of working age and 20.9% — are over working age. By the end of 2021, the population structure was as follows: 18.4–61.1–20.5%, respectively. The consolidated budget of the Magadan district grew in absolute terms in five years, but decreased in percentage to GRP from 3.03 to 2.11% due to the rather rapid growth of GRP. The regional poverty rate fell from 11.1 to 7.9% over the same period. Thus, favorable circumstances contributed to the performance of this region.

The analysis of *Appendix 1* data showed that further research, such as ranking, heat maps and, more importantly, factor analysis, is needed to obtain an adequate interpretation of the results of the efficiency factor calculations. From our point of view, this does not reduce the

practical significance of this method, provided that it is applied as part of a complex study of the effectiveness of budget expenditures for social policy.

Regression analysis of panel data for the period 2017–2022 showed that the efficiency of social expenditures from the regional budget is significantly influenced by a number of related and secondary factors for this indicator. Consider the most significant of them in the first model of the *Appendix 2*.

The principle of influence of variables *x*1, *x*2, *x*7, *x*8, *x*23, *x*27, *x*28, *x*37, *x*38 on the efficiency coefficient seems clear enough for indicators measured in relative units. Any region requires a more economical and effective use of public funds (reducing expenditure while maintaining or reducing poverty), which can be accomplished by improving support targeting to socially vulnerable groups and improving the quality of the social support means test system.

Some of the exogenous factors expressed in rubles should be interpreted and evaluated taking into account that their scale has been increased and they should be considered at least an order of magnitude lower, for example, *x*28 (GRP per capita) considered in thous. rubles, not in mln rubles. The regressors *x*27, *x*35 — *x*37 for the construction of the regression model were converted to trl rubles, but their interpretation makes more sense in the dimension of no more than bln rubles. For example, consider a couple of regressions.

Every additional billion rubles of GRP increases the efficiency of budget expenditures on social policy by about 0.0032 units. The minimum value of GRP in 2021 was in the Jewish AD — at the level of 69.9 bln rubles. The average growth of regional GRP in 2021 is 263.9 bln rubles, median — 114.4 bln rubles, and the minimum — 6.9 bln rubles. Thus, each year, this regressor increases the average efficiency of budget expenditures for social policy by about 0.84 units, and has the highest impact on the largest GRP regions. In this regard, economic growth, as well as its sustainability, should remain the main priorities of economic policy both for Russia as a whole and for individual regions [16]. Principled growth of the region's economy, for example by merging small regions in terms of GRP, is to increase the efficiency of the new territory.

High poverty in inefficient regions of Russia, forcing the population to increase the level of credit debt to finance current consumption expenditures, negatively affects the efficiency indicators. The average level of ruble debt of the population in the regions of Russia in 2020 was 212.3 bln rubles, and in 2021 — about 240.9 bln rubles (+28.6 bln rubles, or 13 27 regions out of 85 debts on loan in rubles exceeded the average in Russia. Of these, 13 had a lower efficiency rate than the national average (the average for 13 regions was 22.55 units, with Altai region having a minimum of 13.46 units). Every additional billion rubles of credit debt (*x*37 factor of *Appendix 1*) leads to a reduction of efficiency in the region by about 0.0114 units. Consequently, each year this factor results in an average reduction of 0.33 units. Such a dynamic is difficult to describe as a major threat to the efficiency of social expenditures at present, given the relatively lower availability of credit for the population.

According to the first regression model it can be seen that the factor of improvement of housing conditions (this is not necessarily growth of mortgage lending) has a positive impact on the efficiency indicator. At the same time, the growth of lending to individuals in all types of loans has a negative impact. Both factors can be at the same time and balance relative to each other. At the same time, growth of debt load of reduces efficiency to a lesser extent than improvement of housing conditions increases. It follows that a reasonable increase in the level of debt load of the population (without the risk of destabilizing the financial system) can improve the housing conditions of Russians and at the same time indirectly increase the efficiency of budget expenditures on social policy in the region.

The second regression model (shortened version of 13 factors) has a lower determination coefficient and explains less efficiency. However, it reduced the number of important regressors and exogenous factors from 13 to 6. At this stage of the study, it was found that the most influential exogenous factor for the efficiency of budgetary expenditures is the size of the region's economy and its growth rate, as well as the level of redundancy of the population.

The expansion of temporal and factor data coverage is difficult due to the lack of reporting on the socio-economic development of regions in open official sources. Further research based on the proposed method should be carried out as part of the expansion of data coverage in the database. It may also be useful to conduct additional iterations to reduce the number of regressions in the regression model, provided that the maximum share of significant factors is maintained and the determination ratio is maximized.

CONCLUSION

This study provides a complex analysis of SFIMSS efficiency. The methodological basis of the study was a simple coefficient analysis and regression analysis of data on the development of 85 regions of Russia for the period 2017–2021.

In combination with method for ranking, heat mapping and supporting descriptive statistics, a simple coefficient analysis method provides comprehensive primary information on the efficiency of social policy expenditures from regional budgets in the context of poverty reduction. Interpretation of calculation results should be carried out on the basis of factor analysis of data of socio-economic development of regions. The improved data is very visible and easy to interpret. The methodology of analysis on the basis of relative efficiency factors allows to compare regions with each other and to track the dynamics of efficiency by regions using rank indicators. This method can be qualitatively improved by its combined application with regression analysis, since in this case it becomes possible to identify a number of additional significant factors that influence the indicator of effectiveness, and on the basis of this to develop appropriate measures of state regulation.

Control of the regional budget deficit, development of the system of budgetary federalism and adequate level of support of the regions from the federal budget, subject to control of the problem of corruption, effective methodologies to ensure the targeting and need for social support and other objectively positive factors contributing to economic growth, allow to increase the effectiveness of budget expenditures on social policy. A qualitative improvement in these factors could make the current financial model of social security in Russia more effective.

One of the most important factors for improving the efficiency of SFIMSS is the size of the regional economy and the high growth rate of GRP. The housing improvement factor is comparable in economic effect to the growth of GRP. The results of the regression analysis show that the growth of ruble loans among the population negatively affects the efficiency coefficient, but its impact is less than that of the improvement of housing conditions. Consequently, it is advisable to continue developing and supporting the public real estate market, including through affordable mortgages, as one of the effects of such a policy will be to increase the efficiency of budgetary expenditures on social policy.

Two regression models showed that the effectiveness of SFIMSS depends on the choice of financial instruments in which people keep their savings. Therefore, the need to continue the policy of increasing the financial literacy of the population with the simultaneous development of the financial market and the adoption of measures to involve a larger share of the population in investment in the Russian stock market is obvious. In this context, the development of infrastructure, including reliable financial market foreign exchange instruments, is also appropriate.

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Appendix 1

Results of the Coefficient Analysis of the Efficiency of Budget Expenditures from the Consolidated Budgets of the Regions of Russia for the Period 2017–2021

No.	Name of the region of the Russian Federation	Efficiency factor KeffB					The rank of the region of the Russian Federation				
		2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
	1	2	3	4	5	6	7	8	9	10	11
Far Eastern Federal District											
1	Amur region	16.41	18.58	18.80	17.02	17.96	71	66	66	58	66
2	Jewish Autonomous District	12.99	12.25	11.12	7.58	7.76	79	80	81	81	82
3	Trans-Baikal region	13.43	14.83	14.95	12.67	12.99	78	75	76	72	77
4	Kamchatka region	15.45	17.31	18.43	17.66	21.92	73	71	68	54	56
5	Magadan region	29.30	32.05	36.15	44.72	49.16	23	23	12	5	5
6	Primorsky region	25.50	27.26	26.06	21.70	25.26	36	35	38	34	42
7	Republic of Buryatia	12.23	13.47	13.80	9.86	10.29	80	78	79	78	78
8	Sakha Republic (Yakutia)	23.08	25.25	26.61	20.27	26.63	47	44	33	40	37
9	Sakhalin region	30.86	47.79	38.25	28.05	41.90	18	6	9	16	8
10	Khabarovsk region	22.93	23.95	22.70	19.06	22.07	48	47	50	46	55
11	Chukotka Autonomous District	27.00	30.31	32.92	34.71	37.99	32	28	18	9	14
Volga Federal District											
12	Kirov region	18.53	18.63	18.00	15.13	17.69	66	65	69	65	68
13	Nizhny Novgorod region	30.36	30.89	30.29	24.70	31.81	20	27	26	23	23
14	Orenburg region	30.37	35.63	33.67	25.50	33.44	19	13	16	20	22
15	Penza region	22.39	23.00	25.70	23.43	27.78	51	50	40	28	33
16	Perm region	28.51	33.68	33.52	24.91	34.30	27	16	17	22	18
17	Republic of Bashkortostan	30.15	32.84	31.01	22.61	30.48	21	19	24	31	27
18	Republic of Mari El	18.85	20.05	20.38	15.02	17.66	64	62	61	66	69
19	Republic of Mordovia	20.20	20.44	21.65	17.69	23.24	57	61	55	53	48
20	Republic of Tatarstan	54.14	61.88	63.98	49.51	67.39	5	4	4	4	4
21	Samara region	31.19	33.08	32.36	24.32	30.88	17	18	20	24	24
22	Saratov region	21.42	21.29	21.81	17.69	21.06	54	56	53	52	59
23	Republic of Udmurt	29.72	32.41	32.19	22.81	29.70	22	21	21	29	28
24	Ulyanovsk region	18.71	18.48	19.80	16.42	19.49	65	67	62	62	62
25	Republic of Chuvash	20.57	20.66	20.80	15.27	18.39	55	60	60	64	64
North-Western Federal District											
26	Arkhangelsk region	20.35	21.93	20.98	17.88	21.91	56	53	59	51	57
27	Vologda region	24.84	26.84	23.80	18.43	24.11	40	38	46	48	45
28	St. Petersburg	54.69	45.53	39.90	34.73	43.93	4	7	7	8	7
29	Kaliningrad region	34.75	36.90	36.91	26.41	35.34	10	12	10	18	15
30	Leningrad region	37.51	41.60	38.74	33.14	40.09	8	9	8	10	9

Appendix 1 (continued)

No.	Name of the region of the Russian Federation	Efficiency factor KeffB					The rank of the region of the Russian Federation				
		2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
31	Murmansk region	22.43	23.39	26.40	29.27	33.74	50	48	36	13	19
32	Nenets Autonomous District	73.11	87.41	86.67	57.18	88.91	3	2	2	3	2
33	Novgorod region	25.18	25.37	25.19	18.41	21.26	38	43	42	49	58
34	Pskov region	17.41	17.90	18.62	13.31	17.07	70	69	67	70	71
35	Republic of Karelia	17.52	18.08	19.13	14.92	20.08	69	68	65	67	61
36	Republic of Komi	26.93	29.43	29.10	19.91	26.86	33	29	29	43	35
North Caucasus Federal District											
37	Republic of Kabardino-Balkarian	14.32	14.22	14.04	7.52	9.48	75	77	78	82	81
38	Republic of Karachay-Cherkess	10.77	10.82	11.24	8.12	9.50	81	82	80	79	80
39	Republic of Dagestan	19.36	18.76	19.19	12.52	13.67	62	64	64	74	76
40	Republic of Ingushetia	6.09	6.88	6.68	4.32	4.96	85	85	85	85	85
41	Republic of North Ossetia-Alania	17.67	17.58	16.82	13.29	14.42	68	70	72	71	73
42	Stavropol region	18.91	19.44	19.52	14.91	17.76	63	63	63	68	67
43	Republic of Chechen	7.89	7.43	6.88	4.51	5.26	83	83	84	84	84
Siberian Federal District											
44	Altai region	14.58	14.46	14.52	12.58	14.34	74	76	77	73	74
45	Irkutsk region	25.58	27.60	17.94	16.83	24.98	35	33	70	60	43
46	Kemerovo region	24.74	27.01	21.62	16.16	22.89	42	36	56	63	52
47	Krasnoyarsk region	28.52	32.65	35.31	27.44	35.28	26	20	14	17	16
48	Novosibirsk region	26.58	27.55	26.49	19.47	23.15	34	34	34	45	50
49	Omsk region	22.38	21.74	21.37	16.93	19.44	52	54	58	59	63
50	Republic of Altai	10.20	11.14	10.96	7.99	9.72	82	81	82	80	79
51	Republic of Tyva	6.95	7.40	7.23	4.89	6.05	84	84	83	83	83
52	Republic of Khakassia	23.31	22.89	24.25	18.70	23.05	46	51	44	47	51
53	Tomsk region	28.71	30.93	30.34	20.65	27.76	25	26	25	39	34
54	Kurgan region	13.59	13.46	15.39	12.24	14.31	77	79	75	76	75
55	Sverdlovsk region	32.00	32.06	31.63	25.88	33.59	16	22	22	19	20
56	Tyumen region	29.01	31.54	23.00	20.05	30.84	24	24	48	42	25
57	Khanty-Mansiysk Autonomous District – Ugra	79.12	85.28	85.61	58.01	87.47	2	3	3	2	3
58	Chelyabinsk region	28.15	28.39	26.80	21.68	26.09	28	31	32	35	38

Appendix 1 (continued)

No.	Name of the region of the Russian Federation	Efficiency factor KeffB					The rank of the region of the Russian Federation				
		2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
59	Yamalo-Nenets Autonomous District	97.52	108.44	101.57	80.99	121.27	1	1	1	1	1
Central Federal District											
60	Belgorod region	49.11	50.95	51.51	43.24	39.85	6	5	5	6	11
61	Bryansk region	19.77	20.90	22.68	18.19	22.49	61	59	51	50	53
62	Vladimir region	25.29	25.10	25.64	21.17	25.82	37	46	41	38	40
63	Voronezh region	32.09	33.58	34.18	28.20	33.56	15	17	15	15	21
64	Moscow	45.94	44.20	40.03	35.31	46.77	7	8	6	7	6
65	Ivanovo region	15.94	16.74	17.54	14.50	18.04	72	73	71	69	65
66	Kaluga region	32.62	34.83	35.70	30.24	38.04	13	14	13	11	13
67	Kostroma region	22.08	22.60	23.17	17.15	20.30	53	52	47	55	60
68	Kursk region	24.60	26.93	28.29	25.04	28.61	43	37	30	21	30
69	Lipetsk region	35.05	37.59	32.75	29.43	34.45	9	11	19	12	17
70	Moscow region	34.29	34.06	31.09	28.31	38.45	11	15	23	14	12
71	Orel region	19.90	21.29	22.17	19.70	23.20	59	57	52	44	49
72	Ryazan region	27.03	26.66	26.46	22.69	26.84	31	39	35	30	36
73	Smolensk region	22.64	23.15	21.59	17.13	23.30	49	49	57	57	47
74	Tambov region	25.04	26.15	23.91	21.99	23.57	39	41	45	33	46
75	Tver region	24.18	26.08	26.36	21.21	28.52	45	42	37	37	31
76	Tula region	24.30	26.41	26.01	23.79	29.53	44	40	39	26	29
77	Yaroslavl region	28.00	28.78	29.57	24.18	30.68	29	30	28	25	26
Southern Federal District											
78	Astrakhan region	32.19	38.18	36.35	21.44	39.90	14	10	11	36	10
79	Volgograd region	27.23	27.88	27.03	22.08	25.62	30	32	31	32	41
80	Sevastopol	20.19	21.53	22.75	16.72	25.99	58	55	49	61	39
81	Krasnodar region	33.12	31.09	30.09	23.49	28.13	12	25	27	27	32
82	Republic of Adygea	19.80	20.92	21.79	17.14	22.12	60	58	54	56	54
83	Republic of Kalmykia	18.00	16.91	15.65	12.02	15.69	67	72	74	77	72
84	Republic of Crimea	14.12	15.26	15.70	12.35	17.43	76	74	73	75	70
85	Rostov region	24.84	25.24	24.94	20.23	24.87	41	45	43	41	44
Descriptive statistics for Russia as a whole											
86	Maximum	97.52	108.44	101.57	80.99	121.27	-				
87	Average	26.38	28.01	27.43	21.94	27.97					
88	Median	24.60	25.37	24.94	19.91	24.98					
89	Minimum	6.09	6.88	6.68	4.32	4.96					

Source: Compiled by the author according to Rosstat and portal Electronic budget. URL: http://budget.gov.ru/epbs/faces/p/Бюджет/Расходы?_adf.ctrl-state=pyzjesslh_82&regionId=45; URL: https://rosstat.gov.ru/folder/210/document/13204 (accessed on 02.01.2023).

Appendix 2

Results of Regression Analysis of Efficiency of Budgetary and Exogenous Variables of Socio-Economic Development of Russian Regions

Exogenous variable	Model 1		Model 2	
	Regression coefficient	Standard error	Regression coefficient	Standard error
x1 (Expenditures of consolidated budgets of regions of the Russian Federation on the implementation of social support measures for individual categories of citizens, % GRP)	**–1.504****	**–0.676**	**–2.469*****	**0.752**
x2 (Social transfers in natural form, % of GRP)	**–0.460****	**–0.231**	–0.279	0.221
x3	–0.376	–0.928	–	–
x4	3.062	–3.6		
x5	–3.785	–3.846		
x6	275.243	–395.963		
x7 (Population under working age, % of total population)	**–1.672****	**–0.666**	0.386	0.682
x8 (Population over working age, % of total population)	**–0.915*****	**–0.317**	0.205	0.234
x9	–649.711	–582.048	–	–
x10	–162.417	–112.495		
x11	–2.032	–418.08		
x12	393.169	–730.978		
x13	75.118	–776.842		
x14	348.478	–225.073		
x15	345.835	–1 258.02		
x16	–1 756.84	–6 601.30		
x17	–8 170.14	–18 417.26		
x18	13 852.32	–32 870.96		
x19	0.076	–0.051		
x20	–0.0001	–0.03		
x21	0.031	–0.034		
x22 (Income of consolidated budgets of regions of the Russian Federation, % of GRP)	**0.179***	**–0.1**	–0.07	0.104
x23 (Expenditures of consolidated budgets of regions of the Russian Federation, % of GRP)	**–0.327*****	**–0.118**	–0.194	0.125
x24	0. 254	–0.161	–	–
x25 (Share of families registered as requiring accommodation in total number of families)	**–0.415****	**–0.167**	–0.011	0.17

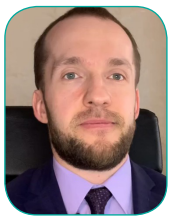
Appendix 2 (continued)

Exogenous variable	Model 1		Model 2	
	Regression coefficient	Standard error	Regression coefficient	Standard error
x26	–0.331	(0. 246)	–	–
x27 (Gross regional product)	**3.177*** **	**–0.726**	**3.906*** **	**0.803**
x28 (Gross regional product per capita)	**13.500*** **	**–1.074**	**7.504*** **	**0.809**
x29	–0.025	–0.02	–	–
x30	0.349	–0.319		
x31	0. 325	–0.325		
x32	–0.874	–2.895		
x33	0.582	–1.545		
x34	1.376	–1.338		
x35 [Funds (deposits) of individuals in rubles, attracted by credit organizations]	**–6.593** **	**–2.825**	**–5.920***	**3.119**
x36 [Funds (deposits) of individuals in foreign currency, attracted by credit organizations]	**14.360*** **	**–5.364**	**5.841**	**5.776**
x37 (Debt on loans in rubles provided by credit organizations to individuals)	**–11.359*** **	**–3.707**	**–19.239*** **	**3.665**
x38 (Index of volume of gross regional product as% of previous year)	**0.150*** **	**–0.054**	**0.367*** **	**0.052**
Constant	–	–	–	–
Number of observations	435		435	
Coefficient of determination R2	**0.778**		**0.667**	
Corrected R2	0.689		0.568	
F-Statistics Data	28.588***		229.012***	
	(df = 38; 310)		(df = 13; 335)	

Source: Compiled by the author.

Note: significance Levels: * – $p < 0,1$; ** – $p < 0,05$; *** – $p < 0,01$.

ABOUT THE AUTHOR



Mikhail L. Dorofeev — Cand. Sci. (Econ.), Assoc. Prof. of the Department of Public Finance, Financial University, Moscow, Russia
http://orcid.org/0000-0002-2829-9900
dorofeevml@yandex.ru

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Threshold Cointegration and Price Transmission in Commodity Marketsof India

A. Mishra, R.P. Kumar
National Institute of Food Technology Entrepreneurship and Management, Sonipat (Delhi NCR), India

ABSTRACT

The **purpose** of this research work is to examine the relationships and price dynamics between agricultural commodities in India, i.e.maize, wheat, barley and soybean. Our approach is to study the long-term relationship using the **method** of modelling the price transmission for both linear and threshold autoregressive (AR) models and vector error correction (VEC) models. **Results** revealed that all the price series are well integrated, and threshold error correction models prove that all price series move to restore the long-run relationship, whereas commodity stock prices respond slightly faster than market prices in the short-run. **Conclusions** from this study show that understanding the price transmission flow and its impact on pricing might help in making better trading strategies. It also regulates the public policy implications of the active participation of farmers in national-level commodity exchanges.

Keywords: price transmission; market integration; threshold cointegration; pricing

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INTRODUCTION

Agricultural trade has been one of the most important aspects of the economies of developing countries for years. It is associated with exports and imports and how domestic prices are integrated with world markets. Many recent studies show that developing countries have relaxed their policies after the 2007–2008 food crisis; they can keep the markets integrated with world agri-commodity prices[1–3]. Researchers have used the Law of One Price (LOP) concept to examine the market linkages in the existence of arbitrage, transport, and other transaction costs. This article has studied the price integration of Indianagri-commodities, considering four commodities: maize, wheat, barley and soybean. It is to establish market integration models between commodity stock prices (NCDEX[1] data) and market prices (eNAM[2]/Agmarknet prices). This article contributes to and extends the limited literature specific to market integration and price transmission for agri-commodities in the Indian context. We considered fouragri-commodities: (i) maize — India is ranked 4th in maize cropland area and 7th in production among maize-producing countries. India's maize production is more than 27.8 million MT during FY 2018–2019[3]; (ii) wheat — India is the second-largest wheat producer with more than 103.6 million MT in FY 2018–2019[4]; (iii) barley — is another critical crop primarily used as feed grains and consumed commercially for animal feed, beer production, seed and human food applications; and (iv) soybean — which is the world'slargest produced seed legume and contributes more than 26% of the world's edible oil and about 65% of the global protein concentrate for farm animals' feeding. Soybean's share is more than 41% of the total seedoils and more than 25% of the edible oils [4]. The market price and commodity stock price trends are shown in the *Appendix, Fig. A1 to Fig. A4* for these four commodities.

REVIEW OF LITERATURE

Market integration has been studied using various models and statistical approaches and has a growing literature available. It gained more attention after the 2008 food crisis [1, 2, 5–9]. It occurs when prices of

[1] NCDEX — National Commodity & Derivatives Exchange Limited is an Indian online commodity and derivative exchange based in India. URL: https://www.ncdex.com/ (accessed on 21.05.2022).

[2] Department of Agriculture G of I. e-NAM Overview. URL: https://www.enam.gov.in/web/ (2022) (accessed on 21.05.2022).

[3] ICAR. India Maize Scenario. URL: https://iimr.icar.gov.in/india-maze-scenario/ (2020) (accessed on 02.11.2021).

[4] IBEF. Wheat production may cross 113 million tonnes: Skymet. URL: https://www.ibef.org/news/wheat-production-may-cross-113-million-tonnes-skymet (accessed on 02.11.2021).

goods follow the same pattern in two spatially separated areas over a period of time [10]. It is believed that if markets are more integrated, they will yield lower price volatility [5]. Generally, market integration refers to the degree but not a specific relationship [9]. Market integration usually requires the existence of price transmission among the markets, which may be in the form of cointegrated prices.

As many researchers have studied market integration and price transmission, some studies confirm the existence of integration [1, 11, 12] but few, in contrast, conclude weak or partial integration (*Table 1*) [13]. Beginning with Fackler, who presented the three market integration measures with a more specific economic interpretation [14]. They have examined how spatial equilibrium behaves when an access demand shock from one market affects another. Ahmedhas proposed a new VAR-BEKK-GARCH model based on the Chinese stock market, international Oil market, and commodities study [3]. They found a one-directional relationship between stock prices and oil prices relative to commodity prices. They also established a shock spillover between oil and stock prices. Arnade has used an ECM model to study long- and short-run price transmission [8]. They also examine the impact of Chinese commodity markets on world commodity prices. They concluded that short-run price transmission is lower than long-run transmission, and the impact of price transmission highly depends upon the commodity. Mensi has examined the transmission between commodity prices and stock prices using a VAR-GARCH model [6]. They have concluded the existence of transmission for return and spillover. Rapsomanikis had extensively discussed market integration and price transmission among agri-commodities in several developing countries, including India [11]. They found that equilibrium exists for commodities like wheat, maize, and milk in the long run but not for meat. Also, domestic transmission among retail and wholesale prices was found to besignificant. Esposti has investigated the price transmission if the market is uncertain for Italy and world prices [15]. They have used the VECM framework and found that the impact of a price bubble is minimal on the price spread and can be controlled by trade policies. Rezitis has used a non-linear ARDL model to investigate vertical price transmission for the Finland dairy market [16]. The researcher established thata positive — long-run price asymmetry is present.Martin-Moreno has used TAR-ECM and Markov-switching approaches to study European oil prices and found short-term and long-term equilibrium [17]. Bonatoinvestigates price correlations and spillovers with the GARCH model for commodities and oil [1]. Svanidze examined the market integration for wheat among several markets using linear and threshold error correction models, which suggest that trade and transaction costs broadly impact the prices [12]. Boffa studied the market integration among wholesale and domestic markets and examined the vertical integration from wholesale to retail prices [13]. Interestingly, they found a perfect vertical integration for wheat only but not forother commodities. They also studied the impact of GST and additional costs on market integration.

Qinexamined the oil, commodity and financial prices using a threshold error-correction model for the US markets [18]. The researchers have found a short-term non-linear asymmetric price transmission pattern, whereas long-term equilibrium does not show asymmetry. Gannevalused Threshold Vector Error Correction Models (TVECM) to study market cointegration and price volatility [10]. Garcia-Germán also used error correction models (ECM) to study the impact of international prices on the agri-commodities of European markets and observed a long-run relationship but lower price transmission elasticity [19]. Ceballosextensive work examined the price transmission and volatility of agri-commodities for 41 food products in 27 countries [5]. Primarily observed a lead-lag relationship among the market prices and price volatility for maize, rice and wheat. Abdulaialso observed a long-run price equilibrium among the significant maize markets in Ghana and concluded that markets are well integrated [20]. Elleby used the two-fold regression method based on estimated price transmission elasticities and domestic food price changes [2]. They concluded that middle-income countries broadly impact international food prices. Greb'sextensive work and conclusions are based on the VECM model using log and short-term price transmission coefficients [7]. Drabikhas studied the US maize price integration with emery market prices and observed an imperfect price transmission [21]. Lence used Brand — TVECM to conclude that transfer cost is underestimated and speed of price transmission is also biased [22]. Hatzenbuehler has studied the prices of seven agri-commodities in Nigerian food markets concerning world and neighboring countries [23]. The price transmission was observed to be high for rice and coarse grains. Hassounehexamined the wheat prices

using threshold vector error correction and multivariate generalized autoregressive conditional heteroscedasticity models and found that price adjustments are in sync with retailers' marketing margins [24]. Also, there is a long-run equilibrium for Slovenian wheat market prices. Distefano examined the rise of arbitrariness in the price formation mechanism [25].

RESEARCH GAP

Market integration is a well-discussed topic and has a growing literature but most of the work has been done either considering spot — future prices or domestic — international prices. Here, we have observed a gap in which market integration and price transmission are not explored mainly from the same commodity-multiple market perspective. We have taken this opportunity to study the integration of prices among multiple commodities and multiple markets.Our study has incorporated two major markets — commodity (stock) market prices and market prices (eNAM) for fourcommodities — maize, wheat, barley, and soybean. Our approach is more holistic and has included all established models of access price transmission. We tried to find out the answers to the questions below:

1. Do market integration and price transmission exist between India's domestic agri-commodity markets?
2. If price transmission exists, then what are the transmission mechanisms?

Threshold cointegration is employed to answer two research questions: are the pairs of price series tied together by a long-run relationship, and which of the series moves to restore the long-run relationship? The findings of this study can be used to understand the price transmissionflow and its impact on pricing to make relative trading strategies; if a commodity is being traded-in multiple markets. The farmers are trading directly at eNAM, and how far they get fair prices in the context of other markets'pricesis a great concern for policy implications.[5] It also regulates the public policy implications oftheactive participation of farmers in national-level commodity exchanges.

[5] Department of Agriculture G of I. e-NAM Overview. URL: https://www.enam.gov.in/web/ (2022) (accessed on 21.05.2022).

METHODOLOGY

In general, there are three types of price transmission; (i) spatial transmission: prices cointegrated between two spatially separated markets for the same commodity; (ii) vertical transmission: cointegrated prices between two points or stages of the value chain e.g.— the price of wheat and price of floor and (iii) cross-commodity: cointegrated prices between two commodities; primarily, they may have substitution effects. Fackler has defined market integration as a measure of the degree to which demand and supply shocks ascending in one market are transmitted to another market [9]. Market integrationis mainly measured by the "price ratio" (R_{XY}) associated with a market shock.

$$R_{XY} = \frac{\partial P_Y / \partial \varepsilon_X}{\partial P_X / \partial \varepsilon_X}, \quad (1)$$

where P_X and P_Y refer to the prices in the markets X and Y respectively, ε_X represents a hypothetical shock in market X and ∂ is for the first-order derivative of the respective price to the market shock. Rapsomanikishas suggested three components to understand the price transmission (i) Co-movement and completeness of adjustments (ii) dynamics and speed of adjustments and (iii) asymmetry of response may be upward or downward [11]. The first completeness of price transmission is in sync with the Law of One Price (LoP). In contrast, the second primarily depends upon policies and market power (short-run impact), several marketing stages, contracts between agents, and transfer costs. As per [11], if P_{1t} and P_{2t} are the prices in spatially separated markets that are integrated in the same order and have stochastic trends, then

$$P_{1t} - \beta P_{2t} = \mu_t. \quad (2)$$

The above equation is called cointegration regression, where · is a cointegration vector, and M is stationary. In other words, the long-run relationship is also termed the cointegrating regression.

As a first step, we have to consider the time-series properties of price data. For that, we have used stationarity and cointegration methods. As per the literature, most of the articles started with an assessment of stationarity in individual price series. We have used the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root

Table 1

Summaries of the Studies on Price Transmission

Study Reference	Methods	Period	Commodity type	Summary
Spillover network of commodity uncertainties [26]	VAR, DY 2014	2007–2016	Energy, precious and industrial metals, and agricultural	Connectedness tends to increase during the period of crisis and the global economic situation influences the connectedness of commodity uncertainty indexes
Vertical price transmission in wheat and flour markets in Bangladesh [27]	Threshold cointegration	2008–2016	Wheat, flour	Evidence of threshold effects hasa significant impact on the speed of adjustment toward the long-run & short-run
Spatial Price Dynamics and Asymmetric Price Transmission [28]	Threshold cointegration	2010–2016	Skim milk powder	New Zealand's export prices arethe market leader as compared with China, and Ireland's export prices are well more aligned with those in international markets
Impacts of COVID-19 and price transmission in US meat markets [29]	Threshold cointegration	2010–2020	Meat	All meat markets are well integrated and unexpected & large price movements are visible during Covid-19
Investigating the Impact of Trade Disruptions on Price Transmission [30]	Threshold cointegration	2014–2019	Commodity markets	Trade disruptions between Canada and China impacted global price transmission and resulted in market fragmentation
Asymmetric price transmission in a changing food supply chain [31]	ECM, threshold cointegration	2008–2018	Salmon	Price transmission relationship exists between the markets for fresh salmon; but not for smoked salmon
Food security and the functioning of wheat markets in Eurasia [12]	TECM	2006–2009	Wheat	A stronginfluence oftrade costs on market integration in Central Asia
Threshold cointegration and spatial price transmission when expectations matter [22]	TVECM, threshold cointegration	2018	Agri commodity	Transfer costs are systematically underestimated and the speed of price transmission is biased in three regime models
Global relationships across crude oil benchmarks [32]	Threshold cointegration	2002–2014	Crude oil	All price series move to restore the long-run relationship is at least one regime
How integrated is the Indian wheat market? [33]	Momentum-threshold autoregressive (M-TAR) model	1984–2003	Agri commodity	Asymmetric adjustments of wheat prices indicate that price signals within states are transmitted in an asymmetric manner
Cointegration and threshold adjustment [34]	Threshold cointegration	1964–1998	Interest rates	Equilibrium exists between short and long-term interest rates but the adjustments from disequilibrium are asymmetric
Spatial price transmission and asymmetry in the Ghanaian maize market [20]	TVECM, threshold cointegration	1980–1997	Maize (Agri commodity)	All major maize markets in Ghana are well integrated

Source: Compiled by the authors.

Notes: VAR: vector autoregressive; DY 2014: Diebold and Yılmaz (2014) model; ECM: Error Correction Model; TECM: Threshold Error Correction Model; TVECM: Threshold Vector Error Correction model; M-TAR: Momentum Threshold autoregressive.

tests to check the stationarity of data, and both tests have been conducted with two models: (a) with intercept and (b) with intercept and trend. Both the tests have been executed at the level, and the first difference and Akaike information criterion (AIC) have been used for optimal lag selection. If the series is not integrated in the same order, then, by definition, they are not cointegrated. After that, we employed thecointegration tests. Engle and Granger (1987) introduced the concept of cointegration, which occurswhen two or more variables are nonstationary but their linear relationship is stationary. Cointegration infers that the price variables move together in the long run but may diverge in the short-run [29]. We can present the standard cointegration relationship as equation (3) below; which shows two nonstationary variables that are linked by a long-run, stable relationship

$$y_t = \alpha + \beta x_t + v_t, \quad (3)$$

where y_t and x_t represents prices at different levels at the time t and error correction term as $v_t = \varphi v_{t-1}$. The behaviour of v_t decides whether the variables are cointegrated. Following the Engle and Granger (1987) cointegration testing procedure we have tested residuals for stationarity (*Appendix, Table A1*). We also used the Johansen cointegration test to check the cointegration between two or more time series. It has the advantage over the Engle-Granger and the Phillips-Ouliaris methods, which can estimate more than one cointegration relationship, if the data set containstwo or more time series. If there is a time series with order p, then

$$Y_t = \prod\nolimits_1 Y_{t-1} + \prod\nolimits_2 Y_{t-2} + \ldots + \prod\nolimits_p Y_{t-p} + u_t, \quad (4)$$

where Y_t is an $n \times 1$ vector of time series that are integrated of order one, that is, I(1), u_t is an $n \times 1$ series of innovations while $\prod_1$ to $\prod_p$ are $m \times m$ coefficient matrices, which is called the impact matrix and determines the extent to which the system is cointegrated.

Two likelihood ratio tests are used to determine the number of cointegrating vectors — (i) Trace test and (ii) Maximum Eigenvalue.

Once stationarity and cointegration tests are complete with confirmation of cointegration, we estimate whether the price transmission and correction of short-run disequilibria are characterized by non-linear, asymmetric behaviour. To test the non-linearity, we can apply the residuals of equation 3 to test whether the threshold cointegration exits. If the tests fail to reject linearity, we can model the residuals using an autoregressive (AR) method and model the cointegrated system as a VEC model. In the third step, we implement three tests to check the linear behaviour (linearity). These are (i) Terasvirta test — which relies on Taylor series expansion of the neural network. (ii) White test — which is also based on the theory of neural networks. (iii) Tsay test — which is Turkey'snon-additivity type test.

Non-linear behaviour in error correction terms suggests that they do not follow a linear Autoregressive process. In particular cases, it can be more appropriately characterized by a self-exciting threshold auto-regression (SETAR) model [29]. The SETAR approach allows for asymmetric adjustment to shocks with the error correction term now following

$$v_t = \begin{cases} \varphi_L v_{t-1} + \varepsilon_t : v_{t-1} < T \\ \varphi_H v_{t-1} + \varepsilon_t : v_{t-1} \geq T \end{cases}, \quad (5)$$

where Threshold value of the two-regime case with regimes L and H. Asymmetric adjustment occurs when φ_L is not equal to φ_H. If the VEC model can be given by

$$\begin{bmatrix} \Delta y_t \\ \Delta x_t \end{bmatrix} = \begin{bmatrix} \tau_1 \\ \tau_2 \end{bmatrix} + \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} v_{t-1} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} \Delta y_{t-1} \\ \Delta x_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^x \end{bmatrix}. \quad (6)$$

This representation can also be extended to the threshold vector error correction model (TVECM) such as

$$\begin{bmatrix} \Delta y_t \\ \Delta x_t \end{bmatrix} = \begin{bmatrix} \tau_1 \\ \tau_2 \end{bmatrix} + \begin{bmatrix} \alpha_1^L \\ \alpha_2^L \end{bmatrix} v_{t-1}^L + \begin{bmatrix} \alpha_1^H \\ \alpha_2^H \end{bmatrix} v_{t-1}^H + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} \Delta y_{t-1} \\ \Delta x_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^x \end{bmatrix}, \quad (7)$$

where L and H are two regimes and v^L and v^H denote the error correction terms for both regimes respectively. Threshold behaviour in cointegration can thus be described by either a SETAR model of the residuals from the cointegrating regression or a TVECM (*Appendix, Table A2*). There could be four possible scenarios; (i) Cointegration and threshold effects — threshold cointegration case, (ii) Cointegration and no threshold effects — linear cointegration case, (iii) No cointegration and no threshold effects — no cointegration case, and (iv) Threshold effects and no cointegration.

We have used both AR and SETAR models and VEC and TVEC models to understand the dynamics of price adjustment. We applied standard and generalized impulse response functions to examine pricebehaviour. Impulse responses depend on the timing, size, and direction of the shocks [29]. The generalized impulse is given by

$$GIF\left(y_{t+1}\right)=E\left(y_{t+k}\mid y_t+v,\ldots,y_{t-j}\right)-E\left(y_{t+k}\mid y_t,\ldots,y_{t-j}\right). \quad (8)$$

We have used regime-specific impulse responses, which use parameters from each regime for the threshold models. Please referto Hansen[35] for a further methodological explanation.

DATA

We have used monthly prices for the period of 2005 to 2019, and lastly, the criteria for selecting the commodity are:

1. Commodities should be listed in more than one market. We have taken four commodities — maize, wheat, barley, and soybean- listed in both NCDEX and thepan-India electronic trading portal (eNAM) and have IMF price data.
2. Volume or quantity of trade in the last five years for that commodity.
3. A foodgrain is being selected considering its importance in the food basket.
4. We have not considered the storable or non-storable categories of commodities.
5. Also, we are not categorizing based on "seasonal" and "non-seasonal"commodities.

The first data source forthe price series is NCDEXCommodity Index data — commodity market data from NCDEXfor 2005 to 2019. We will refer to this data as "Commodity StockPrice". Thesecond price series is Agmarknetdata — wholesale market data for the pan-India electronic trading portal (eNAM)or Agmarknetand we will refer to this data as "Market Price".

RESULTS AND DISCUSSION

Before westart establishing the model for fourcommodities — maize, wheat, barley, and soybean, we have observed that, in general, market prices are higher than commodity stock prices; however, there are cases where this relationship is inverted. Such cases are approximately 12.6% for barley, 32.3% for maize & wheat, and only 8% for soybean.

As the first step, we tested all the time series for stationarity using the Augmented Dickey-Fuller (ADF) Unit root (stationary) test. Along with the Phillips Perron test to check the unit root, the results are listed in *Table A3* of the Appendix. Results show that price series are not stationary at level but become stationary if we take the first difference. All econometric tests and estimations are conducted using the log prices of the commodities.

Once the stationarity is confirmed, we execute the Johansen cointegration testto understand the long-term association between the markets by examining the co-movement of price signals. The null hypothesis is that there areno cointegrating equations ($r = 0$) and at most one cointegrating equation ($r < 1$). Referring to *Table 2* the null hypothesis of no cointegration was rejected at a 5% significance level that shows the existence of cointegration between market prices and commodity stock prices. Additionally, we also used the Phillips-Ouliaris Cointegration Test and the results are presented in *Table A4* in the appendix. Both tests confirm that all the price series are cointegrated and hence VEC models are appropriate for modelling these price series.

Once the cointegration behaviour is confirmed for all the price series, we need to test the non-linear behaviour in the error correction term. Tests of the residuals from the cointegrating regressions are presented in *Table A5* of the Appendix. The results confirm that linearity can't be rejected at 5% significance level for soybean and wheat. At the same time, the barley and maize series are found non-linear by all three tests. Non-linearity conditions have implications for the models considered below, namely differences in transmission and adjustment across the different regimes indicated by thresholds [29]. Next, it's necessary to test for the number of thresholds for barley and maize price series. *Table A6* of the Appendix shows the results of SETAR model of the cointegration equation residuals. In the SETAR model, we have three null hypotheses: (i) no threshold vs. one threshold, (ii) no threshold vs. two thresholds, and (iii) one threshold vs. two thresholds. The results suggest one threshold for both barley and maize. Based on the linearity, we have anAR model for soybeans and wheat and the SETAR model for barley and maize. The estimated parameters are given in *Table 3*. We are interested in the autoregressive parameters, as the larger the autoregressive parameters, the slower will be the adjustment to shocks in the price equilibrium. All the autoregressive parameters

Table 2

Johansen's Cointegration Test Results

	Number of Cointegrating Vectors			
	None		At most one	
	Max. Eigenvalue	Trace	Max. Eigenvalue	Trace
Barley	22.342*	23.338*	0.996	0.996
Maize	32.800*	36.151*	3.351	3.351
Soybean	65.275*	66.436*	1.161	1.161
Wheat	51.829*	53.612*	1.783	1.783

Source: Author's analysis.

Note: Trace test indicates 1 cointegratingeqn(s) at the 0.05 level.Max-eigenvalue test indicates 1 cointegratingeqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

Table 3

AR and SETAR Estimates

		Intercept		AR1		AR2	
		Estimate	Std Error	Estimate	Std Error	Estimate	Std Error
Barley MP – CSP	Low regime	–0.004	0.001	0.552	0.019	0.363	0.020
	High regime	0.002	0.001	0.578	0.027	0.368	0.029
Maize MP – CSP	Low regime	0.001	0.001	0.527	0.018	0.401	0.019
	High regime	0.015	0.004	0.699	0.033	–0.017	0.051
Soybean	MP – CSP	0.007	0.000	0.640	0.018	0.295	0.018
Wheat	MP – CSP	0.004	0.000	0.627	0.017	0.354	0.018

Source: Author's analysis.

Note: MP: market price, CSP: commodity stock price.

are statistically significant, which means the time-related and sequential relationships among the prices. For barley and maize, the regimes are distinguished by the speed of adjustment over the two periods. For barley, the AR(1) term is very close to the high regime in the low regime and almost similar for AR(2). This means the speed of adjustment is the same for both regimes. Likewise, if we consider maize, the high regime parameter is higher than the low regime, but it is reversed in AR(2), which concludes the quicker adjustments in the low regime. Referring to *Table A6* — of the Appendix, the coefficient of error correction term is larger and more significant for the market prices.

Orthogonalized impulse response functions are shown in *Fig.* Shocks to commodity stock prices are quick for barley, maize and soybean in the short-run. For wheat commodity stock prices, shocks are not visible until the first two periods but, after that, move to negative and show an asymmetric relationship in the long run. Barley and wheat market prices, trigger movements in the short-run and responses to shocks are mostly faster than responses in maize and soybean. The impulses indicate that both market and commodity stock prices respond in the short-run andlong-run, whereas commodity stock prices respond slightly faster than market prices. To conclude, impulse responses indicate all the price series are well-integrated. The findings can be helpful for investors as well as policymakers. Since both markets are integrated, the shocks can be more prolonged during the crisis, which can be considered while preparing the policies.

CONCLUSION

We investigated the price dynamics of agri-commodity prices between stock and market prices for India. We have considered four agricultural commodities — maize, wheat, barley and soybean. We used linear and threshold autoregressive (AR) models and vector error correction (VEC) modelsfor long- and short-term relationships. Prima-facie, all four commodity stock prices are cointegrated with market prices. Results reveal that all the price series are well integrated, and threshold error correction models prove that all price series move to restore the short- and long-run relationship, whereas

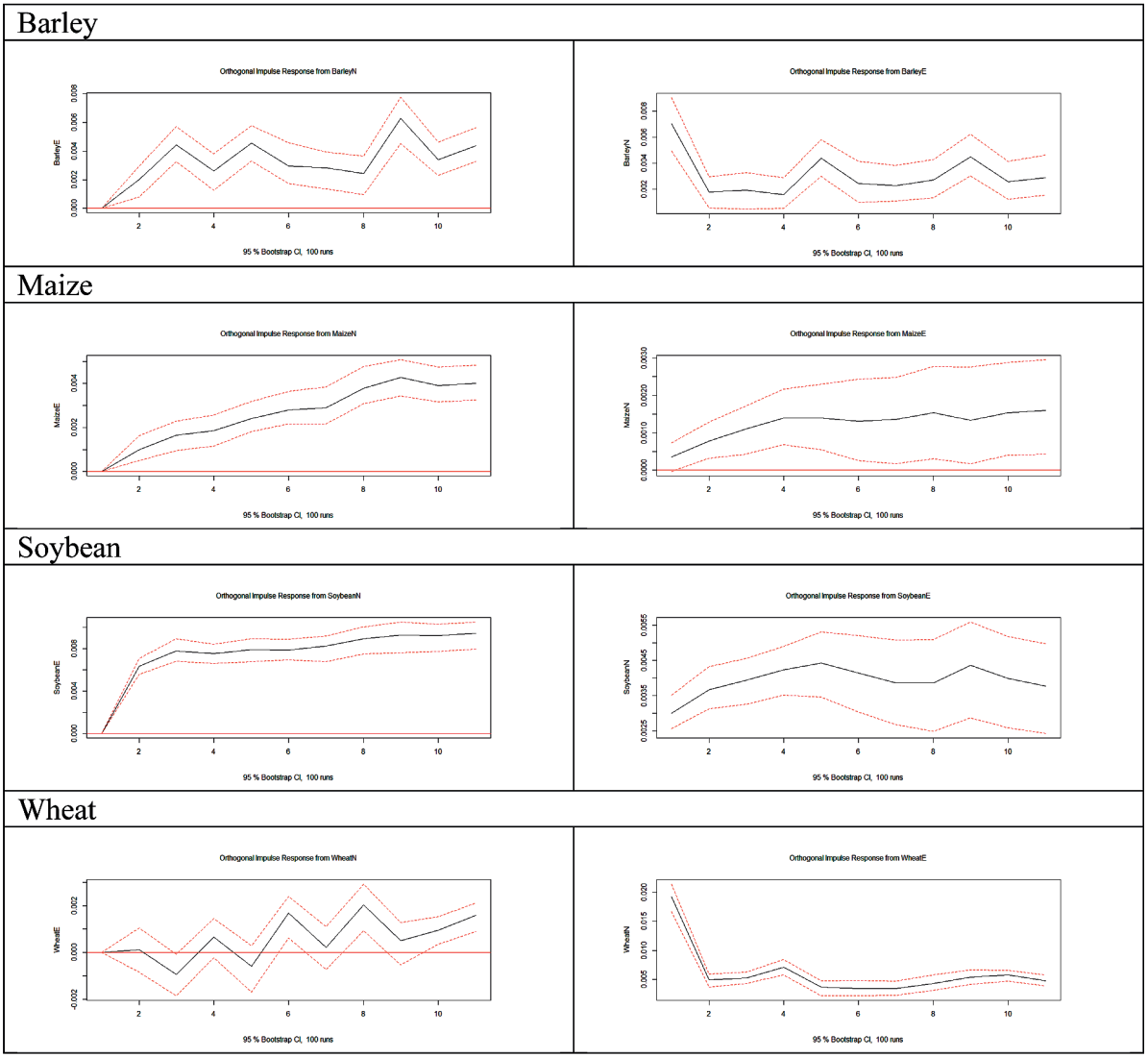

Fig. **Impulse Response**

Source: Author's analysis.

Note: Commodity name with suffix "E": market price andsuffix"N": commodity stock price.

commodity stock prices respond slightly faster than market prices in the short-run. The findings of this study can be used to understand the price transmission flow and its impact on pricing to make relative trading strategies if a commodity is being traded-in multiple markets. The farmers are trading directly at eNAM and how far they get fair prices in the context of other markets' prices is a great concern for policy implications. It also regulates the public policy implications of the active participation of farmers in national-level commodity exchanges.

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ABOUT THE AUTHORS

Arunendra Mishra — Research Scholar, Department of Food Business Management and Entrepreneurship, National Institute of Food Technology Entrepreneurship and Management, Sonipat (Delhi NCR), India
https://orcid.org/0000-0002-6070-1373
Corresponding author:
arunendra.niftem@gmail.com

Prasanth R. Kumar — PhD in Strategic Finance, Assist. Prof., Department of Food Business Management and Entrepreneurship, National Institute of Food Technology Entrepreneurship and Management, Sonipat (DelhiNCR), India
https://orcid.org/0000-0001-5299-7701
prasanth@niftem.ac.in

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APPENDIX

Table A1

Granger Causality Tests Statistics for Selected Agricultural Commodities

	Null Hypothesis	F-Statistic	Prob.	Direction	Relationship
Barley	CSP does not Granger Cause MP	17.2323	7.00E-17	Bi-directional	MP ↔ CSP
	MP does not Granger Cause CSP	16.5151	4.00E-16	Bi-directional	
Maize	CSP does not Granger Cause MP	16.9235	1.00E-16	Bi-directional	MP ↔ CSP
	MP does not Granger Cause CSP	2.52123	0.0276	Bi-directional	
Soybean	CSP does not Granger Cause MP	102.032	9E-101	Bi-directional	MP ↔ CSP
	MP does not Granger Cause CSP	5.46742	5.00E-05	Bi-directional	
Wheat	CSP does not Granger Cause MP	9.83574	2.00E-09	Bi-directional	MP ↔ CSP
	MP does not Granger Cause CSP	10.0031	2.00E-09	Bi-directional	

Source: Author's analysis.

Note: MP: market price, CSP: commodity stock price.

Table A2

VECM Model

VECM Model	ECT	Intercept	Cointegrating vector
Barley: MP	−0.0272(0.0060)***	−0.0432(0.0097)***	1
Barley: CSP	0.0026(0.0036)	0.0046(0.0058)	−1.209868
Maize: MP	−0.0198(0.0036)***	−0.0089(0.0018)***	1
Maize: CSP	0.0040(0.0021).	0.0022(0.0010)*	−1.061873
Soybean: MP	−0.0602(0.0073)***	−0.0045(0.0007)***	1
Soybean: CSP	−0.0139(0.0043)**	−0.0008(0.0004)*	−1.001355
Wheat: MP	−0.0640(0.0099)***	0.0165(0.0025)***	1
Wheat: CSP	−0.0216(0.0105)*	0.0063(0.0026)*	−0.9640472

Source: Author's analysis.

Note: MP: market price, CSP: commodity stock price. ***, ** and * indicate the significance of t-statistics at 1%, 5% and 10% level of significance, respectively.

Table A3

Unit-Root Test Results

	ADF (first difference)		PP (first difference)	
Commodity	**Intercept**	**Intercept & trend**	**Intercept**	**Intercept & trend**
Barley MP	−2.060	−3.700**	−2.790	−14.283***
Barley CSP	−1.902	−4.267***	−1.783	−5.843***
Maize MP	−1.642	−44.215***	−2.124	−4.179***
Maize CSP	−1.466	−54.039***	−2.004	−54.962***
Soybean MP	−1.786	−44.262***	−2.094	−81.267***
Soybean CSP	−2.768	−55.693***	−1.991	−56.037***
Wheat MP	−0.997	−29.792***	−2.354	−39.818***
Wheat CSP	−0.668	−15.768***	−2.293	−19.674***
Critical values				
1% level	−3.960635			
5% level	−3.411076			
10% level	−3.127359			

Source: Author's analysis.

Note: MP: market price, CSP: commodity stock price. The table contains the t-statistics of the ADF & PP tests results, where *** and ** indicate the significance of t-statistics at 1% and 5% level of significance, respectively.

Table A4

Phillips-OuliarisCointegration Test for Selected Agricultural Commodities

	demeaned	p-value
Barley	−404.7***	0.01
Maize	−119***	0.01
Soybean	−631.35***	0.01
Wheat	−1037.2***	0.01

Source: Author's analysis.

Note: MP: market price, CSP: commodity stock price. *** indicate the significance of t-statistics at 1% level of significance.

Table A5

Linearity Tests of Price Differences

	Terasvirta		White		Tsay	
	Statistic	**P-Value**	**Statistic**	**P-Value**	**Statistic**	**P-Value**
Barley	1001***	2.2E-16	11.722***	0.002848	3.022***	2.03E-24
Maize	693.75***	2.20E-16	27.275***	1.20E-06	9.153***	2.29E-21
Soybean	1126.4***	2.20E-16	4.2145	0.1216	8.588***	2.10E-52
Wheat	1678.7***	2.20E-16	2.8488	0.2407	6.929***	1.88E-281

Source: Author's analysis.

Note: MP: market price, CSP: commodity stock price. *** indicate the significance of t-statistics at 1% level of significanc.

Table A6

SETAR Specification Tests

	1vs2: Linear AR vs 1 threshold TAR (setar(2))		1vs3: Linear AR vs 2 threshold2 TAR (setar(3))		2vs3: 1 threshold TAR vs 2 thresholds TAR	
Series	**Test**	**P Value**	**Test**	**P Value**	**Test**	**P Value**
BarleyE — BarleyN						
Low regime	31.3	0.02	70.6	0.81	29.3	0.51
High regime	28.3	0.03	67.6	0.92	24.7	0.67
MaizeE — MaizeN						
Low regime	69.5	0.05	142.6	0.76	63.9	0.70
High regime	77.5	0.02	150.6	0.81	71.5	0.42

Source: Author's analysis.

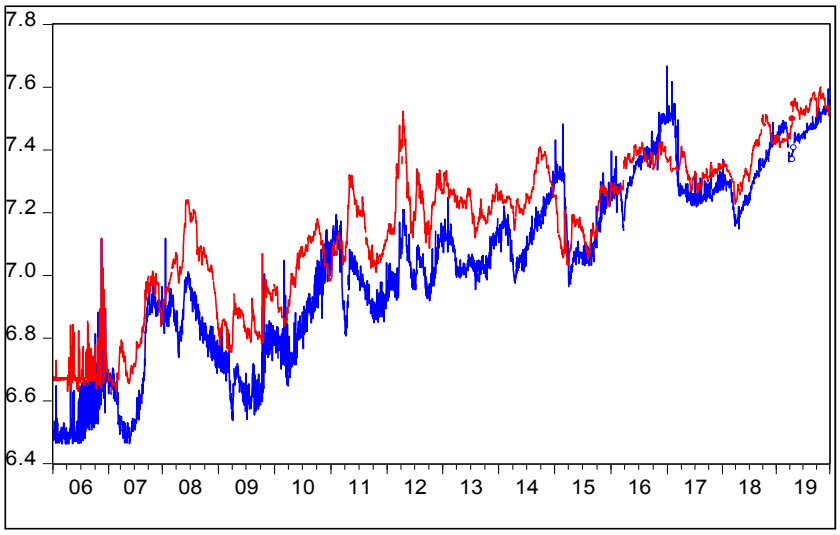

Fig. A1. **Barley Price Series**

Source: Author's analysis.

Note: Blue represent market price (MP) and red commodity stock price (CSP).

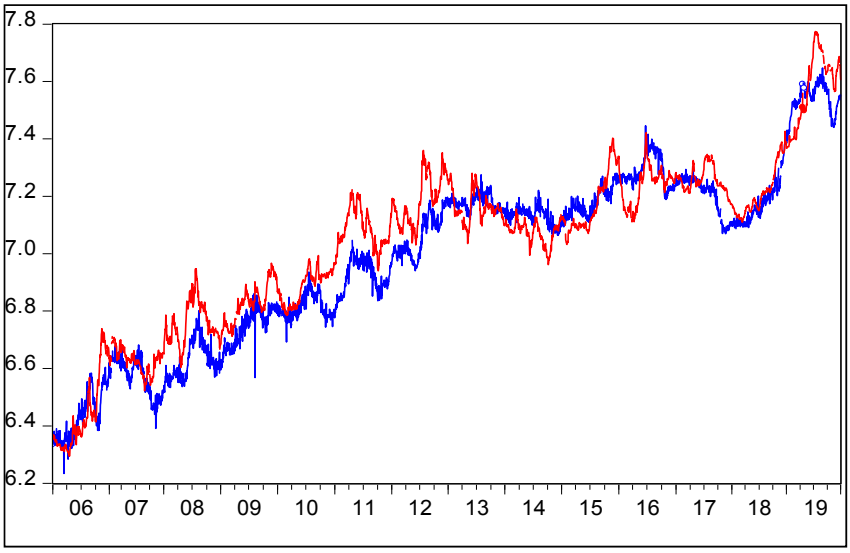

Fig. A2. **Maize Price Series**

Source: Author's analysis.

Note: Blue represent market price (MP) and red commodity stock price (CSP).

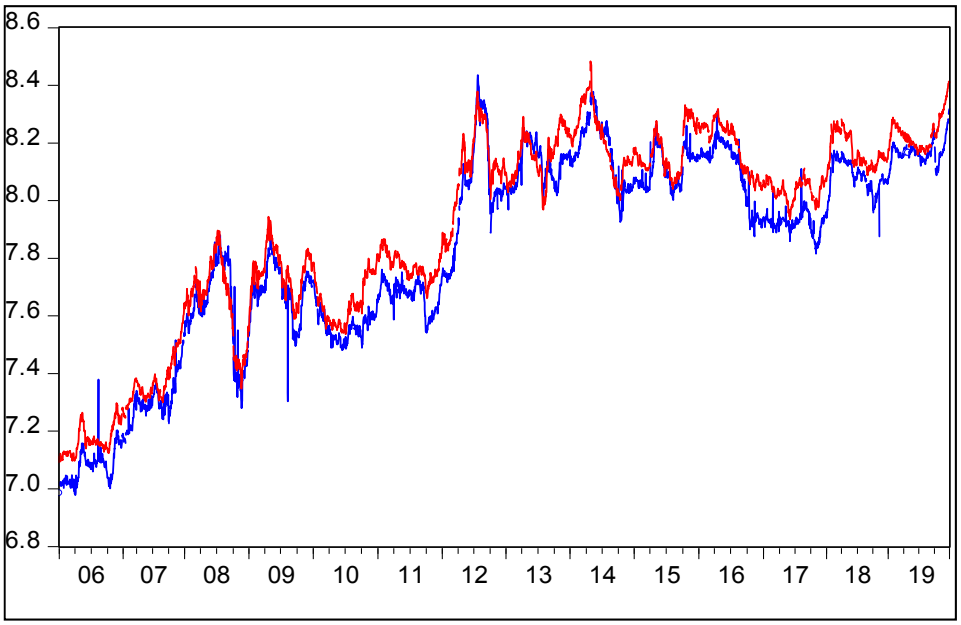

Fig. A3. **Soybean Price Series**

Source: Author's analysis.

Note: Blue represent market price (MP) and red commodity stock price (CSP).

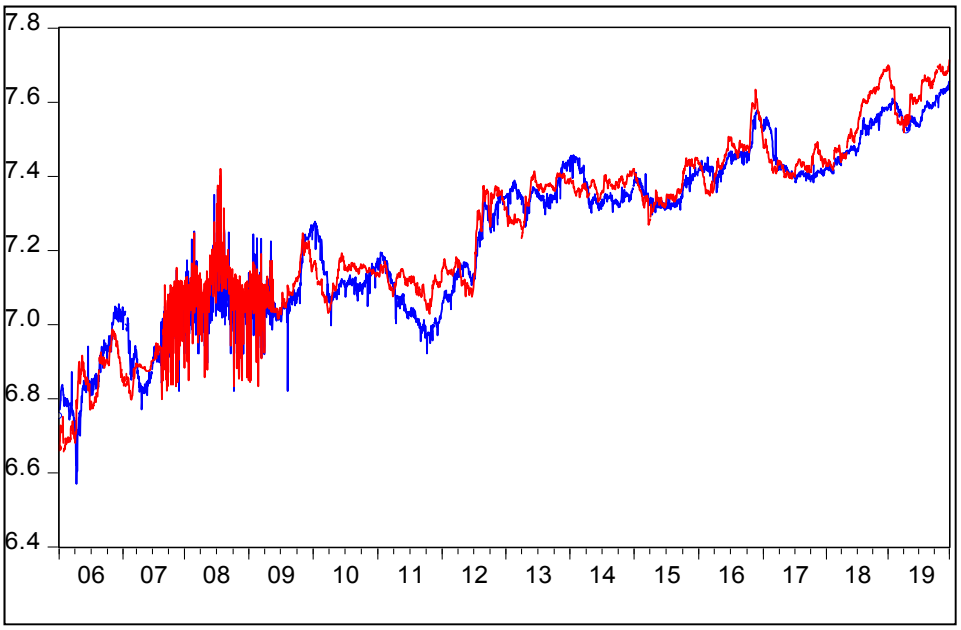

Fig. A4. **Wheat Price Series.**

Source: Author's analysis.

Note: Blue represent market price (MP) and red commodity stock price (CSP).

ORIGINAL PAPER

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Performance Audit: The Development Conditions in China

Yali Liu
Saint Petersburg State University, Saint Petersburg, Russia

ABSTRACT

At the present time, performance audit has become a major work responsibility of auditing institutions in the world. In China, as the reform of national governance and financial modernization progresses, performance audit has received increasing attention, but it has still not been truly implemented. **The purpose** of this paper is to identify that influence the development of performance auditing in China. The **relevance** of the problem is evidenced by the growth of research in the field of public audit and performance audit in recent years. The author reviewed recent publications on this topic by Russian and Chinese authors. In the paper apply the research **method** to analyses keywords in the State Council Audit Report of China 2011–2021. A wide range of methods of information analysis is used. The **results** of the research lead to the following conclusions: the basic orientation of China's performance audit is to supervise and serve the country's governance; the audit field is inclined to the environment, resources, people's livelihood, etc.; the audit content transitions from fund management and use to policy implementation and project management; audit evaluation standards increase equity and environmental friendliness on the basis of "3E" (economy, efficiency, effectiveness); audit methods highlight modern tools such as big data auditing. The attention and promotion of performance audit by the legislative authority is an essential requirement for its growth in China.

Keywords: performance audit; influencing factors; keyword research method; audit content; audit method; performance audit orientation; basic condition

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INTRODUCTION

With the development of market economy, performance auditing has become an inevitable trend to promote economic and political development and an important symbol to measure the modernization of government auditing. As a result, how is the growth of performance auditing in China, and what causes to hinder the development of performance auditing, these issues must be addressed in performance auditing practice. Since the establishment of the Audit Office of the People's Republic of China in 1983, China has been exploring the path of performance auditing and has achieved remarkable results. However, there are still some shortcomings in the formulation of performance auditing standards, the determination of performance auditing content and development mode, the design of performance auditing evaluation indicators, and the function of performance auditing [1, 2]. Therefore, the purpose of this article is to analyze the theoretical development of performance auditing in China in recent years, explore the basic conditions and ideas for the development of performance auditing in China, and search for a reasonable path to promote the development of performance auditing in China.

By using the keyword research method, the author captures the characteristics of the development of performance auditing in China at different levels in the past 10 years, dissects the focus and commonalities of performance auditing, explores the basic conditions for the development of performance auditing, and puts forward the hypotheses of this article.

LITERATURE REVIEW

Research Status of Performance Auditing in Foreign Countries

The construction of performance auditing standards and guidelines has brought together the best of performance auditing theory and practice research. Following the introduction of the performance audit practice at the Sydney conference and the definition of performance auditing from the perspective of the 3Es, the International Organization of Supreme Audit

Institutions (INTOSAI) formulated the performance audit guidelines.[1] INTOSAI revised the original performance audit guidelines in 2016, and the current guideline system consists of 300 Basic Principles of Performance Auditing, 3000 Performance Audit Guidelines, 3100 Performance Audit Core Concepts Guidelines, and 3200 Performance Audit Procedures Guidelines, with the main change being the breakdown of the original performance audit guidelines (3100) into 3100 and 3200.[2] The U.S. Government Accounting Office (GAO) issued newly revised Government Auditing Standards in 2018, which included significant revisions to performance auditing standards.[3] In addition, countries such as the United Kingdom, Australia, and Denmark have developed or revised performance audit guideline manuals. In conclusion, there is a large foreign research literature on performance auditing in a general sense.

With regard to the essential aspect of performance auditing, it is generally accepted that performance auditing is a special kind of assessment act that evaluates performance and performance information [3]. With regard to the objectives of performance auditing, the two main positions include the performance accountability view and the performance improvement view [4]. In the aspect of audit content, Barati and other scholars' views are more representative, and they think that performance audits include efficiency audits, timeliness audits, quality audits, and project result audits [5, 6]. Some scholars have also divided performance auditing into economic, efficiency and effectiveness auditing from the perspective of "3E" [7]. Other scholars have added environmental and equity audits, forming the "5E" (economy, efficiency, effectiveness, equity, and environment), which are supported by many countries such as Canada, the UK, and Australia [8]. With regard to the performance audit methods, more methods of social science research have been used, such as case studies, content analysis, interviews, data analysis, and bench-marking, and factors that influence the choice of performance audit methods include: audit team, audit project, organization, and external environment [9, 10].

Research Status of Performance Auditing in China

Based on the data source of the China National Knowledge Infrastructure (CNKI) journal database, the author selected "Performance Audit" as the title, "Unlimited" to "2021" as the year, "Core Journals" and "CSSCI" as the source category, conducted an advanced search to screen out seminar reports, seminar reviews, and other news articles, and obtained 1261 valid high-quality publications of articles on performance auditing, as shown in *Fig. 1*.

As can be seen from *Fig. 1*, the research results on "performance audit" in China were mainly concentrated between 2004 and 2012; the number of publications was relatively stable in the first period, rising and then falling after 2004, reaching a peak in 2010, and then decreasing year by year. With regard to the objectives of performance auditing, Chen Siwei thinks that the immediate objective of performance auditing is economy, efficiency, effectiveness, and the ultimate objective is to check public fiduciary responsibility [11]. Ni Weizhou considers that performance audit objectives include general objectives, which are "3Es", and specific objectives, which relate to specific audit projects [12]. In the aspect of audit content, most of the literature discusses the content of performance auditing for a special fund, such as science and technology funds, poverty alleviation funds, social security funds, etc., and the content of performance auditing generally considers fund raising, use, management (including internal control), project

[1] The XXII INTOSAI in Abu Dhabi (2016), guided by the principles of promoting SAI independence, good governance and knowledge-sharing, endorsed an amendment of the Statutes to align them to the Lima, Mexico and Beijing Declarations as well as the Strategic Plan 2017–2022.

[2] ISSAI 300 defines and expresses INTOSAI's recognition of the principles for the auditing of economy, efficiency and effectiveness. It constitutes the basis for performance audit standards in accordance to the ISSAIs. With ethical significance in 2001Content reformulated and endorsed as Fundamental Principles of Financial Performance Auditing in 2013. With the establishment of the INTOSAI Framework of Professional Pronouncements (IFPP), renamed as Performance Audit Principles with editorial changes in 2019. URL: https://www.issai.org/pronouncements/issai-300-performance-audit-principles/ (accessed on 06. 06.2022); ISSAI — 3000 — Performance Audit Standard reflects the experience of SAIs with a long tradition and well-established standards of performance auditing. It is aimed mainly at those SAIs that are carrying out or are planning to carry out this type of auditing. Endorsed as Standards and guidelines for performance auditing based on INTOSAI´s Auditing Standards and practical experience in 2001. Endorsed as Standard for Performance Auditing in 2016. With the establishment of the INTOSAI Framework of Professional Pronouncements (IFPP), renamed to Performance Audit Standard with editorial changes in 2019. URL: https://www.issai.org/pronouncements/issai-3000-performance-audit-standard/ (accessed on 06. 06.2022).

[3] Government Auditing Standards: 2018 Revision Technical Update April 2021. URL: https://www.gao.gov/products/gao-21–368g (accessed on 06. 06.2022).

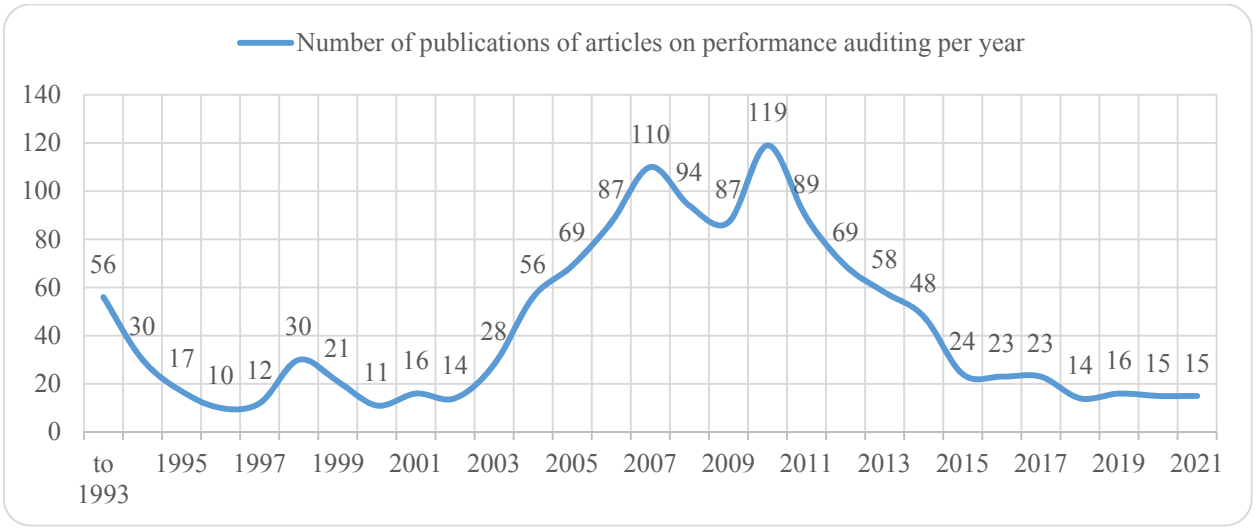

Fig. 1. **Statistics of Publications of Articles on Performance Auditing**

Source: Compiled by the author based on statistical output.

expenditure, and fund effectiveness [13–17]. Regarding performance auditing methods, Zhao Baoqing and Li Wenjuan analyze and study the evaluation method with public satisfaction as the evaluation standard, and use hierarchical analysis and fuzzy comprehensive evaluation method to determine the public satisfaction of government performance [18]. Other scholars have researched the application of a particular characteristic performance auditing method, such as the efficacy coefficient method, trend analysis method, forward-looking comprehensive evaluation method, value chain analysis method and survey questionnaire method [19, 20].

Review of the Literature

Scholars at domestic and international levels have conducted extensive and in-depth researches in performance auditing, and a large number of research results have been obtained, which have laid an abundant research and literature foundation for this article. However, the above-mentioned researches also have certain limitations. On the one hand, the existing performance audit-related studies are characterized by superficiality, a single research method, repetitive research content, and fragmented research objects, and there are many studies on foreign performance auditing secondary data, but fewer studies on primary data and latest progress. On the other hand, the existing literature lacks systematic research on performance auditing theory, which is not strong guidance for performance auditing practice. By combing and summarizing the current literature, it can be seen that the development of government budget performance management, the evolution of government auditing, the change of the performance audit object, and the advancement of performance auditing abroad all have an impact on the development process of performance auditing in China.

ANALYSIS OF FACTORS INFLUENCING PERFORMANCE AUDITING IN CHINA

The Development of Government Budget Performance Management

The Chinese government's budget performance management started in 2003, when the Third Plenary Session of the 16th Central Committee of the Chinese Communist Party proposed "establishing a budget performance evaluation system", and has gone through the stages of piloting and promoting performance evaluation (2003–2010), gradually moving toward the stage of full process budget performance management (2011–2012), and comprehensively promoting budget performance management (2012-present). In 2012, the Ministry of Finance issued the "Budget Performance Management Planning (2012–2015)", which marked a new stage of performance management in China and a new era of performance audit. In 2018, the "Opinions on the full implementation of budget performance management" mentioned "establishing an all-round, full-process, full-coverage budget performance management system", and required "audit organs to

carry out audit supervision of budget performance management in accordance with the law". It can be seen that the development of performance management will put forward new requirements for performance auditing, and performance auditing will also react to performance management, and the two will keep moving forward in a spiral.

The Evolution of Government Auditing

As a part of government auditing, the reform and development of performance auditing is inevitably related to the evolution of government auditing. On 4 December 1982, the Constitution adopted at the Fifth Session of the Fifth National People's Congress of China included the audit supervision system for the first time, clarifying the legal status of government auditing. The promulgation of the Audit Law in 1994 marked that government auditing in China gradually possessed a set of standardized and scientific audit systems, and performance auditing had a law to follow in its work, highlighting the legitimacy and authority of performance auditing. In 2020, General Secretary Xi Jinping gave an important instruction on auditing work to "give full play to the functional role of auditing in promoting the modernization of the national governance system and governance capacity". In the context of national governance, the positioning and scope of government auditing are evolving, which means that the importance and focus of performance auditing are changing, and the scope of performance auditing will be extended.

Changes in the performance audit object

The changes in performance audit objects are mainly reflected in two aspects. On the one hand, during the promotion of full audit coverage, the content of performance audits is no longer limited to the use of financial funds and budget expenditures of various departments, but the effectiveness of public policies, the management of natural resource assets, the supervision of public works projects, and the operation of government funds are all included in the scope of performance audit evaluation. On the other hand, in the era of big data, more and more data and information exist in electronic form, and traditional audit means are limited everywhere, making it difficult to ensure the effectiveness of the audit. Therefore, performance auditors must continuously optimize the audit mode and methods, and make full use of new audit tools such as networked audit, big data audit, and blockchain audit to cope with changes in the audit object in order to improve the quality and effectiveness of their work [21].

The promotion of performance auditing in foreign countries

In the 1970s, the widespread economic crisis in Western countries triggered the New Public Management movement, and countries such as Britain, the United States, Australia, and Sweden began to set off a wave of government performance auditing. Performance auditing in China has learned from the advanced experience of foreign performance auditing in many aspects, such as the model and evaluation system, and then combined it with China's basic national conditions and special audit system to explore the road of performance auditing with Chinese characteristics.

The analysis shows that the legislature's attention to and promotion of performance auditing is the basic condition for the development of performance auditing. Throughout the development of auditing around the world, it is easy to find that any innovation and progress in the auditing system are basically the result of the game of various political forces and power relations outside the auditing authority, among which the legislature always plays a key role.

DATA AND METHODOLOGY

Hypothesis Formulation

Based on the above analysis of the influential factors influencing the development of performance auditing in China, this article makes the following assumptions about the current development characteristics of performance auditing in China.

H1: With the in-depth promotion and high-quality development of full audit coverage, the fields and contents of performance audits will be expanded, especially in the areas of environment, resources and social security.

H2: With the transformation of the overall positioning and role of government auditing in the new era, the positioning of performance auditing will also reflect distinctive features of the times, and the role of performance auditing will be strengthened.

H3: With the promotion of comprehensive budget performance management, the key focus of performance

Fig. 2. **The Word Cloud Diagram for the 2021 Performance Audit Report**

Source: Compiled by the author based on statistical output.

audit implementation remains fiscal funds and projects in the short term. And with the in-depth development of digitalization and informatization of audit objects, the performance audit method will transition from the traditional audit method to the big data audit method.

H4: With the changing environment of the performance audit system, the objectives of performance auditing in China will transition from the "3Es" to the "5Es".

Research Method

The research method used in this article is the keyword research method proposed by Raymond William in the UK, which is an empirical research method based on human language. It involves screening keywords in the target document based on customized criteria, analyzing the keywords, then re-categorizing and combining the known information, and finally discovering the essence and inner logic of the problem and proposing solutions [22]. Through keyword analysis, the author captures various characteristics of Chinese performance auditing practice in recent years, both as a whole and in different cross-sections, dissects the key points and commonalities, and analyzes the changing trends to strengthen the macro grasp of Chinese performance auditing practice.

Data Source

The performance audit report is the final product of the performance audit and can best reflect the various performance audit situations in the year. The year 2011 was an important turning point in China's performance management, and at this point, China officially entered the stage of fully promoting budget performance management. Therefore, the author selects the 2011–2021 Audit Report of the State Council on the Implementation of the Central Budget and Other Financial Revenues and Expenditures[4] issued by the Audit Office of the People's Republic of China as the subject of analysis, from which the current situation of the development of performance auditing in China is penetrated and the influencing factors and basic conditions for the development of performance auditing in China are analyzed through the analysis of key words under different cuts.

Overall Analysis

First, in order to quickly grasp the development status of performance auditing, a keyword analysis of China's 2021 audit report was conducted, and a word cloud diagram was obtained as shown in *Fig. 2*. As can be seen from *Fig. 2*, by frequency, "funds" (71), "audit" (63), "fiscal" (47), "project" (41), "management" (39), "enterprise" (37), "Policy" (29), "Resources" (28), "Construction" (27), "Government" (24) and "Development" (17).

From the frequency of "funds", "financial", and "projects" in the 2021 audit report, it is clear that "projects" and "funds" are important vehicles for the implementation of China's major economic policies and decisions, the high frequency of which highlights the typical characteristics of

[4] Audit Report of the State Council on the Implementation of the Central Budget and Other Fiscal Revenues and Expenditures. URL: https://www.audit.gov.cn/n5/n26/index.html (accessed on 10.06.2022).

auditing institutions to focus on their main responsibilities and performance in the implementation of major policies, with major projects and "fiscal" funds as the main grasp. At the same time, the frequency of "management" and "development" is also very high. It can be seen that performance audit, as an external monitoring mechanism of performance management, has expanded its scope of action from a single financial fund management to project construction management and engineering management. In addition, in the context of the big data era, "sharing of data resources" and "sharing of scientific instruments and facilities" are the key elements of the performance audit in 2021. This shows that the concept of performance auditing in China is developing and improving, the macroscopic view of performance auditing is expanding, and its global view and political standing are being enhanced.

Specific Analysis

By observing the dynamic development trend of performance auditing in the past 11 years, this article compares the results of word frequency analysis of China audit work reports from 2011–2021 (*Table 1* and *Table 2*).

As seen in *Table 1* and *Table 2*, the word "project" has been in the top five positions from 2011–2021. The word "funds" is similar to "projects", ranking in the top three for nine out of eleven years. The word "policy" was mentioned about 20 times in the audit report, but ranked seventh with 29 consecutive times from 2019–2021. This indicates that performance audits in China are mostly focused on funds and projects. From 2011 to 2021, most of the top 20 keywords appearing in audit reports were related to public infrastructure, such as environment, transportation, healthcare, and education. This shows that social programs and livelihood projects have been the focus of performance audits for a long time. In addition, "innovation" is also mentioned to varying degrees at one time, especially since 2018, with the more prominent terms "big data", "informatization", and "modernization" and other words indicating both a change in the audit environment and a significant shift in the technical means and working methods of performance auditing. Finally, "rectification", "supervision" and "regulation" are all expressions of the role of performance auditing, and the frequency of these terms representing the role of performance auditing is generally on the rise in the eleven reports, and the form of words used is more diverse and specific. This suggests that oversight is a fundamental function of performance auditing work.

Research Results

Through in-depth reading and understanding of the text, combined with the results of keyword analysis, and sorting and classifying keywords, the characteristics embodied in these eleven audit work reports can be clearly presented.

Basic Positioning and Role of Performance Auditing

As can be seen in *Table 3*, performance auditing has started to provide decision-making advisory services to the executive and legislative branches in addition to its traditional monitoring and inspection functions [23]. Performance auditing is gradually liberating itself from the mindset of "strengthening performance management" and "improving macro management", taking the promotion of "deepening reform" as its grasp, promoting "full audit coverage" as its means, and advancing the "modernization of national governance system and capacity" as its goal, to promote "full audit coverage" as a means to promote the "modernization of the national governance system and governance capacity" as a goal, to fully play the function of "motivation and guidance" of performance audit, in order to achieve high-quality development of the whole society.

Performance Audit Areas of Concern

As shown in *Table 4*, except for the first two years when the scope of performance audits was more concentrated, the performance audit work from 2014 has expanded the audit coverage based on the focus. The four areas of "environmental protection", "public transportation", "health care" and "cultural and sports education" are the objects that performance audits focus on almost every year. In addition, after 2014, "science and technology industry", when it has entered the vision of performance audit work, and the frequency has increased, until now, it has entered the performance audit work report for six consecutive years. In general, these areas are important projects related to the protection of people's livelihood.

Main Content of Performance Audit

As shown in *Table 5*, "policy implementation", "fund implementation and management" and "project supervision and operation" are the core and most

Table 1

Word Frequency Changes in Performance Audit Work Reports in China from 2011–2016

2011		2012		2013		2014		2015		2016	
Keywords	Word frequency	Keywords	Word frequency	Keywords	Word frequency	Keywords	Word frequency	Keywords	Word frequency	Keywords	Word frequency
Audit	96	Fiscal	81	Fiscal	105	Audit	59	Audit	92	Audit	71
Fiscal	84	Audit	76	Audit	80	Funds	56	Funds	67	Management	58
Project	60	Project	55	Funds	77	Project	38	Fiscal	60	Funds	57
Management	59	Funds	54	Management	54	Management	27	Management	54	Fiscal	49
Funds	59	Investment	28	Project	32	reform	21	Project	52	Project	44
Investment	41	Construction	25	Special	30	government	20	Enterprise	28	Enterprise	41
Construction	30	Special	20	Construction	24	Construction	14	Special	27	Special	32
System	27	Policy	17	Investment	22	Investment	14	System	27	poverty alleviation	24
Engineering	25	highway	12	resource	16	System	14	poverty alleviation	25	Policy	21
Policy	23	…	…	expenses	16	Information system	14	Policy	24	Investment	19
Development	23	Engineering	10	poverty alleviation	15	…	…	Investment	16	Construction	13
Special	17	Performance	9	System	14	Land	13	finance	16	Regulation	12
finance	15	Regulation	7	finance	14	overall planning	12	overall planning	16	System	10
…	…	rectification	5	Bank	12	Planning	10	innovation	15	Bank	10
Environment	14	finance	5	subsidy	12	Guarantee	10	Bank	15	Institution	10
rectification	12	…	…	Policy	10	rectification	8	Construction	13	Resource	10
people's livelihood	11	Dedicated funds	4	State-owned capital	9	Bank	8	Institution	13	finance	9
State-owned capital	10	Transport	4	Dedicated funds	8	Economy	7	Guarantee	12	Guarantee	8
Medical	8	Coordination	4	Sea	8	Minerals	7	Economy	11	Performance	8
Education	7	traffic	4	Social Insurance	7	finance	7	Resource	11	Engineering	8
Technology	7	Environment	4	traffic	6	Engineering	6	Scientific Research	10	Innovation	7
Performance	6	Energy saving and emission reduction	4	Supervision	6	State-owned capital	6	Regulation	9	Overall planning	6
Coordination	5	Operations	3	Integration	5	Policy	6	Insurance	9	Insurance	6
Science and Technology	5	Innovation	3	Effectiveness	5	traffic	5	Performance	7	Facility	6
Innovation	4	Integration	2	Agriculture and Forestry	5	technology	5	Coordination	7	Safety	6
Integration	4	Facility	2	Technology	5	Science and Technology	4	Environment	6	Dedicated funds	6
Insurance	4	Supervision	2	Education	4	people's livelihood	4	Engineering	6	Environment	4
Agriculture	4	Internet	2	Environment	4	Hygiene	4	Facility	5	Subsidy	4
Regulation	3	Medical	2	overall planning	3	Innovation	3	Subsidy	5	Natural Resources	4
Supervision	2	Roads	1	Supervision	3	Supervision	3	Agriculture	5	Supervision	3

Source: Compiled by the author.

Table 2

Word Frequency Changes in Performance Audit Work Reports in China from 2017–2021

2017		2018		2019		2020		2021	
Keywords	Word frequency	Keywords	Word frequency	Keywords	Word frequency	Keywords	Word frequency	Keywords	Word frequency
Audit	78	Funds	60	Audit	65	Fiscal	65	Funds	71
Funds	54	Audit	57	Funds	52	Audit	60	Audit	63
Project	40	Project	55	Project	50	Funds	48	Fiscal	47
Fiscal	38	Enterprise	47	Fiscal	45	Management	47	Project	41
Management	29	Management	34	Management	39	Project	41	Management	39
Enterprise	28	Fiscal	31	Enterprise	30	Investment	29	Enterprise	37
Special	27	finance	29	Policy	23	Policy	29	Policy	29
Investment	27	Special	27	…	…	Enterprise	28	Resource	28
Policy	24	Investment	24	Guarantee	18	finance	21	Construction	27
System	18	Institution	24	finance	17	Reform	21	government	24
finance	18	Reform	23	Reform	15	Special	20	Special	22
overall planning	17	Performance	22	Special	14	Resource	19	Insurance	21
poverty alleviation	16	poverty alleviation	19	Investment	13	Construction	18	Institution	19
government	14	Policy	17	Employment	13	Insurance	18	Investment	18
rectification	14	Construction	17	Performance	13	government	17	Employment	17
Performance	13	System	16	government	12	Economy	17	Development	17
Construction	12	Subsidy	15	Science and Technology	12	overall planning	15	finance	16
Supervision	12	Regulation	14	Construction	11	System	13	Bank	16
Institution	11	government	12	Regulation	11	…	…	Guarantee	15
Guarantee	11	Guarantee	11	Institution	11	Guarantee	11	overall planning	14
Insurance	10	rectification	10	poverty alleviation	9	Environment	11	Reform	12
Regulation	9	Remediation	10	Insurance	8	Medical	10	System	12
Engineering	9	Technology	10	overall planning	8	supervise and urge	9	Economy	12
Environment	8	Insurance	9	Medical	8	rectification	9	Governance	12
Bank	6	Economy	7	rectification	8	Employment	9	rectification	10
Innovation	6	Innovation	7	Retirement	8	Natural Resources	8	Performance	9
Remediation	6	Resource	7	Environment	7	Retirement	7	Engineering	9
Resource	5	Approval	7	Bank	7	Bank	6	Regulation	8
Subsidy	4	Environment	5	supervise and urge	6	Innovation	6	Supervision	8
Agriculture	4	Supervision	5	Modernisation	5	Performance	5	Informatization	8

Source: Compiled by the author.

basic audit contents of performance audit, which are covered in all the eleven audit reports without exception. Therefore, the content of performance auditing can be divided into three main areas: policies, funds, and projects. With the development of the times, the audit content is also changing, combining "resource and environment enhancement" and "engineering construction" on the basis of the first three areas with new members "smart city construction" and "network security and information construction" appearing in 2020 and 2021, forming a performance audit content model of "foundation + new infrastructure".

Performance Audit Evaluation Dimension

As shown in *Table 6*, "economy", "efficiency", and "effectiveness" are the general objectives of performance

Table 3

Comparison of the Positioning and Role of Performance Audits from 2011–2021

Report Year	Supervision Guarantee	Improve macro management	Enhanced performance management	Coordination of development	Deepening reform	Promote full audit coverage	Promote the modernization of governance system and governance capacity	Motivation and Orientation	Boosting high-quality development
2011	√	√	√	√		√			
2012	√		√						
2013	√	√							
2014	√	√	√	√	√	√			
2015	√	√	√			√			
2016	√	√	√	√		√			
2017	√	√	√	√		√			
2018	√	√	√	√	√	√			
2019	√	√	√		√	√	√		
2020	√	√	√		√	√		√	
2021	√	√	√	√	√	√	√		√

Source: Compiled by the author.

Table 4

Changes in Areas of Performance Audit Focus From 2011–2021

Report Year	Environmental protection	Public transportation	Health care	Cultural and sports education	Community construction	Talents	Pension	Natural resources assets	Science and technology industry
2011	√	√	√	√	√				√
2012	√	√		√	√				
2013	√	√		√	√				
2014	√	√			√	√			√
2015	√	√		√	√				√
2016	√			√	√	√		√	√
2017	√					√		√	√
2018	√								√
2019	√		√				√		√
2020	√		√			√	√	√	
2021	√		√		√		√		√

Source: Compiled by the author.

Table 5

Changes in the Main Content of Performance Audits from 2011–2021

Report Year	Policy implementation	Fund implementation and management	Project supervision and operation	People's livelihood development	Engineering construction	Resource and Environmental Audit	Smart city construction	Network security and information construction
2011	√	√	√	√	√			√
2012	√	√	√		√			
2013	√	√	√			√		
2014	√	√	√	√	√	√		
2015	√	√	√		√	√		
2016	√	√	√		√	√		
2017	√	√	√		√	√		
2018	√	√	√		√	√		
2019	√	√	√	√	√	√		
2020	√	√	√	√	√	√	√	
2021	√	√	√	√	√	√		√

Source: Compiled by the author.

auditing. In the 2014 audit report, it was mentioned that it is necessary to "balance the value-added space of social and economic effects", to "maximize the social and economic effects of government investment projects" in 2017, and then to include the evaluation dimension of "social effects" in several projects in 2018. It can be seen that the weight and attention of "social effects" in the performance audit evaluation of government public infrastructure and public welfare projects has been increasing. In the audit reports for 2017, 2018 and 2020, "eco-efficiency" has again become a high-frequency word in the evaluation of effectiveness, which is also in line with the concept of "green development" advocated by China. Finally, it is also clear that in the 2020 and 2021 audit reports, the highlighted performance audit evaluation dimensions have been added to the earlier "3E" evaluation, "fairness" and "environmental" dimensions, moving towards the substantive "5E" evaluation dimension.

Performance Audit Methodology Model

The technical methods commonly used in auditing are review method, analysis method, comparison method, inventory method, correspondence method, etc. Since the analysis text is the audit work report of each year, these basic methods are not mentioned too much in the eleven reports, but through the reading of the reports, it can be found that these methods are reflected. In addition, since 2016, the audit technology method has been gradually combined with technology, including Internet and space remote sensing technology. The method of "big data analysis" and "satellite image data analysis" have been promoted and applied to improve the efficiency of work while effectively guaranteeing the accuracy and reasonableness of audit results.

Therefore, the comparative analysis of the texts basically confirms all the hypotheses presented in this article. In terms of the basic conditions for the development of performance auditing in China, on the one hand, the contradiction between the demand for government public expenditure and the supply of national financial resources is prominent, and the urgency of improving the economy, efficiency and effectiveness of public resources managed by the government has driven the rapid development of performance auditing. On the other hand, China's political system provides more

Table 6

Changes in Performance Audit Evaluation Dimensions from 2011–2021

Report Year	Economy	Efficiency	Effectiveness	Social and economic effects	Eco-efficiency	Fairness	Environmental
2011	√	√	√				
2012	√	√	√				
2013	√	√	√				
2014	√	√	√	√			
2015	√	√	√	√			
2016	√	√	√				
2017	√	√	√	√	√		
2018	√	√	√	√	√		
2019	√	√	√				
2020	√	√	√		√	√	√
2021	√	√	√		√	√	√

Source: Compiled by the author.

Table 7

Changes in Performance Audit Methodology Model from 2011–2021

Report Year	Data Analysis	On-site verification	Contrast Analysis	Document Review	Big data analysis	Satellite image data analysis	Use of third-party related information
2011	√	√	√	√			
2012	√	√	√	√			√
2013	√	√	√	√			
2014	√	√		√			√
2015	√	√	√	√			
2016	√	√	√	√	√		
2017	√	√		√		√	
2018	√	√	√	√		√	
2019	√	√		√			
2020	√	√		√	√		
2021	√	√	√	√	√		

Source: Compiled by the author.

favorable conditions for the development of performance auditing.

CONCLUSION AND RECOMMENDATION

Conclusion

The author analyzes and summarizes the current situation of performance auditing in China from the existing researches, and deduces the development characteristics of performance auditing in China by exploring the influencing factors and basic conditions for the development of performance auditing, and draws the following conclusions from this article.

First, the basic positioning of performance audit is supervision: it has risen to the level of promoting the modernization of national governance capacity and governance system, as well as promoting high-quality development, from improving macromanagement, strengthening performance management, and promoting full audit coverage.

Second, in China, performance auditing primarily concerns livelihood programs, but in recent years, it has expanded to include developing fields such as fundamental scientific research, shared data management, and network security.

Third, the content of performance audit extends from the management and use of funds to the implementation

of policies and project management, and is dynamically adjusted and updated with the national will and local development planning. And the diversification of performance audit methods, based on traditional audit methods to actively explore big data audit, satellite image analysis and other information technology tools.

Fourth, the evaluation dimension of performance audit has developed from "3E" to "5E", which profoundly reflects the change in demand for high-quality development transformation due to the change in the main contradictions of Chinese society in the new era.

Recommendation

From the textual content of these eleven reports, and looking at the general environment of performance auditing in China, it can be found that performance auditing has reached a critical transition period for high-quality development, and it is urgent to achieve a more standardized and professional development. In this regard, this article makes the following recommendations. First, it is necessary to establish a sound system of professional and technical specifications for performance auditing in China. Second, it is to expand the content of performance auditing. Auditing departments must pay more attention to the process and results of performance auditing and increase the performance auditing of fund revenues and expenditures of major public sectors such as administrative units and public institutions. Thirdly, it is to build a performance audit system with diversified subjects. To improve the level of performance audits, it is required to develop a perfect and sound audit system headed by government auditing institutions and confirmed by social auditing, to strengthen the monitoring of government performance auditing, and to optimize the management function. Finally, it is necessary to innovate the method of performance auditing. With the digital development of auditing, it has become necessary to establish a big data audit platform to realize continuous performance auditing.

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ABOUT THE AUTHOR

Yali Liu — Postgraduate Student, the department of Statistics, Accounting and Audit, Saint Petersburg State University, Saint Petersburg, Russia
https://orcid.org/0000-0002-8915-6006
18193158922@163.com

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Analysis of the Share of Corporate Property Tax in the Structure of Tax Revenues by Regions and Economic Activities

R.V. Balakin, A.A. Popov, S.D. Shatalov
Tax Policy Center of Financial Research Institute of the Ministry of Finance of the Russian Federation, Moscow, Russia

ABSTRACT

The subject of the study is the revenues from the corporate property tax in the context of types of economic activity and regions. **The purpose** of the study is to determine the role of corporate property tax in the structure of tax revenues in terms of economic activity to identify areas for potential growth of revenues from this tax and determine the fiscal and economic consequences of the transition to the cadastral valuation of real estate with the appropriate development of proposals to improve the taxation of real estate. **The relevance** of the research is due to the fact that the article is devoted to a little researched topic — analysis of property taxation in the Russian Federation in the economic activity context. **The main method** of research is the calculation of indicators characterizing the structure and dynamics of the corporate property tax and other property taxes, analysis and synthesis of the obtained results and their inter-sectoral comparison. **As a result**, a comprehensive view of the situation with the tax on the property of organizations in the context of economic activity is presented, which serves as a basis for finding bottlenecks in this part, identifying the factors that hinder the expansion of property taxation and other promising areas for research in this area. The interpretation of the obtained results in terms of the role of corporate property tax and other property taxes at different levels of the budget system should be attributed to the **main conclusions**. The cross-section allowed us to identify points for the potential growth of tax revenues from the corporate property tax in terms of objects, for which the tax base is the cadastral value.
Keywords: property taxation; corporate property tax; structure of tax revenues; sectoral breakdown; types of economic activity; OKVED-2; regional breakdown; budget revenues; consolidated budgets of the RF subjects; local budgets

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INTRODUCTION

Property taxes are not among the taxes showing a substantial share of revenues to budgets of the budgetary system of the Russian Federation. According to the data of the tax reporting in 2021, the entire group of property taxes accounted for 5.19%, of which 3.43% — for corporate property tax (hereinafter — CPT). This value, however, requires two important comments. First, in the last few years this share has decreased significantly, in 2013 the share of property taxes accounted for 8,01%. This is due primarily to the fact that in 8 years (from 2013 to 2021) revenues from property taxes grew from 900 billion rubles to 1.44 trillion rubles, i.e. 1.5 times, while the growth of total tax revenues for the same period was 2.8 times. But even this value is completely incomparable with the share of property taxes in some countries. An important moment is also the question of how burdensome the tax is for taxpayers and whether the share that the tax provides in the structure of tax revenues of budgets of the budgetary system is comparable with the share of this tax in the tax payments structure of the taxpayer.

The second important comment is the fact that the Russian tax system is arranged in such a way that property taxes remain entirely in the regions and form a substantial share of the revenues of regional and local budgets, so it is more correct to consider the share of these taxes not in the overall federal volume of revenues, but to explore their significance for the budgets of regions and areas.

REVIEW OF LITERATURE

Most publications on corporate property tax are devoted to changes in tax legislation in this part and practical recommendations for their implementation. For example, in paper A. V. Lashchenov [1] gives an explanation of the changes that taxpayers must take into account in 2021. In another paper [2], the author further stipulates that when calculating local taxes should take into account the changes provided for by the normative acts of the constituent entities of the Russian Federation and local authorities (results of cadastral assessment, tax rates, benefits), information about which for each municipality can be obtained on the website of the of the Federal Tax Service of Russia. In paper [3] the author gives an overview of the activities to improve the taxation of property implemented and planned for implementation in 2021, and further steps in this direction are analysed.

Some publications address practical issues such as the cancellation of declarations on certain property taxes. For example, in the paper of S. A. Sosnovsky and V. V. Grigoriev [4] examines the cancellation of declarations on transport and land taxes, examines first experience and identifies the first problems associated with this.

Another area of practice discussed is the use of cadastral value for the purposes of property taxation of organizations. For example, in the paper of N. P. Petrukhina and L. P. Podbolotnova [5] reviewed the system of taxation of real estate in the Russian Federation with emphasis on local taxes. Identified problems faced by the taxpayer when paying real estate taxes and ways to solve them. It should be noted that the introduction of cadastral value is one of the most discussed directions for reforming the CPT. So, for example, paper of N. Z. Zotikov [6] is devoted to identifying the role and importance of property taxes in the formation of income of regional and local budgets and the determination of directions of improvement of property taxation. The paper of Yu. A. Lisovtseva [7] also deserves special attention, which analyzed the experience of foreign countries in the property taxation aspect to identify best world practices that have already proved their validity. In paper of D. A. Smirnov [8] describes the stages of reform of the property taxation system in Russia, which took place

over the last 20 years, reveals the main positive and negative aspects introduced in the Tax Code of the Russian Federation chapters devoted to the taxation of property of organizations and individuals. The author conducts a critical analysis of the main elements of the tax and formulates proposals for improvement of the relevant legislation. This analysis may be supplemented by paper I. Yu. Arlashkin [9], which examines the instruments of interbudgetary regulation applied in Russia from the perspective of their possible impact on regional economic growth.

Many authors note the important role of property taxes for regional and local budgets. For example, the paper of A. V. Makarova and E. P. Ogorodnikova [10] is devoted to the problems of the formation of local budgets, including the impact of property taxes, as well as the structure and dynamics of incomes to local budgets, and the proportion of property tax in the local budget of the Russian Federation were studied. And, for example, in the article F. S. Aguzarova [11] emphasizes the urgent need to increase the importance of property taxes. The paper of S. A. Kurbanov and R. V. Batashev [12] analyzes factors that have a significant impact on income tax on property of organizations and individuals in regional and local budgets, and identifies alternative ways to increase them. In the paper Kh. M. Musaeva et al. [13], the authors argue that property taxes do not play a substantial role in the formation of the income base of territorial budgets.

The need to increase the importance of property taxes in the income structure of the consolidated budget of the regions is also noted in the paper of V. N. Konovalov [14], where the author rightly proposes increasing the value of regional and local taxes by adjusting their individual components to the financial situation of the payers. The idea of insufficient impact of property taxes on the volume of budget revenues is also developed in the paper of E. V. Minaeva et al. [15], where the authors performed a comparative analysis of tax revenues of individuals and legal entities to the consolidated budget of the Russian Federation. According to the results of the study, taxes paid by individuals are one of the leading places alongside taxes such as corporate income tax and VAT. Also, we note the paper of L. G. Baranova and V. S. Fedorova [16], which is devoted to the impact of changes in property taxation on the economic processes of the macro- and micro-level.

In conclusion, we will note a few more deserving of attention papers devoted to various aspects of property taxation in Russia. An interesting investigation by B. I. Alekhin [17] does to evaluate the notion that increasing regional tax autonomy, as indicated by the proportion of property taxes to regional budgetary expenditures, improves regional budget balances. Separately, we would like to mention the paper of I. V. Boboshko [18] about the sectoral reduction of income from property tax. The paper discusses issues of mobilization of revenues of regional budgets at the expense of property tax of organizations. As we continue our discussion of the sectoral breakdown, we will mention the work of E. N. Timchenko and A. I. Pogorletsky [19], which is focused on determining how digitalization and the probability of a change in property taxation are related. On the other hand, in the paper of N. I. Malis and L. P. Grundel [20] noted that the difficult economic situation in Russia, associated with both the coronavirus pandemic and the fall in world energy prices, has extremely negatively affected the state of the income base of budgets of all levels. The paper of O. A. Sinenko and A. Yu. Domnikov [21] is dedicated to the study of fiscal mechanisms of regulation of property taxation in the territories with special economic status.

DATA AND METHODOLOGY

For the characterization of the property tax situation use groups of indicators that include sectoral characteristics of revenue from CPT. For economic activity (hereinafter — EA) in the context of regions were estimated four indicators:

- CPT tax burden as ratio of revenues from EA on CPT in the region to regional tax base under CPT:

$$t_b = \frac{T_{ij}}{B_i}, \quad (1)$$

where t_b — tax burden; T_{ij} — revenue from EA on CPT in the i-region; B_i — regional tax base under CPT;

- share of revenues from EA on CPT in the region to total tax revenues from EA in the region:

$$t_t = \frac{T_{ij}}{T_{IJ}}, \quad (2)$$

where t_t — share; T_{ij} — revenue from EA on CPT in the i-region; T_{IJ} — revenues from EA in the i-region;

- share of revenues from EA on CPT in the region to EA's CPT revenues in all regions:

$$t_j = \frac{T_{ij}}{T_J}, \quad (3)$$

where t_j — share; T_{ij} — revenue from EA on CPT in the i-region; T_J — revenues from EA on CPT in all regions;

- share of revenues from EA on CPT in the region to revenues from EA in all EAs in region:

$$t_i = \frac{T_{ij}}{T_I}, \quad (4)$$

where t_i — share; T_{ij} — revenue from EA on CPT in the i-region; T_I — revenues from EA in all EAs in region.

Thus, in addition to estimating the tax burden of the CPT in the breakdown of the EA in the regions, the study identified the contribution of the CPT to the total tax revenue of the region in the breakdown of the EA, the region's contribution to the CPT for all regions for each EA and the contribution of each EA to the CPT for each region and for the federal level. Analysis of indicators conducted in the dynamics from 2017 to 2020. Source for calculations was data based on statistical forms of reporting FTS 1-NOM.

RESULTS

In Russia, 11.4% of all revenue of the consolidated budgets of the regions of the Russian Federation belongs to property taxes, with 7.6% or two thirds belonging to CPT. If we calculate an average proportion of all regions, this proportion will be even slightly higher — 8.9%. Minimum shares (less than 4%) are shown by the Murmansk and Omsk regions, as well as the city of Sevastopol. In Yamalo-Nenets AD, Khanty-Mansiyskc AD and Nenets AD, the Jewish Autonomous Region and the Republic of Komi, on the contrary, more than 20% of all revenues of the consolidated budgets of the regions of the Russian Federation belong to CPT.

When it discusses dynamics, it should be highlighted that the CPT share has a positive dynamic in only 11 regions. These are the Kaliningrad, Sakhalin, Astrakhan and Magadan regions, the Jewish Autonomous Region, the city of Sevastopol, the Republic of Sakha (Yakutia), Altai, Crimea, Kalmykia and North Ossetia-Alania. Vologda region and the Republic of Ingushetia demonstrate the maximum decrease of shares, as well as the regions noted by us, showing the maximum shares, Yamalo-Nenets, Khanty-Mansiysk and Nenets AD.

Table 1 presents the share of CPT revenues in the consolidated budgets of regions of the Russian Federation in terms of EA. EA is presented in accordance with the All-Russian

Table 1

Revenue from Corporate Property Tax by Economic Activities, % of Revenues of Consolidated Budgets of the Subjects of the Russian Federation

Activity	2017	2018	2019	2020	2021
A	0.131	0.158	0.133	0.119	0.118
B	1.237	1.401	1.282	1.343	1.156
C	1.166	1.212	0.884	0.807	0.759
D	1.079	1.138	0.969	0.979	0.790
E	0.110	0.105	0.104	0.104	0.098
F	0.194	0.189	0.171	0.134	0.107
G	1.827	1.710	1.495	1.522	1.137
H	1.322	1.455	1.235	1.290	1.088
I	0.065	0.065	0.061	0.054	0.059
J	0.194	0.180	0.081	0.054	0.042
K	0.360	0.319	0.237	0.260	0.213
L	1.061	1.044	1.029	1.038	0.968
M	0.340	0.327	0.288	0.303	0.240
N	0.074	0.075	0.035	0.035	0.031
O	0.234	0.213	0.200	0.213	0.161
P	0.388	0.407	0.397	0.409	0.349
Q	0.213	0.228	0.201	0.194	0.168
R	0.114	0.139	0.142	0.137	0.121
Others	0.360	0.114	0.131	0.035	0.033
Total	10.470	10.480	9.074	9.030	7.637

Source: Authors' calculations based on the data of statistical reporting forms No. 1-NM and No. 1-NOM. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/ (accessed on 02.07.2023).

Classification of Economic Activities in force since 2017 (the so-called OKVED-2).

Wholesale and retail trade (as well as repair of motor vehicles and motorcycles) make the most of the contribution to CPT's proceeds. It should also be noted that this EA in the region does not have a low load, as in other EAs. The significant contribution of CPT to revenue can also be mentioned in the mining and transportation and storage sectors. Moreover, in terms of the share of EA in revenue the value of transportation and storage indicators are comparable with the indicators of mining. It should be noted that the maximum values of the contribution of this EA to CPT revenue have border regions. Real estate operations and electricity, gas, steam and air conditioning also make a significant contribution.

The paper analysed the set of indicators described in the previous section, formula (1)–(4). For the indicators indicated, an analysis of correlation according to economic activities was carried out, on the basis of

Table 2

Correlation Coefficients of Indicators Characterizing the Tax Burden on Corporate Property Tax by Economic Activities

Activity	Tax burden / Share of activity	Tax burden / Share of tax	Tax burden / Share of region	Share of activity / Share of tax	Share of activity / Share of region	Share of tax / Share of region
A	0.99	0.17	0.71	0.18	0.70	0.11
B	0.98	0.01	0.56	0.02	0.56	–0.04
C	0.98	0.02	0.52	0.01	0.52	–0.02
D	0.94	0.45	0.18	0.41	0.16	0.01
E	0.99	0.43	0.85	0.42	0.88	0.25
F	0.88	0.46	0.11	0.59	0.12	0.04
G	0.97	0.86	0.60	0.85	0.59	0.62
H	0.98	0.52	0.21	0.53	0.22	0.32
I	0.94	–0.00	0.46	0.00	0.37	–0.01
J	0.92	0.53	0.09	0.52	0.13	–0.16
K	0.98	0.65	0.36	0.58	0.42	–0.03
L	0.96	0.09	0.62	0.08	0.68	0.04
M	0.98	–0.05	0.19	–0.07	0.21	0.02
N	0.88	0.42	0.30	0.28	0.16	0.19
O	0.96	0.73	0.31	0.72	0.31	0.52
P	0.94	0.72	0.03	0.67	0.03	0.19
Q	0.91	0.72	–0.01	0.68	–0.01	0.17
R	0.96	0.78	0.17	0.75	0.18	0.17
Others	0.99	0.62	0.55	0.64	0.59	0.17

Source: Authors' calculations based on the data of statistical reporting forms No. 1-NM and No. 1-NOM. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/ (accessed on 02.07.2023).

Table 3

Comparison of Correlation Coefficients of Tax Burden and Share of Economic Activities

Activity	Property Tax	Profit tax
A	0.9908	0.9473
B	0.9841	0.4574
C	0.9816	0.8680
D	0.9369	0.9093
E	0.9869	0.7839
F	0.8829	0.6206
G	0.9704	0.1540
H	0.9780	0.8252
I	0.9404	0.4795
J	0.9174	0.9257
K	0.9787	0.2791
L	0.9623	0.8008
M	0.9833	0.5268
N	0.8816	0.9708
O	0.9568	0.9952
P	0.9362	0.9196
Q	0.9140	0.7985
R	0.9585	0.9142
Others	0.9905	0.8041

Source: Authors' calculations based on the data of statistical reporting forms No. 1-NM and No. 1-NOM. URL: https://www.nalog.gov.ru/rn77/related_activities/statistics_and_analytics/forms/ (accessed on 02.07.2023).

which the correlation matrix presented in *Table 2* is constructed.

Table 2 shows that the maximum correlation values are observed for the pair of tax burden indicators and the share of EA. For all EAs, the correlation factor is greater than 0.9. The slightly smaller size of the coefficient (although still indicating a close correlation of indicators) is demonstrated by construction and administrative activities. The tax burden is closely linked to the share of CPT in revenue in trade, public administration, education, health and cultural, sports, leisure and entertainment activities. With the region's share in revenue, the tax burden demonstrates a close link between agriculture and water supply, water disposal, collection, waste disposal, pollution elimination activities. Due to the close link between the tax burden and the share of the EA, the latter also demonstrates a close link (although slightly less strong) within the same EAs with the CPT share of revenue and the region's share, respectively. The share of CPT in revenue and the share of the region as a whole do not show close links. Against this background, a relatively greater linkage can also be mentioned in trade and public administration.

It will also be interesting to determine whether the strong association between the tax burden and the share of EA is specific to the CPT or whether it applies to other taxes as well. Statistical tax reporting allows for such analysis on only one tax — corporate profit tax. *Table 3* shows a comparison of the correlation factors for the tax burden and the share of EA in corporate profit tax and CPT.

Table 3 data also shows high correlation for corporate profit tax too. However, if for CPT this was typical for all industries in general, there are exceptions for corporate profit tax. Let's first discuss about the trade and financial sectors. For these industries, the tax burden correlation coefficients and the proportion of EA are low and

prevent us from inferring a connection between the data. Scientific and technical correlation coefficients for the fields of mining, construction, hotels and catering, as well as professional fields, indicate that there is an average strength connection, but they are significantly lower than the values reported by CPT. For processing, water supply, transportation and storage, real estate operations and health and social services, the rates are high and indicate a close correlation, but significantly lower than the CPT data. Accordingly, only 7 of the 18 industries have the same high correlation rates as the CPT, suggesting that the close relationship between the tax burden and the share of EA is a special characteristic of CPT.

The sectoral characteristics of CPT revenue by region will be examined next. However, in some areas, a specific EA makes a larger contribution to the CPT revenues of all EAs. And it may not just be particular values from specific regions. For example, in the spheres of public administration and military security, as well as social security, in almost half of the regions the tax burden is greater than the overall federal value. EA demonstrates greater uniformity of burden indicators across regions compared to EA's contribution to revenue.

For most EAs, however, the situation is characterized by the fact that regions with the highest CPT tax burden have a higher burden than the respective EA's share of CPT revenue. A typical example is the education sector, where the share of EA in revenue in the leading regions is marked in the same order, and the burden differs more substantially. However, this is not typical for all EAs. Thus, in financial and insurance activities there is the opposite situation, when the share of EA in revenue in the regions showing maximum indicators in this parameter, vary considerably, and the burden differs less significantly. In the spheres of public administration, military security and social welfare, the burden is also more uniform than the contribution of EA to revenue.

It should be noted that the highest tax burden is shown by the regions that have demonstrated a higher share of EA in revenue CPT. There are also exceptions, for example, in the field of supply of electricity, gas, steam and air conditioning, the city of Sevastopol demonstrates the importance of the contribution of EA to CPT revenue in 2020 at the level of 75%, providing a significant gap in this indicator from the values of other regions, while in tax burden the region occupies only eighth position. Or, for example, in the sphere of activities of hotels and catering companies the share of EA was greater in the Republic of Crimea, the tax burden is higher in Krasnodar region. An interesting exception is the fact that in the field of real estate transactions, the Republic of Altai demonstrates a burden of less than the overall federal value, while the share of EA in revenue in the region is higher than the general federal value. At the same time, in the Samara region, the same EA has the opposite situation — the share of revenues is lower than the overall federal, and the burden — is higher.

It should be noted that there are situations where maximum indicators are presented by regions that do not have top values either in terms of the level of tax burden or the contribution of EA to CPT revenues when measuring the percentage of CPT in the structure of tax revenues.

For example, the largest share of CPT in the sphere of public administration and military security, as well as social welfare have companies in Belgorod region, which did not show the highest values either in the contribution of EA to CPT revenue or in the level of tax burden on this tax. Another example of this situation is the leadership of the regions of the North Caucasus Federal District in terms of the value of the indicator in the sphere of activity of hotels and catering companies. We will also note the Krasnodar

region and the Republic of Tatarstan, which have a significant contribution to the revenue of CPT companies working in agriculture, while not showing a high level of tax burden, which indicates the relatively larger tax base for this tax in agricultural these regions.

The opposite situation is typical, for example, for the extraction of minerals. The relatively low share of CPT in the structure of EA tax revenues is due to the fact that this EA is the source of one of the most productive taxes — mineral extraction tax, which accounts for a substantial share of EA tax revenue. The same is due to the actual absence of mining regions among those with a high share of CPT in the structure of tax revenues.

The city of Moscow makes the maximum contribution to the CPT's achievements on the data of all EAs. In some EAs, Moscow has a significant gap from the values of other regions, and more than half of all CPT revenues in these EA are in that region. The capital region demonstrates the maximum contribution in virtually all EAs, except for agriculture, forestry, hunting, fishing, fisheries (Belgorod region has the greatest contribution), mining (Khanty-Mansiysk AD), processing industries (Republic of Tatarstan), water supply, water disposal, waste collection and disposal, pollution elimination activities (St. Petersburg) and wholesale and retail trade, as well as repair of motor vehicles and motorcycles (Yamalo-Nenets AD). It is important to note that Moscow may not have either the maximum values of the EA contribution or a high level of tax burden. For example, in the construction sector, the Moscow accounts for 34.16% of all CPT revenues. While the region demonstrates relatively large indicators and EA share in revenue and tax burden, and CPT share in the structure of EA tax revenues, these figures have not been leading anywhere, especially with such a significant gap. This may indicate that both the tax base and the amount of revenue from other taxes in the EA in that region exceeds the other regions with the same margin as its share of revenues.

CONCLUSION

The analysis made it possible to obtain information about the factually unexplored direction of property taxation — its sectoral breakdown. The calculation of the tax burden, the share of EA revenues on CPT in the region to the total tax revenues from EA in the area, to the revenues by EA on CPT in all regions, and to CPT revenues in all EAs of the region allowed for a thorough examination of the CPT situation across industries, which serves as a basis for identifying gaps in this section, identifying factors which prevent to the expansion of property taxation, and other potential research directions.

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ABOUT THE AUTHORS

Rodion V. Balakin — Cand. Sci. (Econ.), Senior Researcher, Tax Policy Center of Financial Research Institute of the Ministry of Finance of the Russian Federation, Moscow, Russia
https://orcid.org/0000-0002-0494-9702
Corresponding author:
balakin@nifi.ru

Alexey A. Popov — Senior Researcher, Tax Policy Center of Financial Research Institute of the Ministry of Finance of the Russian Federation, Moscow, Russia
https://orcid.org/0009-0008-8269-6131
apopov@nifi.ru

Sergey D. Shatalov — Dr. Sci. (Econ.), Chief Researcher, Tax Policy Center of Financial Research Institute of the Ministry of Finance of the Russian Federation, Moscow, Russia
https://orcid.org/0000-0001-9680-4166
shatalovsd@nifi.ru

Authors' stated contributions:
R.V. Balakin — critical analysis of the literature, description of the results and formation of the conclusions of the study.
A.A. Popov — collection of statistical data, tabular and graphical presentation of the results.
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Assessment of the Impact of Fiscal Policy on Economic Growth in the Republic of Armenia

M.A. Voskanyan, A.G. Galstyan
Russian-Armenian University, Yerevan, Armenia

ABSTRACT

Fiscal policy plays a crucial role in ensuring economic growth and development in the country and overcoming economic recessions. The **subject** of the research is the tax system in the Republic of Armenia. The study **aims** to identify and assess the impact of the fiscal policy on economic growth in the Republic of Armenia. Since the global financial crisis of 2008, the Armenian economy has been in stagnation, reaching pre-crisis GDP levels only in 2018. Both theory and practice point to the ambiguous nature of the impact of fiscal policy on economic growth. At the same time, the 2020 crisis caused by the pandemic exacerbated the situation by focusing the attention of economists on fiscal policy to stimulate the real sector of the economy, which justifies the **relevance** of the current study. The paper's **novelty** lies in assessing the impact of certain types of taxes on the economic growth rates in Armenia. To achieve the goal of the study, the authors use such **methods** as a comparative analysis of foreign studies and systemic and statistical analysis. To econometrically assess the impact of taxes on economic growth in the country, a vector autoregression (VAR) model was applied. As a **result** of the study, the authors found that both tax regulation in general and the individual taxes are restrictive in nature and have a negative impact on economic growth in the country. The authors **conclude** that such a restrictive policy has led to a slowdown in economic growth in the Republic of Armenia over the past decades.

Keywords: State budget; economic growth; taxes; state budget expenditures; fiscal policy; macroeconomic management

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INTRODUCTION

The question of whether changes in fiscal policy can affect economic growth is widely covered in the scientific literature [1–6]. In order to guarantee the nation's economic progress, fiscal policy is important [7, 8]. In the short-term, counter-cyclical fiscal policies support aggregate demand and increase growth during cyclic recessions [9]. On the contrary, budget cuts help to cool the economy in times of unsustainable growth and the risk of overheating. In particular, developed economies have a long history of using taxes and government spending to smooth the business cycle [10]. At the same time, fiscal policy can also have a major impact on medium- and long-term economic growth. This is particularly relevant to developing countries, where the real sector is relatively weak and underdeveloped [11]. For example, public expenditure on infrastructure has greatly intensified business activity in the economy [12, 13], public spending on education has contributed to the development of human capital, a vital component of long-term growth [14, 15]. However, the tax portion of the budget can cause significant damage to economic growth [16–18], as certain taxes distort the behavior of business entities to some degree. Endogenous growth models [19] prove that fiscal policy will have both a temporary and a permanent impact on economic growth rates. Empirical research, however, gives sometimes unclear results.

The purpose of this study is to identify the impact of tax policy in the Republic of Armenia (hereinafter — RA) on the rate of economic growth.

In the scientific literature, there are many studies on the relationship between taxes and economic growth that show a weak or unreliable relationship [20, 21], revealing strong links [22–26]. Tax policy can

potentially have a major impact on long-term growth [27]. Public policies have a significant impact on economic growth by influencing private incentives for the accumulation of physical and human capital. Even relatively small changes in tax rates can lead countries to stagnation or even regression if this policy eliminates growth incentives.

The scientific literature that is now available can distinguish between long-term and short-term periods of influence when looking at how taxes affect economic growth [28]. The long-term impact of taxes on economic growth can be predicted quite reliably, and in general this relationship corresponds to the theoretical explanation: a reduction in the tax burden in the long-term has a positive effect on the rate of economic growth, and, on the contrary, an increase in such a burden reduces the volumes of aggregate demand. As far as the short-term effect is concerned, its definition appears to be quite problematic.

Among the comparatively recent researches, a key feature has been the theory that tax changes are fairly neutral to the income of the population, since increasing income from one type of tax leads to a decrease in income from other types of tax [23, 24, 29, 30].

The literature review indicates that it can be difficult to determine the exact impact of tax revenues on the rate of economic growth. However, with some certainty, tax policy can influence economic growth in the long term and can be an incentive to sustainable growth.

TAX REVENUES OF THE STATE BUDGET IN ARMENIA

Tax relations in the Republic of Armenia are governed by the Constitution, the ratified international treaties of the Republic of Armenia, the Tax Code and the laws of the RA. The Republic of Armenia has a two-tier tax system, which includes state and local taxes. State taxes include value added tax (hereinafter — VAT), excise tax, tax on profit, income tax, environmental tax, road tax, turnover tax, patent tax.[1] Local taxes include: real estate tax and vehicle property tax.[2] In addition to tax payments, fixed payments are also applied in the manner prescribed by the legislation of RA.

In Armenia there are also general and special tax regimes.[3] Companies are subject to VAT and/or income tax in accordance with the general tax burden. But there are special tax regimes which, under certain conditions, provide for taxation instead of the above-mentioned types of sales tax and patent tax.

In special taxation systems: 1) in the framework of the organization's turnover tax system, individual entrepreneurs and notaries are subject, inter alia, to turnover taxes replacing VAT and (or) income tax; 2) in the framework of the patent tax system, organizations and individual entrepreneurs are subject, inter alia, to a patent tax replacing VAT and (or) income tax; 3) in the framework of the family business system, organizations and individual entrepreneurs in the cases established by Chapter 56 of the Tax Code are exempt, inter alia, from VAT and (or) income tax and turnover tax.

Since the key task of this study is to try to determine the impact of the tax policy of Armenia on the rate of economic growth, in the framework of this work we have considered the dynamics of key indicators of tax policy in general, as well as individual taxes in particular.

Dynamics of the annual plan of tax revenues of the state budget is presented in *Fig. 1*. As we can notice, in times of crisis, the annual plan and actual implementation differ significantly. However, since 2014, the annual plan has consistently not been implemented.

[1] Tax Code of the Republic of Armenia. URL: http://www.parliament.am/law_docs5/011116HO165_rus.pdf (accessed on 11.04.2022).

[2] Tax Code of the Republic of Armenia. URL: http://www.parliament.am/law_docs5/011116HO165_rus.pdf (accessed on 11.04.2022).

[3] Tax Code of the Republic of Armenia. URL: http://www.parliament.am/law_docs5/011116HO165_rus.pdf (accessed on 11.04.2022).

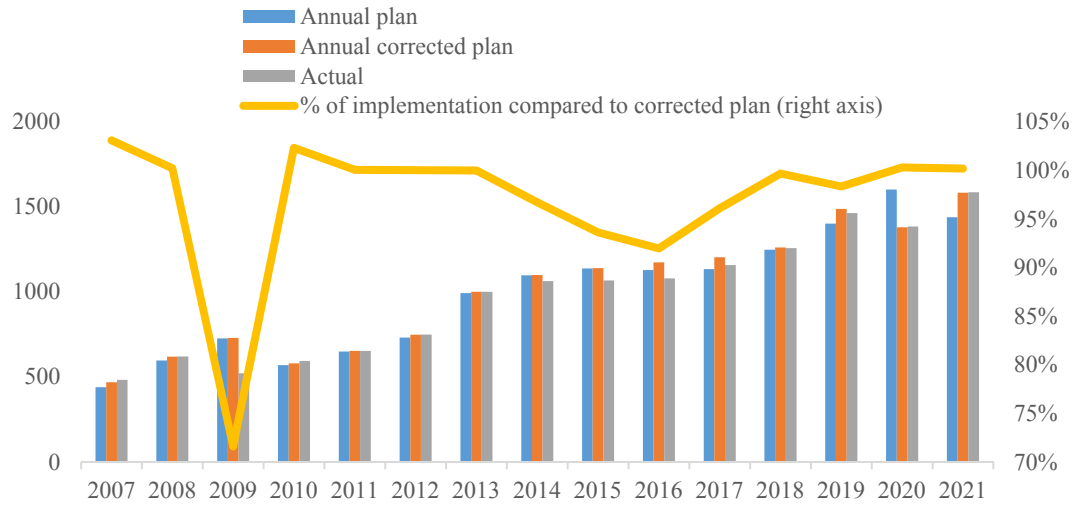

Fig. 1. **Tax Revenues and State Duties, in bln AMD**

Source: Database of the Ministry of Finance of RA.

This may indicate the inefficiency of tax administration in the first place.

However, the dynamics of tax revenues (*Fig. 2*), as well as the tax burden relative to aggregate demand, suggest that the significant increase in tax burdens on the economy has led to a reduction in tax collection to some degree.

Overall tax revenue dynamics show steady growth, both in absolute terms and relative to the country's GDP. Important is also how tax revenue dynamics change during times of crises. If in 2009 volumes and the share of tax revenues to GDP decreased, we notice an increase in this indicator during the 2014 crisis. After the global financial crisis, tax policy was largely restrictive, regardless of the cyclical nature of the economy.

When comparing this indicator with data from the world, or groups of countries with medium or high income, we can see that the share of tax burden on the economy in Armenia is much higher than it can be observed in other countries.

The structure of tax revenues is also of interest in terms of economic growth, where three stages can be observed (*Fig. 3*). The first phase (until 2009) was characterized by a decrease in tax revenue flows, mostly through the VAT. The 2010–2012 period was marked by a sharp increase in tax revenues, mostly in terms of VAT, but growth in revenues from other types of taxes could also be observed.

Since 2013, we have not only seen an increase in total tax revenues, but also a significant increase in income-tax revenues. This dynamic is due to the tax reform, which combined social deductions from employers per employee and wages, which ultimately increased the income tax base almost three times and allowed a significant increase in gross wages.

Tax reform has had a direct and sufficiently positive impact on the taxation process. The amount of tax payments, as well as the time spent on the preparation and payment of certain taxes, has been significantly reduced (*Fig. 4*). From the point of view of the beneficial impact on the business environment, positive trends can be noted. However, the lack of significant economic growth during this period suggests that, at least in the medium term, these positive developments have not affected the pace of economic growth.

In Armenia, the prevalence of indirect taxes has been observed for almost the entire period (*Fig. 5*). However, since 2013 it is possible to consider the alignment of the ratio of indirect and direct taxes in the structure of tax revenues of the state budget of Armenia.

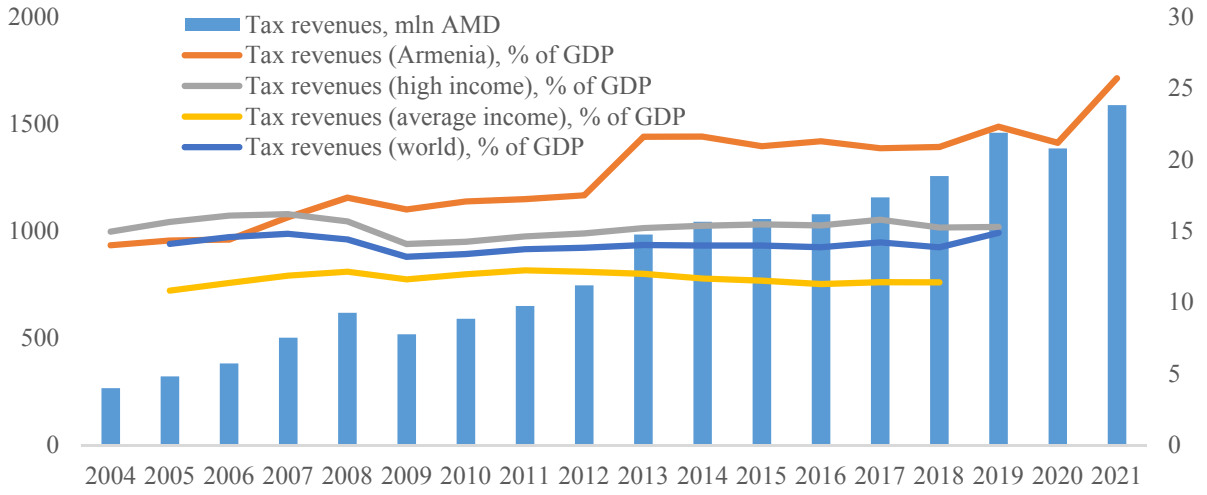

Fig. 2. **Tax Revenues, in bln AMD and % of GDP**

Source: RA Tax Service database and World Bank database.

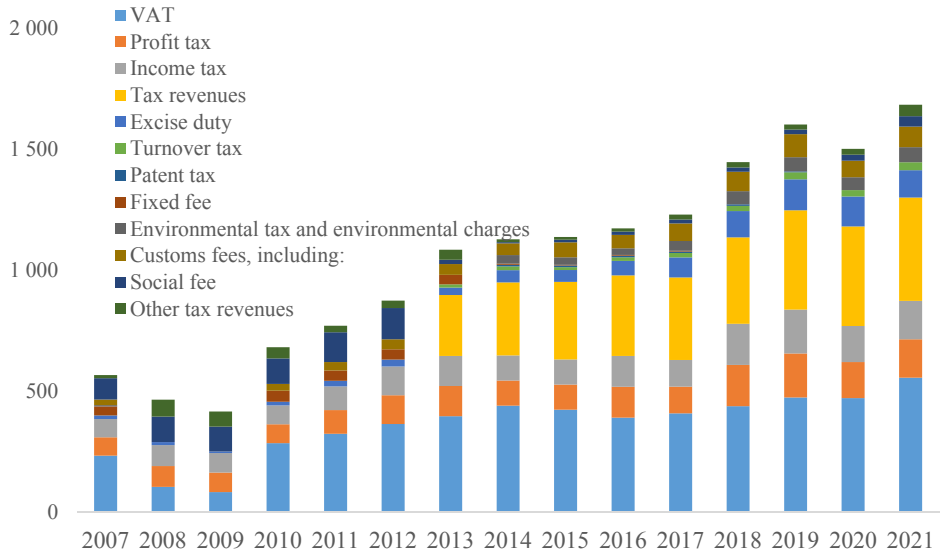

Fig. 3. **Tax Revenues in bln AMD, its Structure**

Source: Database of the State Revenue Committee Service of RA.

INDIRECT TAXES

The group of indirect taxes in Armenia includes value added tax (VAT), excise duties and turnover tax. The majority of these taxes are imposed by the VAT. The dynamics of VAT over the last fifteen years are represented on *Fig. 6*. As we can see, the period 2007–2009 was characterized by a sharp decrease in the amount of VAT in the structure of tax revenues. As of 2009, the share of VAT in GDP was 2.7%, and the share in taxes income — 16.1%. Since 2010, we have seen an increase in both VAT and GDP, as well as in the tax revenues of the state budget.

Since 2012, we have seen a significant decrease in the share of VAT in taxes income (48.8% in 2012 and 25.2% in 2019). However, the share of GDP remains virtually the same, excluding a certain increase in 2021. VAT dynamics show some decrease only in 2020–2021, which can be explained by a pandemic and a decline in worldwide trade turnover.

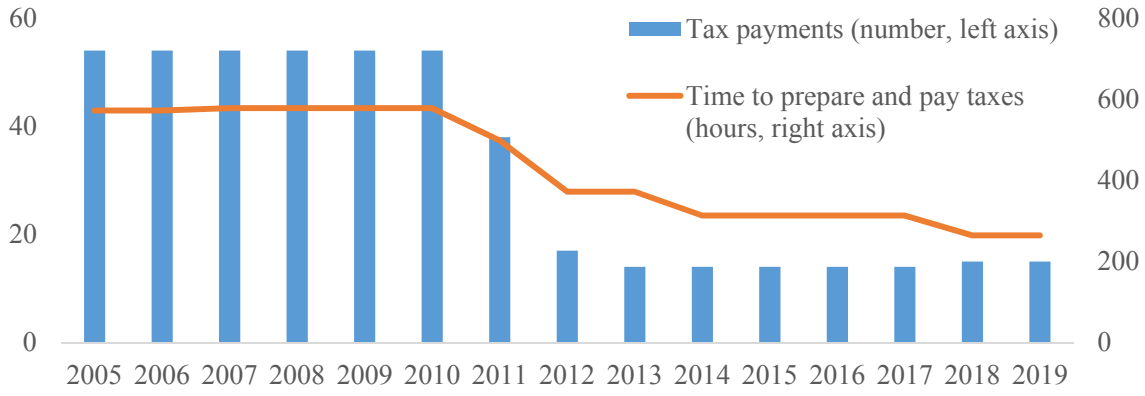

Fig. 4. **Tax Payments (Number) and Time to Prepare and Pay Taxes (Hours)**

Source: World Bank database.

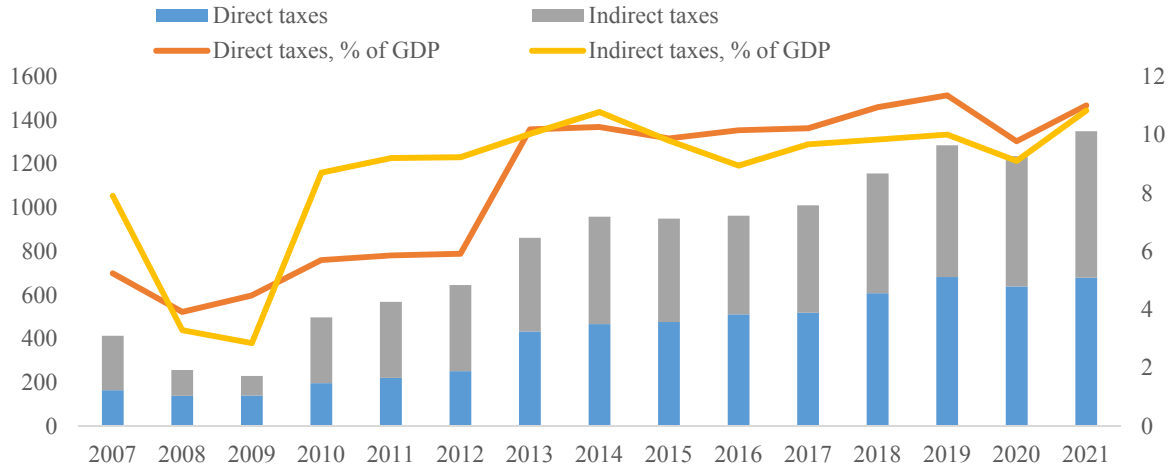

Fig. 5. **Ratio of Indirect and Direct Taxes in RA, bln AMD**

Source: Calculated by the authors based on the database of the State revenue committee and Statistical Committee of RA.

The dynamics of the amount of excise tax, as well as its share in total tax revenues and in GDP are represented in *Fig. 7*. As with VAT, we have seen a rise in excise tax revenues starting in 2014, and a significant increase in these revenues beginning in 2017. Also, the dynamics of reduction are observed during the COVID-19 pandemic.

The share of excise duties in GDP is rather insignificant and is not more than 1%, so the tax has no direct impact on economic activity through a large tax burden. As for the share of total tax revenues, it was 7.7% as of 2019. It should be noted the noticeable dynamics of the growth of the share of excise duty in tax revenues in the period under consideration, which is due, among other things, to the increase in the absolute value of the volumes of the excise tax in the last ten years.

Dynamics of turnover tax amounts represented in *Fig. 8*. As in absolute terms, as in the share of GDP or share of tax revenues of the state budget, we see a noticeable increase. The share of tax on turnover from GDP in 2021 was 0.5% and the share in tax revenues as of 2019–2%.

The dynamics of VAT, excise and turnover tax revenues are marked by significant growth. This is due to both a certain increase in rates and an increase in income from these taxes. This trend also indicates a restrictive policy aimed not only at filling up the state budget, but also at reducing aggregate demand, primarily in terms of population consumption.

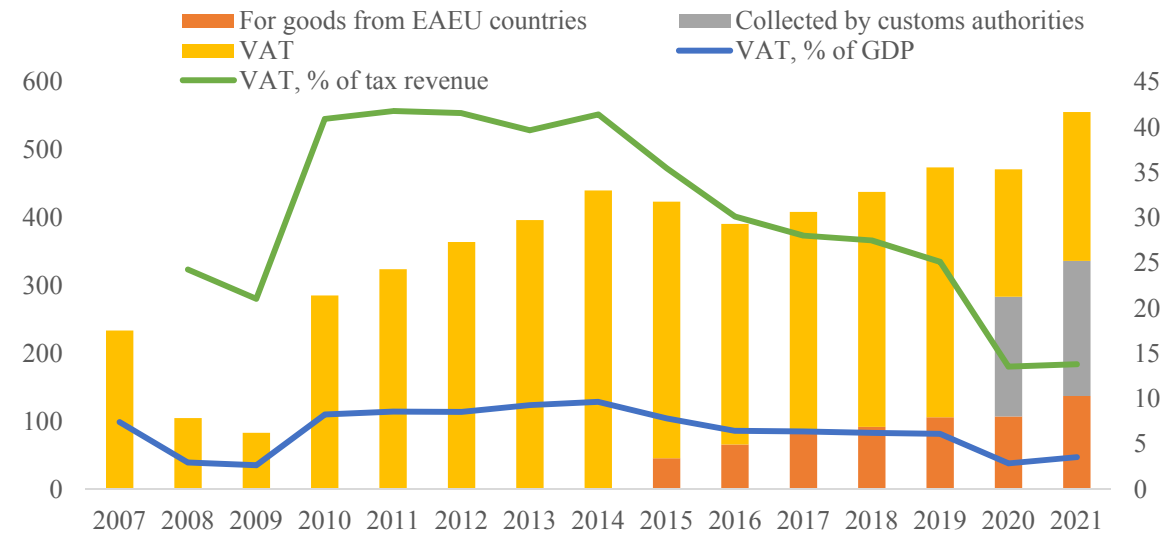

Fig. 6. **VAT in bln AMD, and % to GDP and % to Tax Revenues**

Source: Database of the State Revenue Committee Service of RA.

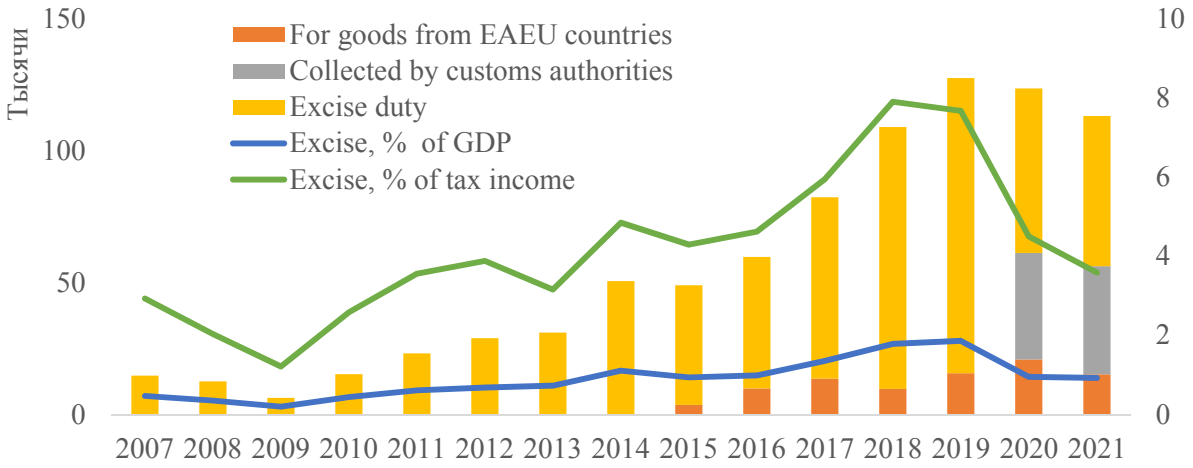

Fig. 7. **Excise in bln AMD, and % to GDP and % to Tax Revenues**

Source: Database of the State Revenue Committee Service of RA.

DIRECT TAXES

Direct taxes are of much greater importance to the real sector, since they directly affect the producer. On the other hand, the dynamics of direct taxes are more sensitive to changes in economic activity, and in this sense, direct taxation and real-sector activities are more directly interdependent.

Income tax is considered to be the most important tax in terms of economic activity (*Fig. 9*). The share of income tax in GDP is not very significant and is 2.6% as at 2021. However, the overall trend of the share of income tax in GDP indicates a slight increase, which also characterizes the deterrent nature of tax policy in Armenia. At the same time, the reduction in the share of income tax in the total tax revenues of the state budget should be noted. As of 2019, this share was 12.4% compared to 15% in 2007.

In terms of dynamics, income tax is of greater interest (*Fig. 10*). Tax reform in 2012 is significantly increased both income tax and share of budget tax revenues as well as share of GDP. In both absolute and relative terms, we are seeing almost threefold growth. The

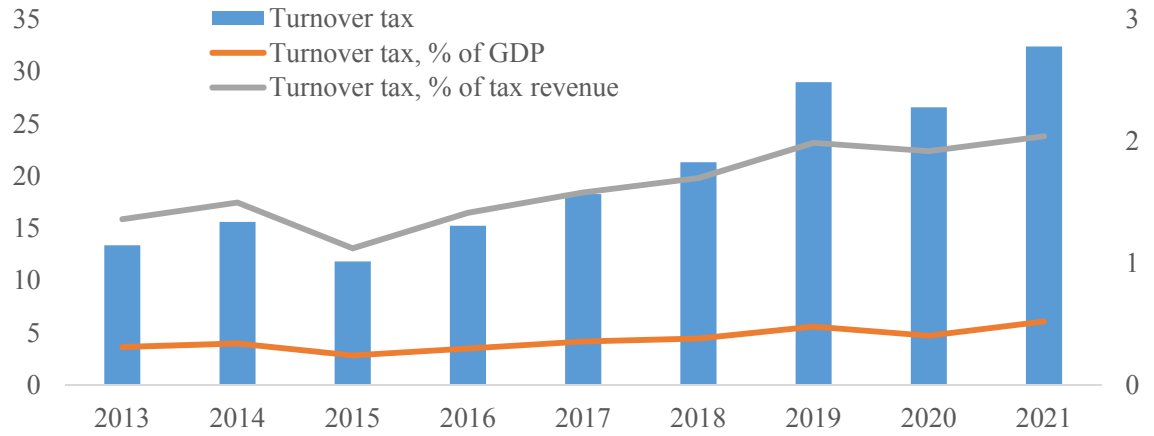

Fig. 8. **Turnover Tax in bln AMD, and % to GDP and % to Tax Revenues**

Source: Database of the State Revenue Committee Service of RA.

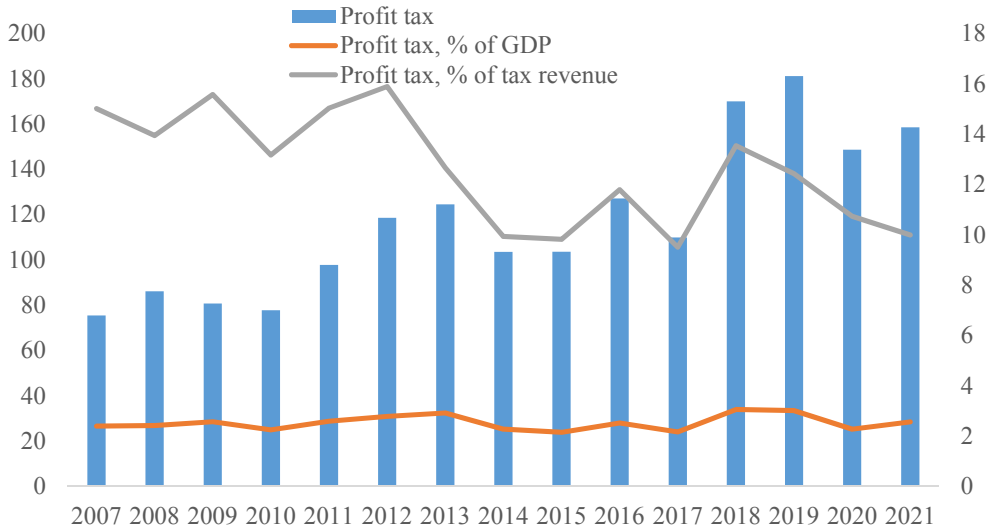

Fig. 9. **Profit Tax in bln AMD, and % to GDP and % to Tax Revenues**

Source: Database of the State Revenue Committee Service of RA.

overall trend both before and after the income tax reform is accompanied by an increase in the tax burden.

Given the recession that we have seen in the Armenian economy since 2009, we can see a significant increase in tax revenues from the income tax line to the state budget. This fact is also confirmed in *Fig. 11*, which reflects the dynamics of income tax, income tax and capital gains combined. As of 2019, this figure as a percentage of total revenue was 37.4%, compared to 21.1% in 2012 and in 2004–14.5%. Thus, throughout the period, we have observed a deterrent tax policy on virtually all taxes that have a significant share of tax revenues.

In summarizing the analysis of tax policy in general, it should be noted the clearly dissuasive nature of the past 15 years. Both direct and indirect taxes have the greatest impact on the consumer (or households), which, in the absence of a noticeable growth in economic activity and income of the population, leads to increased income inequality, as well as an increase in poverty levels in the country.

In general, there is a need to assess the role of tax revenues and tax policy in ensuring

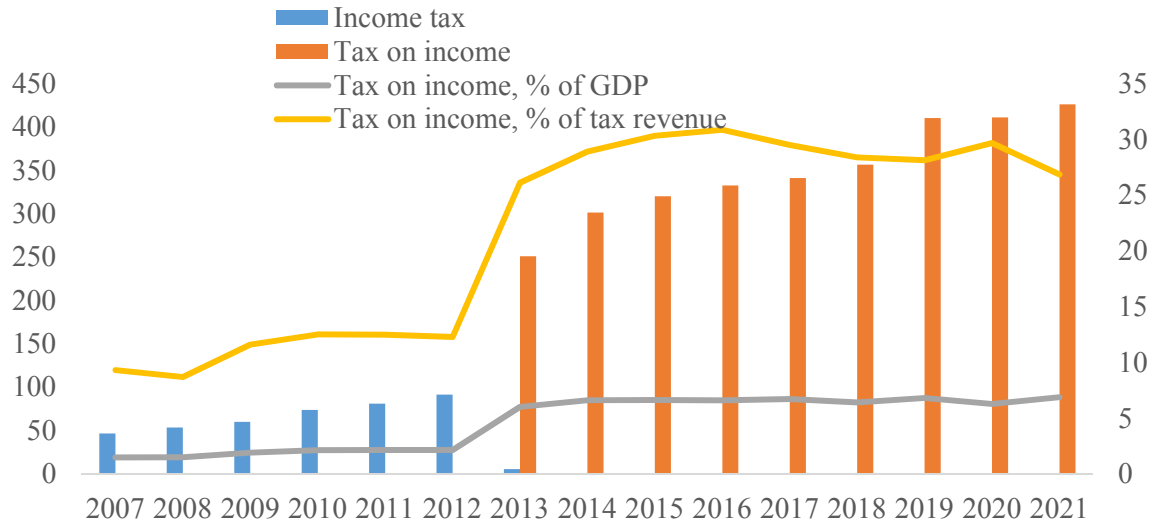

Fig. 10. **Income Tax (Tax on Income) in Bln AMD and % to GDP and % to Tax Revenues**

Source: Database of the State Revenue Committee Service of RA.

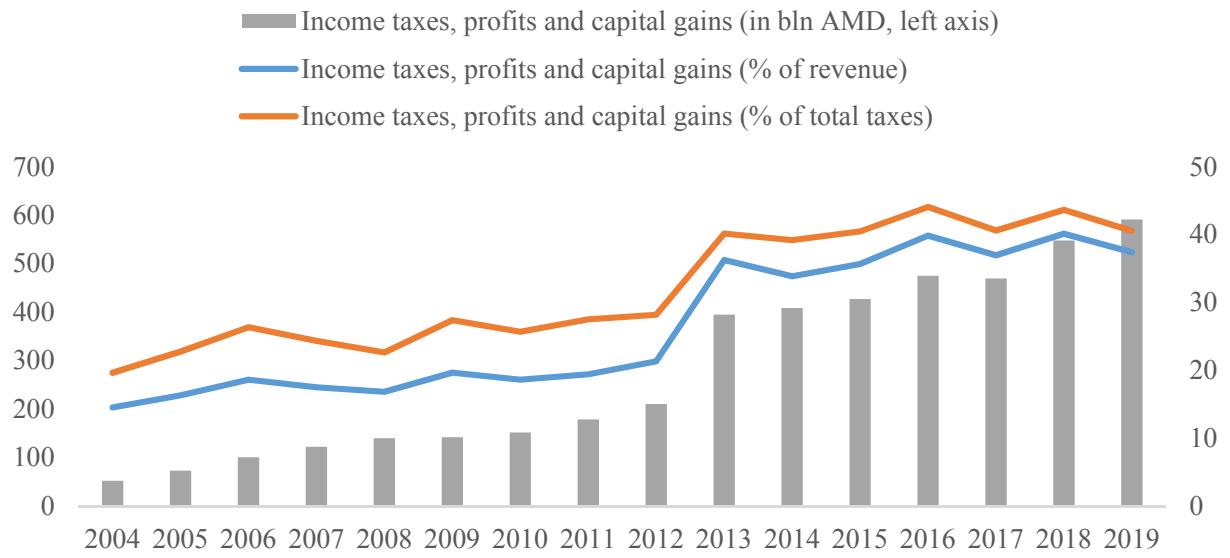

Fig. 11. **Taxes on Income, Profits and Capital Gains**

Source: The World Bank database.

economic growth, as discussed in the next section of this paper.

TAXES AND ECONOMIC GROWTH IN ARMENIA (MODEL)

As shown above, the analysis of the dynamics of tax revenues to the budget allows to conclude a deterrent policy throughout the period under consideration. Based on this, we argued that deterrent policies had led to a slowdown in economic growth. In this regard, it is necessary to assess the impact of tax policy on economic growth.

One of the most popular methods of assessing the impact of tax policy on economic growth is the assessment of impact factors using a vector autoregression model (VAR). We have developed a VAR model to assess the impact of state budget tax revenues on Armenian GDP. The study used quarterly GDP data of Armenia and data on all types of taxes from 2008 to 2022. The source of the data on

Table 1

Descriptive Statistics of the Variables

	GDP	Profit_t	Income_t	VAT	Excise_t	Turnover_t	GDP_RF
Mean	0.0583	0.0481	0.0726	0.0847	0.1538	0.1204	0.0915
Median	0.06486	0.0432	0.0618	0.0628	0.1704	0.1676	0.0769
Maximum	0.2107	0.6835	0.2434	0.5033	1.1595	0.7178	0.2754
Minimum	–0.1339	–0.5635	–0.1765	–0.4058	–0.9066	–0.4383	–0.1172
Std. Dev.	0.0679	0.2852	0.0804	0.1985	0.4001	0.2607	0.0928
Skewness	–0.5752	0.0758	0.0177	0.0507	0.0644	–0.3179	0.1057
Kurtosis	3.5748	2.6447	4.0308	3.2651	4.4671	2.9071	2.9874
Jarque-Bera	3.6527	0.3295	2.3492	0.1779	4.7899	0.5679	0.099
Probability	0.161	0.8481	0.3089	0.9149	0.0912	0.7528	0.9517
Observations	53	53	53	53	53	33	53

Source: Calculated by the authors using the EViews 10 econometric package.

tax returns is the database of the Tax Service of RA and the National Statistical Service of RA.

The following variables have been used as endogenous factors affecting economic growth:

- Value added tax (VAT), mln AMD, 2008Q1–2022Q1;
- Profit tax (Profit_t), mln AMD, 2008Q1–2022Q1;
- Income tax (Income_t), mln AMD, 2008Q1–2022Q1;
- Excise tax (Excise_t), mln AMD, 2008Q1–2022Q1;
- Turnover tax (Turnover_t), mln AMD, 2013Q1–2022Q1.

Due to the substantial changes made to the Armenian Tax Code in 2013, problems arose in view of the long time series on income tax. In order to compare the temporary income tax lines up to 2013 with income tax (a single tax including social benefits, in force since 2013) we have summed up the amount of compulsory social benefits and income tax.

As an exogenous variable, it is customary to include in the model of GDP the largest trading partner of the country, which in the case of Armenia is the Russian Federation. In this regard, we have chosen GDP of the Russian Federation (GDP_RF). We have also included the REM model as a factor reflecting external shocks.

The relevant time series verification showed seasonality in both GDP and exogenous variables and income dynamics for all taxes. In this regard, all timescales were adjusted for seasonality with the Census X-13 procedure, which allowed the timescale to be cleared from seasonality's while preserving the dynamic structure. The following standard procedure has been applied to obtain the stationary time rows: logarithm of the time row using the natural logarithm (e), calculation of the first differences in relation to the corresponding quarter of the previous year. The final time rows were tested for stagnation (ADF unit root test) and normality of distribution (Histogram and Jarque-Bera test). The descriptive statistics of the variables are presented in *Table 1*. The primary statistical data processing resulted in fixed time series with normal distribution from 2009Q1 to 2022Q1 (2014Q1 through 2022Q1) in the case of turnover tax).

In connection with the time series starting with 2013, the impact of this type of tax

Table 2

The Output Results of VAR (3) Model for Tax Policy

Variables	Coefficient	Standard error	P-value	t-statistics
GDP (–1)	0.200600	0.1479	0.1773	1.35628
GDP (–2)	0.108847	0.14772	0.4625	0.73686
GDP (–3)	0.226013	0.15438	0.1455	1.46398
Income_t (–1)	**0.283552**	0.10351	**0.007**	**2.7395**
Income_t (–2)	0.000369	0.09312	0.9968	0.00397
Income_t (–3)	**–0.220898**	0.10214	**0.0323**	**–2.16266**
Profit_t (–1)	**–0.06064**	0.02479	**0.0157**	**–2.44635**
Profit_t (–2)	–0.009534	0.02343	0.6847	–0.4069
Profit_t (–3)	–0.02094	0.02541	0.4113	–0.82407
VAT (–1)	**–0.113832**	0.05489	**0.04**	**–2.07379**
VAT (–2)	–0.017517	0.06773	0.7963	–0.25862
VAT (–3)	–0.007524	0.05506	0.8915	–0.13665
GDP_RF	**0.425471**	0.13246	**0.0016**	**3.21204**
REM	**0.094507**	0.04186	**0.0256**	**2.25752**
C	0.003897	0.01708	0.8198	0.22821
R-square	0.686594			
R-square adj.	0.557545			
F-statistic	5.320393			
Akaike AIC	–3.348198			
Schwarz SC	–2.769069			
Durbin-Watson stat	1.990072			

Source: Calculated by the authors using the EViews 10 econometric package.

on the GDP of Armenia was considered separately. The analysis revealed that excise tax was not a significant variable for Armenian GDP and was excluded from the model. *Table 2* presents the results of the first vector auto-regression model. We have chosen a three-lag model based on the quality analysis of the model according to the Akaike and Schwartz criteria.

We have carried out all the necessary tests to verify the reliability of the results of the evaluation of coefficients using the VAR model (3). *Table 1* shows that according to Durbin-Watson statistics, the model has no problem with the autocorrelation of the residues of the regression model. We also conducted a test for heteroscedasticity and normality of residues (*Table 3*). The results show that random model errors are homoscedasticity and the residual distribution is normal.

The VAR (3) model with estimated coefficients is presented below:

Table 3

Tests for Heteroscedasticity and Normal Distribution

Model	Test	Chi-sq / Jarque-Bera	df	Prob.
VAR (3)	Heteroscedasticity	719.217	756	0.8276
	Normal distribution (Cholesky of covariance)	11.47399	12	0.4888
VAR (4)	Heteroscedasticity	59.32584	60	0.5003
	Normal distribution (Cholesky of covariance)	2.803403	4	0.5912

Source: Calculated by the authors using the EViews 10 econometric package.

$$\begin{gathered}\mathrm{GDP} = 0.2*\mathrm{GDP}(-1)+0.109*\mathrm{GDP}(-2)+0.23*\mathrm{GDP}(-3)+0.28* \\ *\mathrm{INCOME\_T2}(-1)-0.0004*\mathrm{INCOME\_T2}(-2)-0.22* \\ *\mathrm{INCOME\_T2}(-3)-0.06*\mathrm{PROFIT\_T}(-1)-0.01*\mathrm{PROFIT\_T}(-2)- \\ -0.02*\mathrm{PROFIT\_T}(-3)-0.11*\mathrm{VAT}(-1)-0.017*\mathrm{VAT}(-2)-0.01* \\ *\mathrm{VAT}(-3)+0.42*\mathrm{GDP\_RF}+0.09*\mathrm{REM}+0.003.\end{gathered}$$

In identifying the impact of the turnover tax on the GDP of Armenia, a similar four-lag model was developed. The results of the VAR model (4) are presented in *Table 4*. The results of the tests for heteroscedasticity and normality of the residue distribution (*Table 3)* show that random errors in the model are homoscedasticity and that the residual distribution is normal. No autocorrelation observed in the model.

Below is a VAR (4) model with estimated coefficients:

$$\begin{gathered}\mathrm{GDP} = 0.33*\mathrm{GDP}(-1)+0.19*\mathrm{GDP}(-2)-0.003*\mathrm{GDP}(-3)- \\ -0.06*\mathrm{GDP}(-4)-0.06*\mathrm{TURNOVER\_T}(-1)+0.17*\mathrm{TURNOVER\_T}(-2)- \\ -0.21*\mathrm{TURNOVER\_T}(-3)+0.1*\mathrm{TURNOVER\_T}(-4)+ \\ +0.35*\mathrm{GDP\_RF}+0.11*\mathrm{REM}+0.006.\end{gathered}$$

The results of the econometric analysis show:

- excise tax does not affect the GDP of Armenia;
- tax on income has a significant impact on the GDP of Armenia with a 5% level of significance. The inclusion of 1% tax on income in the state budget leads to a 0.28% increase in GDP in the first quarter after the shock and a 0.22% decrease in the GDP already in the third quarter.
- income tax has a significant impact on the GDP of Armenia with a 5% level of significance. A 1% increase in state budget from income tax leads to 0.06% decline in GDP in the first quarter after the shock;
- value added tax has a significant impact on the GDP of Armenia with a 5% significance level. A 1% increase in state VAT revenue leads to 0.11% reduction in GDP in the first quarter after the shock;
- turnover tax has a significant impact on the GDP of Armenia with a 10% level of significance. A 1% increase in state budget from turnover tax leads to 0.21% GDP decline in the third quarter and 0.1% increase in GDP in the fourth quarter after the shock.

Table 4

The Output Results for VAR (4) Model for Tax Policy

Regressor	Coeff.	Standard error	P-value	t-statistics
GDP (–1)	0.327043	0.16574	0.0566	1.97326
GDP (–2)	0.19558	0.19936	0.3335	0.98109
GDP (–3)	–0.002659	0.28608	0.9926	–0.00929
GDP (–4)	–0.064281	0.2539	0.8017	–0.25317
Turnover_t (–1)	–0.057548	0.08091	0.4818	–0.71126
Turnover_t (–2)	0.169985	0.11848	0.1605	1.43467
Turnover_t (–3)	**–0.213114**	0.10973	0.0604	**–1.94217**
Turnover_t (–4)	**0.101439**	0.05825	0.0906	**1.74152**
GDP_RF	**0.351128**	0.18767	0.07	**1.87098**
REM	**0.113897**	0.0629	0.079	**1.81081**
C	0.006323	0.01761	0.7218	0.006323
R-square	0.799569			
R-square adj.	0.681669			
F-statistic	6.781743			
Akaike AIC	–3.334312			
Schwarz SC	–2.810945			
Durbin-Watson stat	1.680729			

Source: Calculated by the authors using the EViews 10 econometric package.

CONCLUSION

Summarizing the above analysis, it can be noted that both theory and practice indicate a rather ambiguous nature of the impact of tax policy on the rate of economic growth. A review of the theory showed that the impact of tax policy in general or hotel taxes on economic growth rates depends heavily on the structure of the economy, the degree of development of the institution, the presence of market and state regulation, and a variety of other factors. At the same time, developed and developing countries differ significantly in terms of the impact of tax policy on economic growth. In general, the conclusion of the theoretical review suggests that tax policy cannot directly influence the economic growth and development of a country, but contributes to the creation of a suitable business environment for the activities of the real sector, which in the long term allows to ensure sustainable rates of economic growth.

As far as the experience of Armenia is concerned, the key conclusion on the nature of tax policy is that both tax regulation in general and individual tax dynamics are dissuasive. In our view, this fiscal policy over the past few decades has led to a slowdown in economic growth. Moreover, Armenia's tax policy is deterrent both in times of economic growth and in periods of recession and crisis. The steady rise in tax charges and tax burden has led to a decrease in cash flow in the real sector, which in turn holds back the pace of economic growth. Thus, Armenia's tax policy can be characterized not only as deterrent, but also as pro-cyclical, where, regardless of economic cycles, the state chooses either deterrent or incentive regulation. In this context, a counter-cyclical strategy that would enable the market to deal more effectively with both internal and foreign shocks is one of our main recommendations from the perspective of Armenia's common tax policy.

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ABOUT THE AUTHORS

Mariam A. Voskanyan — Dr. Sci. (Econ.), Assoc. Prof., Head of the Department of Economics and Finance, Russian-Armenian University, Yerevan, Armenia
https://orcid.org/0000-0002-5417-6648
mariam.voskanyan@rau.am

Ani G. Galstyan — PhD (Econ.), Assoc. Prof., Department of Economics and Finance, Russian-Armenian University, Yerevan, Armenia
https://orcid.org/0000-0002-7800-7232
Corresponding author:
ani.galstyan@rau.am

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A Conceptual Model for Evaluating Digital Intellectual Assets

O.V. Loseva, M.A. Fedotova, N.M. Abdikeev
Financial University, Moscow, Russia

ABSTRACT

The **object** of the study is the valuation and commercialization of digital intellectual assets. The **subject** of the study is a conceptual model for assessing the value of digital intellectual assets, reflecting the regulatory framework, objects, subjects, principles, approaches and methods of evaluation involved in civil turnover. The **relevance** of the study is related to the development of the digital economy and emerging new types of digital assets, including digital intellectual assets, which require their identification and the formation of a theoretical and methodological basis for valuation. The **purpose** of the study is to build a conceptual model for estimating the value of digital intellectual assets for subsequent commercialization with consideration of the identified identification characteristics, substantiated principles, factors, approaches and methodological tools. The **methods** of comparative analysis, generalization, classification, logical, semantic and functional modeling, cost estimation are used in the paper. The trends of digitalization of the economy are analyzed, the identification features of digital intellectual assets are determined based on the study of the concepts of "digital asset", "intellectual asset", "object of valuation". A semantic model of the valuation of digital intellectual assets is proposed, illustrating the relationship of its conceptual elements. A process-functional model for estimating the value of digital intellectual assets in IDEF0 notation is constructed. It is **concluded** that digital intellectual assets as objects of valuation in the conditions of the current regulatory regulation are: 1) the results of intellectual activity created with the use of digital technologies, for which digital rights are fixed in the information system in the form of NFT tokens; 2) digital rights to use intellectual property objects that exist in digital or other forms. Their cost can be determined by the method of analogues, the method of discounted cash flows or the cost of creation method, depending on the purpose of the assessment, the identified factors and taking into account the principles of evaluation.

Keywords: digital intellectual assets; semantic model; functional model; value; commercialization; approaches and methods of valuation

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INTRODUCTION

The relevance of the study of digital intellectual assets as objects of valuation for purposes of commercialization is due to the recent intensification of digitization processes in all spheres of life of society, both worldwide and in the Russian Federation.

If we discuss global trends, according to the international portal Statista,[1] in 2023 revenue in the digital asset segment will reach 1 965,00 mln USD, and the number of users in the Digital Asset segment by 2027 will be 37 520 thous. people. According to the analysts of the portal, the market of digital assets in the coming years will continue to rise. Factors like the active adoption of digital technology (mainly blockchain), the rising interest in decentralized finance, and the acceptance of irreplaceable tokens contribute to enable this. However, as in any developing market, there are also risks and challenges related to regulatory uncertainty and potential volatility. Furthermore, the functioning of the digital asset market requires the creation of a favorable digital environment — widespread adoption of digital technologies, development of digital competences of the population and formation of a scientific and methodological base for the management of new asset types.

In Russia, gross expenditure on the digital economy in 2021 amounted to 3.7% of the country's GDP, or 4 848 bln rubles, which is 19% higher than in 2020. At the same time, the internal costs of organizations for the creation, dissemination and use of digital technologies and related products and services increased to 2 947 bln rubles, i.e. by 30.3%, and the corresponding expenses of households exceeded 1.9 trn rubles. In the context of the digitization of everyday life, the population is increasingly interested in acquiring relevant competences. Almost 82% of Russian citizens aged 16–74 use the Internet on a daily basis, including 53% for financial transactions and 46.6% for ordering goods and services.[2]

The development of digital technologies in the economy and digital competences of the population provides the necessary ground for the use of new digital assets, but without appropriate regulation their inclusion in the civilian circulation and subsequent gain from ownership is impossible.

Russia has chosen a model of direct regulation of digital assets, providing for their allocation to a separate object of civil circulation with special legal status. In particular, legal conditions have been created for the release and circulation of new digital instruments —digital utility rights (hereinafter — DUR) and digital financial assets (hereinafter — DFA), that can be issued and circulated in information systems using distributed registry technology. Digital utility rights within the meaning of the Federal Law No. 259 from 02.08.2019[3] mean digital rights, including:

- right to demand the transfer of the thing (things);
- right to demand the transfer of exclusive rights to the results of intellectual activity and/or the rights of use of the outcomes of intellectually activity;
- right to demand the execution of works and/or the provision of services.

In essence, the acquisition of digital utility rights has become a way of investing in digital assets, including digital intellectual assets using various investment, including crowdfunding platforms. At the fundamental level and within the framework of the specific regulation of the law, it is required that the holder has direct (without intermediaries)

[1] URL: https://www.statista.com/outlook/dmo/fintech/digital-assets/russia (accessed on 07.05.2023).

[2] Abdrakhmanova G., Vasilkovsky S., Vishnevskiy K. et al. Digital Economy 2023: a brief statistical collection. Moscow: HSE; 2023. URL: https://issek.hse.ru/mirror/pubs/share/802513326.pdf (accessed on 07.05.2023).

[3] Federal Law No. 259 from 02.08.2019 "On attraction of investments using investment platforms and on introduction of amendments to separate legislative acts of the Russian Federation". The Russian Federation Code. 2019. No. 31. Art. 4418.20.

access to his digital rights using information technology (including a unique code for the DFA), including the right to obtain information about the digital rights that the individual possesses and the ability to dispose of them.

A key role in regulating the digital asset market was played by the adoption of the Federal Law No. 259 from 31.07.2020,[4] which introduced the concept of a distributed register, as well as the regulation of relations arising from the issuance, accounting and circulation of DFA.

According to a number of experts, these innovations will lead to the fact that the Russian market of digital financial assets in 2023 will amount to more than 1 trn rubles, and by 2028 will grow to 3.5–4 trn rubles.[5]

Despite the fact that the majority of digital assets currently belong to DFAs, the role of digital intellectual assets (hereinafter —DIA) as objects of valuation and commercialization is also increasing in connection with the increasing importance of intellectual property for the competitiveness of the Russian economy as a whole and in particular. So far, the share of intellectual property in the country's GDP is extremely small and seems insignificant against the background of the growth of intellectual property share in the GDP of other countries. Meanwhile, the issue of classifying digital assets to DIA as objects of civilian circulation remains unresolved. The problems of scientific and theoretical justification of the valuation of these assets are poorly studied. his reduces the commercialization potential of DIA and increases the lost profit of Russian entrepreneurs, which ultimately negatively affects the global competitiveness of the Russian economy in difficult geopolitical conditions.

Thus, the purpose of the study is to develop a conceptual model of the value of digital intellectual assets for subsequent commercialization, taking into account identified characteristics, substantiated principles, factors, approaches and methodological tools. The tasks that follow must be performed in order to achieve the goal:

- identify the key features of digital intellectual assets, identify those DIAs that may be valued;
- identify the subjects, principles, factors, approaches and methods of valuation of digital intellectual assets for the purpose of subsequent commercialization;
- develop a semantic and functional model for the valuation of digital intellectual assets.

RESEARCH MATERIALS AND METHODS

The information base for writing the article was the results of the own research conducted in 2022 within the framework of the first phase of implementation of the grant of RSF on the topic "Formation of concept of valuation and commercialization of digital intellectual assets" [1, 2], as well as the work of domestic and foreign lawyers, economists, IT-specialists on the relevant subject, regulatory and legal acts of digital property relations, intellective property objects, valuation activities, data from open sources and specialized sites, including the Ministry of Economic Development, Rostat, Rospatent, the Bank of Russia, business internet portals, etc.

The emergence of digital assets would not have been possible without the development of blockchain technology, which is based on the protocol first proposed by American cryptographer David Chaum in his thesis "Computer systems established, maintained and trusted by mutually suspi-cious groups" [3]. In developing this idea, the researchers, focusing on the emerging commercial possibilities of the described technology,

[4] Federal Law No.259 from 31.07.2020 "On digital financial assets, digital currency and on amendments to individual legislative acts of the Russian Federation". The Russian Federation Code. 2020. No. 31 (Part I). Art. 5018.

[5] URL: https://zakon.ru/blog/2023/03/31/intellektualnaya_sobstvennost_kak_cifrovye_ finansovye_ aktivy_cfa_informacionnoj_sistemy_centralnogo_ (accessed on .05.2023).

focused on the application of blockchain for financial markets, banks, IT-companies, real-sector companies, gaming business and even government registers and personal data personification [4–6]. Finally, Russian and foreign scientists addressed the problem of identifying digital assets, primarily in terms of their legal regulation [7–10]. Much less attention is paid to the economic nature and types of digital assets in Russian and foreign sources. For example, the paper [11] defines as: "digital asset is a virtual object of civilian circulation with real financial value and operating in a distributed register as a unique identifier". As types of digital assets are listed cryptocurrencies, tokens, as well as "any file on a computer, storage device or website and any online account or subscription". It is difficult to agree to such a division, because not all files can be used in a distributed registry and have value. The number of studies of foreign and Russian authors devoted to digital non-financial assets — 3D-models [12, 13], digital art[6] [14], NFT-tokens in the sphere of intellectual property [15].[7] However, the papers devoted to the comprehensive study of digital intellectual assets as objects of valuation for the purposes of commercialization, related basic categories, disclosure of their specific characteristics, is practically absent. Comparative analysis, generalization, classification, logical, semantic, and functional modeling techniques, as well as cost analysis, were all used to fill this gap.

RESULTS OF THE STUDY

Digital Intellectual Assets as Objects of Valuation for Commercialization

To define a digital intellectual asset as an object of valuation, it is necessary to examine the relationship between the concepts of "digital asset", "intelligent asset" and "object of valuation".

For all these concepts is the economic characteristic of any asset — the ability to benefit the owner from realization or use, including in the form of income.

Digital asset (hereinafter — DA) and any object of valuation (OV) are objects of civil (property) turnover, as defined in the Civil Code of the Russian Federation following the adoption of the Federal Law No. 34 from 18.03.2019[8] and the Federal law No. 135 from 29.07.1998[9] "On valuation activities in the Russian Federal Federation". According to existing Russian legislation, digital assets include some instruments (*Fig. 1*).

The most important feature of a digital asset is the possibility of its existence exclusively in intangible (electronic) form. Digital assets issued on the blockchain may not have any connection to real assets and values outside the blockchain, but at the same time give their owner certain rights. Or, on the contrary, they may be related to financial and non-financial assets and, for example, be reserved in a traditional accounting system (depositary, custodian) or be deposited with the responsible persons.

Intellectual activity results, which are objects of valuation, also have an intangible form. However, not every DA is the subject of civil rights. In particular, virtual (game) property, although established by the creative work of the developer or the player himself, at the moment has no legal regulation, while it can bring its owner quite real income.

We note that digital intellectual assets created by artificial intelligence or with the application of machine learning (Big Date)

[6] Mario 3D Modeling Costs — 5 Factors That Affect Project Pricing. URL: https://www.cadcrowd.com/blog/3d-modeling-costs-5-factors-that-affect-project-pricing/ (accessed on 05.04.2023).

[7] A World's Largest NFT Data Resource. Nonfungible.Com. URL: https://nonfungible.com/market/history (accessed on 01.05.2023).

[8] Federal Law No. 34 from 18.03.2019 "On amendments to one, two parts and article No. 1124 of the third Civil Code of the Russian Federation" (on digital rights). URL: https://www.consultant.ru/document/cons_doc_LAW_320398/ (accessed on 16.05.2023).

[9] Federal Law No. 135 from 29.07.1998 "On appraisal activities in the Russian Federation". URL: https://www.consultant.ru/document/cons_doc_LAW_19586/ (accessed on 16.05.2023).

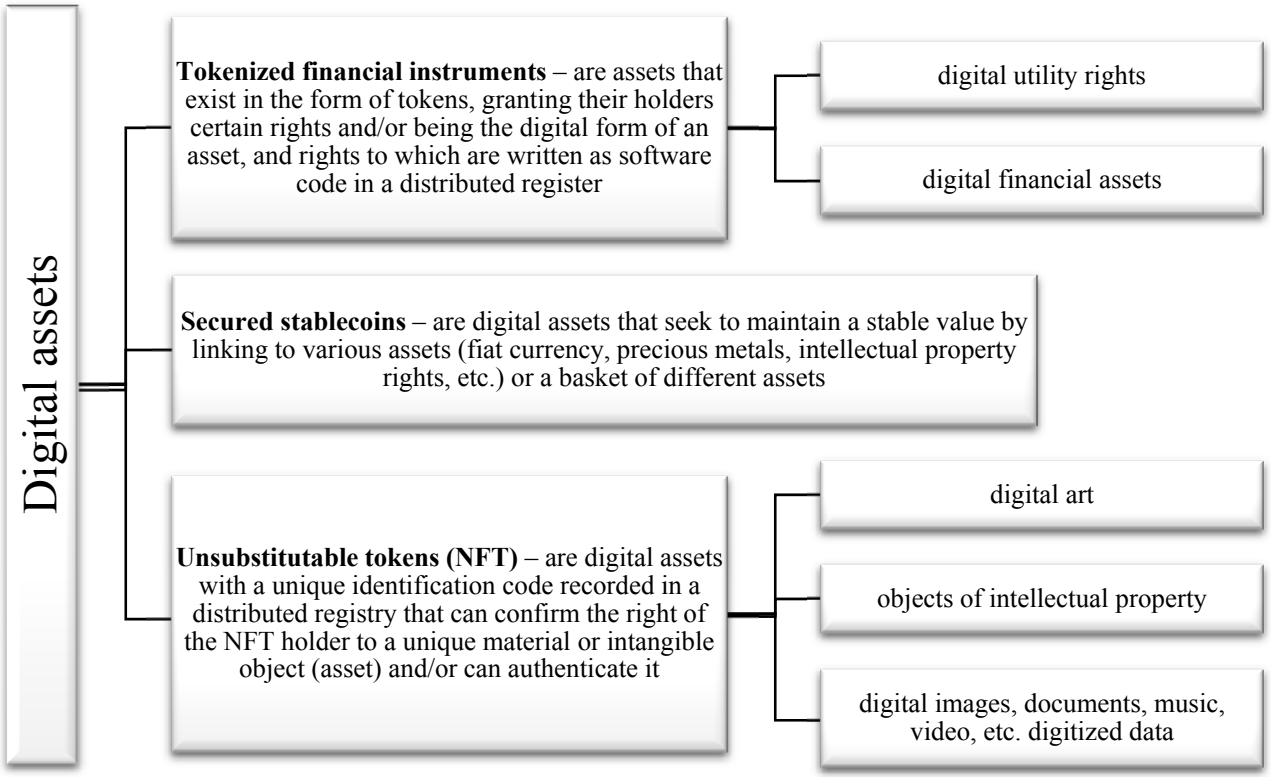

Fig. 1. **Types of Digital Assets in Russian Legislation**

Source: Compiled by the authors.

because of the uncertainty of their legal status, as well as intellective assets not regulated as objects of intellectually owned property are not the subject of our research — scientific discoveries, inalienable human intellectual capital in the form of knowledge, competences, experience, etc.

According to the results of the analysis on *Fig. 2*, we present the ratio of the desired concepts in the form of Euler's diagram.

Fig. 2 shows that a digital intellectual asset has the characteristics of all three component elements: has an intangible nature as an IA, is the object of civil circulation as IA and VP, is created and functions as a digital asset in an information system, in which it is possible to establish ownership and disposal of the digital right without resorting to a third party, brings economic benefit to its owner as any asset. In other words, it refers to the economic, legal and technological essence manifested in the information system [1].

Since DIA assume exclusive digital rights to the results of intellectual activity (intellectual property objects in accordance with Art. 1225 of Part IV of the Civil Code of the Russian Federation), they can be classified as objects of intellectually owned property: DIA of copyright (literary and artistic works, software for computer); DIA of industrial property (inventions, industrial designs, utility models, trademarks and other means of individualization); specialized DIA (know-how, selection achievements, integral chip topology); complex DIA, including several protected results of intellectual activity (audiovisual works, multimedia products, databases, etc.)

At the same time, it is important to establish DIA, which are unique objects that can only exist in electronic (digital) form and whose commercialization is only possible through complete transfer of ownership rights. NFT-tokens, which are a type of digital certificate that can only be issued in a single copy, are the most suitable form of commercialization in this situation. Digital art objects (Digital Art — digital painting,

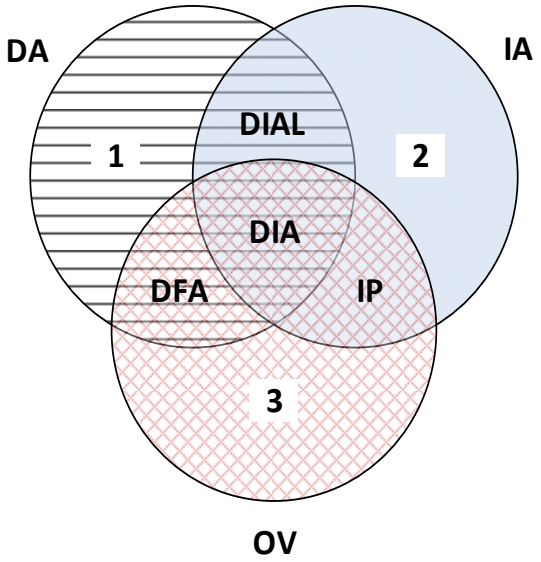

Fig. 2. **The Relationship Between the Concepts of "Digital Asset", "Intellectual Asset", "Object of Valuation"**

Source: Compiled by the authors.

Notes: DA — digital assets; IA — intellectual assets; VP — valuation objects; DIA — digital intellectual assets; IP — intellectual property; DFA — digital financial assets; DIAL — digital intellectual assets without legislative regulation. Examples of undeveloped assets: 1 — digital currencies; 2 — scientific discoveries, intellectual capital of the employee; 3 — real estate, etc. material objects.

electronic music, computer animation, etc.), which are produced using software, are an excellent instance of such assets. The creators record their ownership of digital works by issuing NFT-tokens and recording them in the blockchain. In the form of NFT-tokens can also be commercialized unique 3D models, accounts, content of sites (NFT-domains[10]), performances of works, trademarks and other unique digital intellectual property objects that do not have a material "prototype" (bearer) and/or do not imply "fragmentation" of intellective rights when alienated, i.e. the presence of several DIA owners at the same time.

Other DIA, although created in an elective form, may have a material prototype (the same 3D-models recognized as copyright due to their originality) or be embodied on material media (CDs, flash drives, design documentation, etc.). At the same time, DIA copyright holders are interested in their commercialization by type of simple (non-exclusive) license. In this context, the most appropriate form of commercialization of DIA is tokenized financial instruments in the form of digital utility rights, involving the right to demand the transfer of exclusive rights to intellectual activity results and/or rights to use intellective activity results. These rights are also exercised using distributed registry technology, which allows digital asset market participants to certain positive effects and benefits (*Fig. 3*).

It is necessary to distinguish between the results of intellectual activity in digital form, which can be attributed to DIA when recording digital rights on them in the information system, and digitized data (copies of material analogues). The last one could turn into, for example, an NFT token that contains a copy of a famous project of art and attests to the owner's digital rights to that copy, but it won't become a digital intellectual asset because "digitalization" isn't a creative project.

Thus, for the purposes of our study, all DIAs with the identified characteristics above, i.e. intellectual property objects capable of civilian circulation, on which digital rights are established in an information system operating on the basis of distributed registry technology, can be attributed to the objects of valuation.

This approach combines the DIA of two types (*Fig. 4*):

1) IPOs in digital form, created and circulating exclusively in the information system in the form of NFT-tokens, i.e. are digital property and relate to other objects of civil rights, in respect of which the legislation of the Russian Federation established the possibility of their participation in civil circulation;

2) other types of IPOs in digital or other form, for which digital rights are recorded in

[10] NFT-domain (non-replaceable domain) — is a domain in the public blockchain that allows the user to have full ownership of their stored data

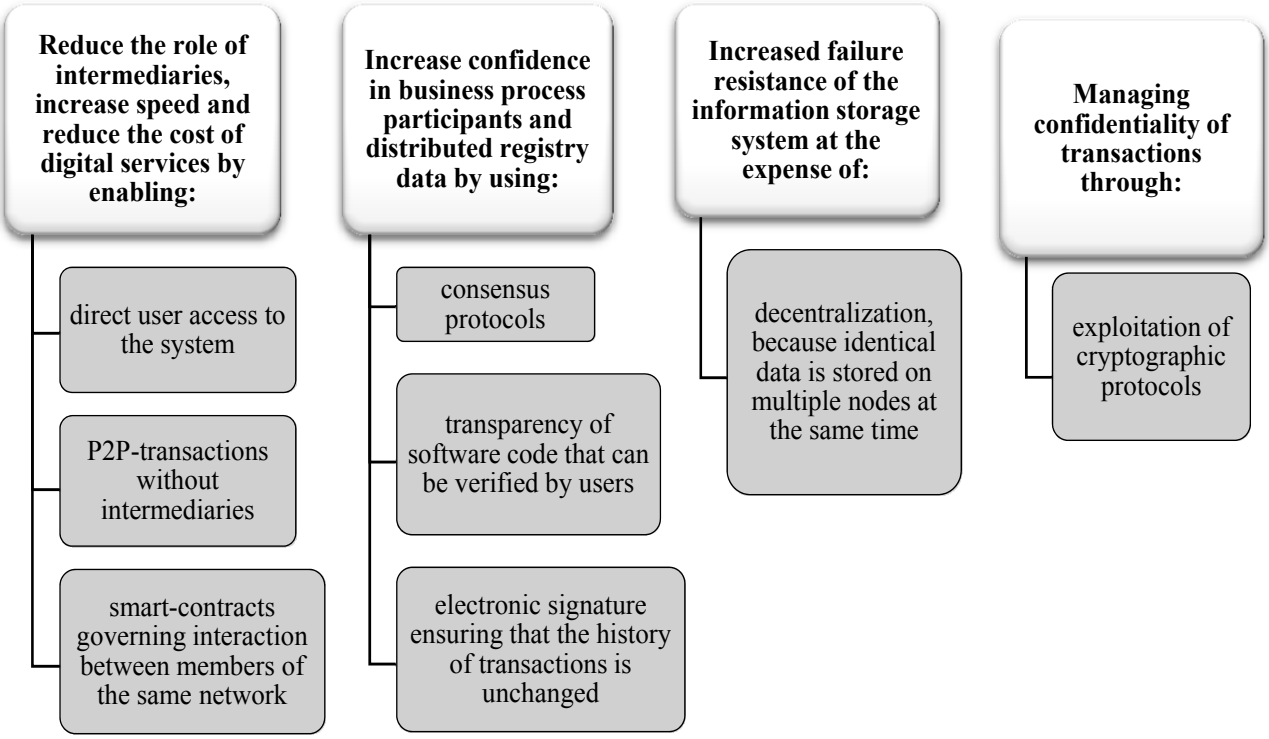

Fig. 3. **Advantages of Using Distributed Registry Technology for the Digital Intellectual Assets Market**

Source: Compiled by the authors.

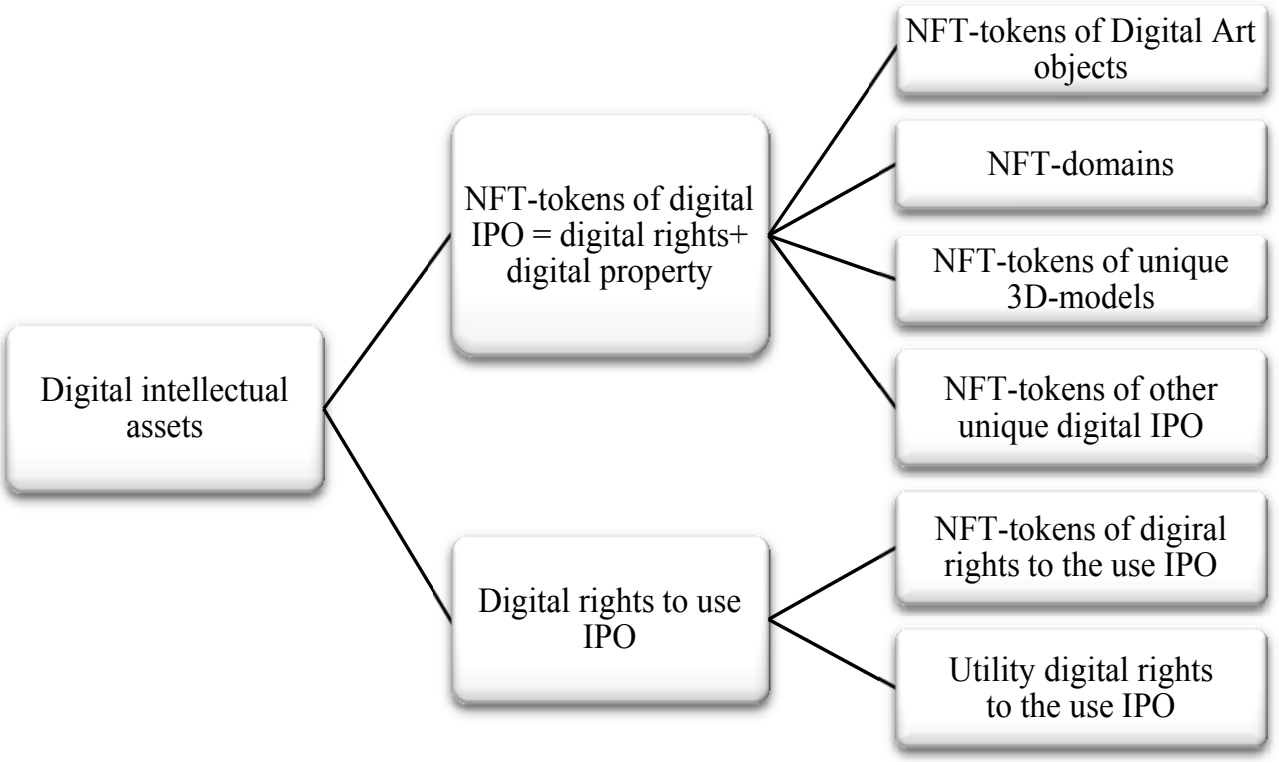

Fig. 4. **Types of Digital Intellectual Assets as Valuation Objects**

Source: Compiled by the authors.

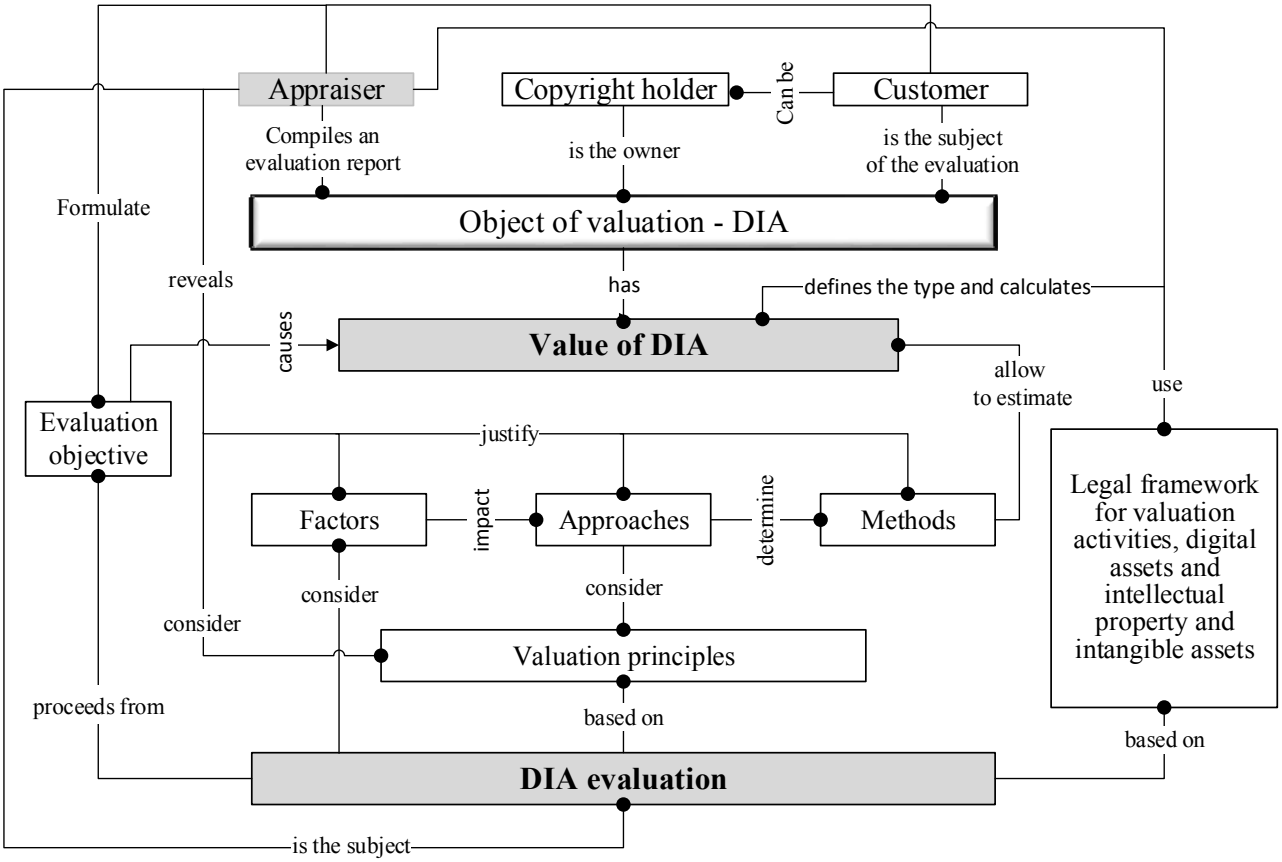

Fig. 5. **Semantic Model for Evaluating Digital Intellectual Assets**

Source: Compiled by the authors.

the information system through the issuance of digital certificates (NFT-tokens, utility digital rights), only certifying the right of the owner to a specific IPO or the right to use it (similar to a license agreement) and not generating a new object of civil rights in the form of digital property, i.e. being digital rights to use IPO and, therefore, objects of evaluation in accordance with the new FSO No. XI.[11]

Construction of a Conceptual Model of Valuation of Digital Intellectual Assets

The conceptual model of value assessment of DIA is based on the basic categories of valuation activities and should reveal the subjects, objectives, types and factors of value, the principles, approaches and methodological tools of evaluation taking into account the specificity of the object being valued, i.e. represent a kind of semantic network describing the relationships between the specified categories. On the other hand, since evaluation is a process, it is logical to present it in the form of a functional model, for example in the IDEF0 notation.

Conceptual and semantic model of evaluation DIA, reflecting the relationship between the object, the subject and the evaluation process, is presented on *Fig. 5*.

The main task of the appraiser — is to determine the value of DIA on the basis of professional judgment, depending on the purpose of appraise, formulated jointly with the customer, who may be the owner of DIA at the same time. In order to address this

[11] Order of the Ministry of Economic Development of the Russian Federation No. 6259 from 30.11.2022 "On approval of the Federal standard of evaluation "Evaluation of intellectual property and intangible assets". URL: https://smao.ru/files/content/FSO/prikaz_minekonomrazvitiya_rossii_ot_30.11.2022_n_659__fso_xi.pdf (accessed on 01.06.2023).

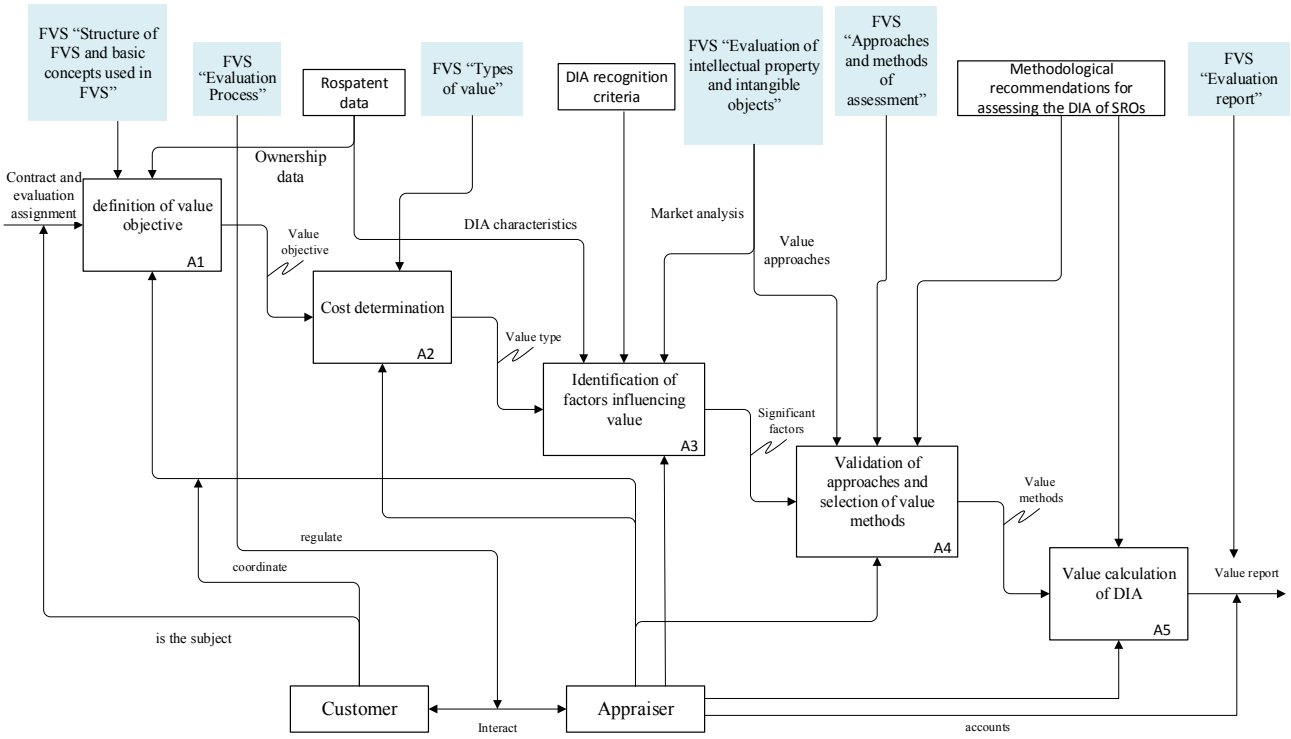

Fig. 6. **Process-Functional Model of Valuation of Digital Intellectual Assets**

Source: Compiled by the authors.

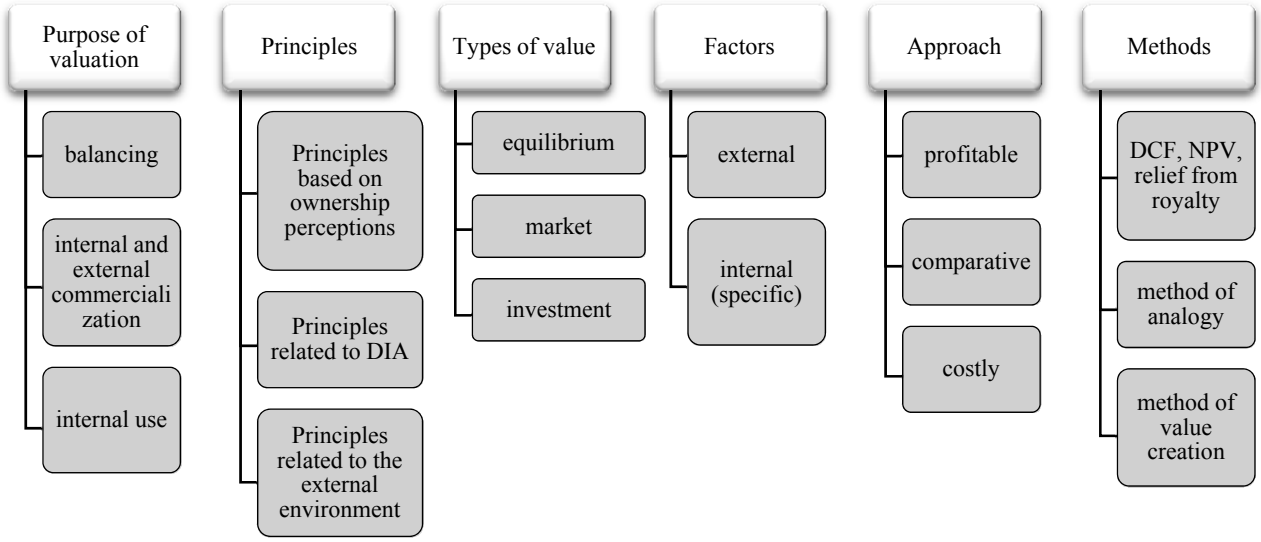

Fig. 7. **Basic Elements of the DIA Conceptual Model**

Source: Compiled by the authors.

challenge, the appraiser must, based on the appraisal principles and the legal framework in the area of appraising activities, digital assets and intellectual property, determine the type of value of the DIA, identify the factors affecting the value of DIA, justify the application of the approaches and methods to appraise DIA, calculate the cost of DIA and prepare a report on the evaluation of DIA. The process-functional model for solving this problem is presented in the IDEF0 notation on *Fig. 6*.

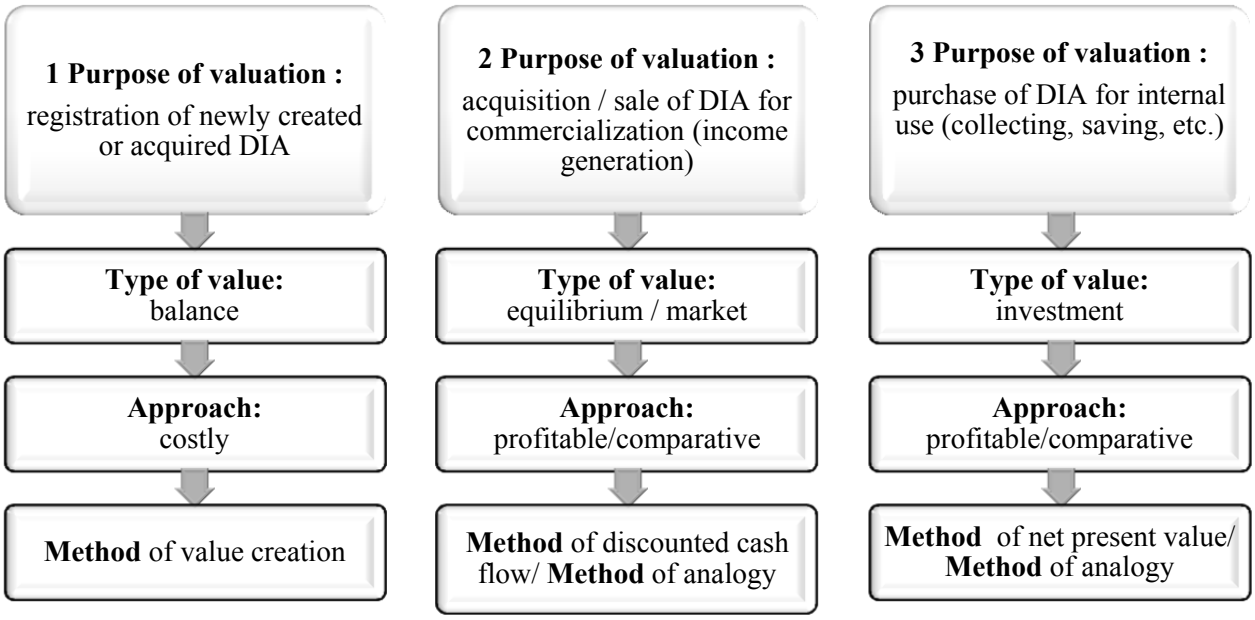

Fig. 8. **Relation of the Objectives of the DIA Cost Assessment, Types of Cost, Approaches and Methods**

Source: Compiled by the authors.

Consider the basic elements of these models in detail (*Fig. 7*).

Fig. 8 shows possible options for the DIA's assessment objectives with relevant value types, applied approaches and assessment methods.

Consider the application of conceptual provisions to the estimation of the cost of DIA on a conditional example. Suppose an IT-company needs to raise the rating or attract additional players to a previously created computer game to increase sales revenue. For this purpose, the purchase of a unique 3D model of the car for use as a new character in the game may be considered. In this case, the purpose of valuation is to extract profits from internal use for the specified investment purposes, hence, the type of value — investment (if the specific features of the transaction are taken into account, then — balance value). The profitable approach and method of net present value (NPV) will be used, where the initial investment will be the purchase of the NFT-token with the selected car model or the acquisition of the rights to use the digital model on a digital platform, as well as the cost of introducing the character to a computer game. Future cash flows will be obtained by estimating the growth of revenue and risks from the use of the new computer character, taking into account macroeconomic factors as well as internal factors characterizing the extent of DIA rights and specific factors for the digital 3D-model:

- Animated (static or animated model) — to use animation significantly increases the final time of work, and consequently, the cost of the model;
- Rigged (internal "scaffolding")— to separate object control system is created for models with animation, which increases their cost;
- VR models (virtual reality) / AR-models (augmented reality) / Poly (polygonal models) — drawing quality decreases as the chain of patterns is transitioned;
- PBR (physically correct rendering) — reflects the quality of light interaction with the model;
- Textures (model texture) — different options of choice of possible textures increase the cost of the model;
- Materials (model materials) — different options of choice of possible materials increase the cost of the model.

If the revenue flows from the introduction of a digital model in a computer game are difficult to predict, then you can use a comparative approach and find suitable analogues of the model using open data from different digital platforms.

The result of the valuation is expressed in rubles or other currency in accordance with the assignment for valuation with the indication of the equivalent of rubles and can be presented in the form of a number, a range of values, be the result of mathematical rounding.

After defining the theoretical basis and conceptual model of assessment of digital intellectual assets, it is further necessary to move to methodological recommendations for assessing the cost of specific types of DIA taking into account the specific factors characteristic of a particular digital asset. With regard to the assessment of digital rights to use IPOs, the value of such rights may be estimated in the analogy of the estimation of the price of licensing agreements with adjustments to the risks of transferring digital rights in the information system.

CONCLUSION

From the research that was done, it is possible to draw the following conclusions:

1. Digital intellectual assets are digital rights to the results of intellectual activities that are recorded in the information system. They have an economic, legal and technological character and are valuable in the distributed register system.
2. Not all digital intellectual assets can be classified as objects of civil circulation because there are currently no legal grounds for regulating them (e.g. virtual gambling assets). Non-civil DIAs are not valuable.
3. As objects of valuation in accordance with applicable legal regulations may act: 1) intellectual property objects in digital form, which is NFT-token, which includes both DIA itself, and information about the owner and rights to the asset (Digital Art objects, NFT-domains, etc.); 2) rights to use of the intellective property object, recorded as NFT-tokens or digital utility rights in the information system.
4. The conceptual model of assessment of value of digital intellectual assets is a semantic (sensual) relationship of basic assessment categories (subjects, objectives, principles, factors, approaches and methods), as well as a functional description of the process of determining the value of DIA in accordance with the normative and legal framework of the assessment activity. Possible types of value of DIA, depending on the purposes of valuation are: balance, market and investment.
5. Further investigations on DIA could include methodological recommendations for the valuation and commercialization of specific types of digital intellectual assets, taking into account their specific characteristics and value factors.

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ABOUT THE AUTHORS

Ol'ga V. Loseva — Dr. Sci. (Econ.), Assoc. Prof., Prof. of the Department of Corporate Finance and Corporate Governance, Financial University, Moscow, Russia
http://orcid.org/0000-0002-5241-0728
Corresponding author:
ovloseva@fa.ru

Marina A. Fedotova — Dr. Sci. (Econ.), Prof., Deputy Scientific Director, Financial University, Moscow, Russia
https://orcid.org/0000-0003-4862-5440
MFedotova@fa.ru

Niyaz M. Abdikeev — Dr. Sci. (Engin.), Prof., Director of the Institute of Financial and Industrial Policy of the Faculty of Economics and Business, Financial University, Moscow, Russia
http://orcid.org/0000-0002-5999-0542
nabdikeev@fa.ru

Authors' declared contributions:
O.V. Loseva — the essence and classification of digital intellectual assets as objects of valuation, definition of principles, factors, approaches and methods of valuation, development of valuation models.
M.A. Fedotova — statement of the problem, development of the concept of the article.
N.M. Abdikeev — literature analysis, graphical representation of models and results.

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ORIGINAL PAPER

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Is There Any Impact of CSR on Financial Performance? Evidence from Indian Firms

R.K. Sawhney[a], P. Goel[b], S. Bhardwaj[c]
[a] Amity University, Noida, Uttar Pradesh, India; University of Delhi, Delhi, India;
[b] Amity College of Commerce and Finance, Noida, Uttar Pradesh, India;
[c] MIT University, Moradabad, Uttar Pradesh, India

ABSTRACT

The sceptical attitude towards linking corporate social responsibility (CSR) and corporate financial performance (CFP) forms the basis of this study. The available literature concentrates only on the positive side of CSR activities and benefits derived from them. The Companies Act, 2013, has made it mandatory for Indian companies of a certain turnover and profit to use 2% of their profits from the past three years on CSR activities. Given this background, this study examines the impact of CSR on the financial performance of the business itself. The economic legitimacy of CSR is also probed, that is, does CSR have a positive economic impact? For this examination, the Pearson Fixed effects panel regression analysis was performed on Nifty 50 companies during the period 2010–2018. Data regarding financial performance variables was obtained from Prowess IQ database. The CSR data was collected from the companies' annual reports and content analysis was done using NVIVO software. The results of the study provide insights into the corporate response to the mandatory requirement of CSR activities and their impact on the company's financial performance. The results of the study conclude that there is no significant influence of CSR on the financial performance of Indian companies.

Keywords: corporate social responsibility; corporate finance; India; financial performance

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INTRODUCTION

Sustained financial inequality, environmental destruction, social exclusion, situational collapse and business and political corruption and scandals [1–5] have pushed all the stakeholders such as investors, suppliers, customers, government and the public towards instituting a mechanism that leads to inclusive growth of the economy. For business organisations to achieve success, there is a need to protect and promote the interests of all stakeholders [6]. Maximising shareholder wealth as the ultimate goal of the corporation is being questioned. This goal is being criticised on the grounds that it is not sustainable, inclusive, ethical or democratic [7–10]. Now, there is continuous pressure on corporations to justify their acts by generating value for investors and simultaneously contributing to social good [11].

Corporate social responsibility (CSR) is contextual, which varies by country, economic systems and institutional pressures. Firms operating in developed nations or firms with multinational operations tend to make more disclosure about their CSR activities [12]. The country's economic system also influences the type and quantum of CSR disclosures. In some countries, CSR disclosures are voluntary (e.g., the United States). Countries such as Malaysia in 2007 and Sweden, Denmark and China in 2008 have made CSR disclosure mandatory [6, 13, 14]. Even within Asia, CSR is largely normative. It's strategic in Korea, but in Japan, CSR is viewed as social cohesion and follows the stakeholder value system. In India, CSR has been made mandatory by The Companies Act, 2013, for companies of a certain revenue and profit, making it the first country to implement the mandate on both CSR reporting and expenditure.

To the best of the authors' knowledge, no systematic study has been conducted to measure CSR disclosures in a scientific manner and relate them to financial performance. This study provides an innovative methodology to

measure CSR performance. In this study, CSR disclosure scores are calculated by the author through content analysis using NVIVO software. Secondly, this study uses both qualitative measures (CSR disclosure) and quantitative measures (CSR expenditure) in order to study the proposed linkage. Till now, no study has taken both measures of CSR into consideration simultaneously. Financial performance is measured through both market- and accounting-based measures. Thus, this study provides a robust estimation of the probable linkage between corporate social responsibility and financial performance.

Objective: To measure the impact of CSR on corporate financial performance of the Indian firms.

The study is based on the following theoretical framework (*Fig.*).

The structure of the paper is as follows: the next section covers a review of the literature; on the basis of the review, the subsequent section explains the research methodology adopted for the study; the findings and results are explained in the following section; and in the last section, the results of the analysis are discussed in light of existing literature and theories to put forward the conclusion of the study.

REVIEW OF LITERATURE

Many countries, for example, Denmark in 1995, Belgium in 1996, the UK in 1999, Norway and Sweden and the United States in 2002, have passed legislation requiring companies to report CSR activities [15]. In 2013, India issued rules as part of The Companies Act, 2013, requiring companies with a certain revenue and profit to report their CSR activities in their annual financial reports. India also became the first country to mandate companies to compulsorily invest about 2% of the average net profits of preceding three years in CSR activities. However, in India, both CSR expenditure and disclosure are mandatory whereas in other countries only disclosure is mandatory if they are incurring any CSR expenditure [16].

Many empirical studies have examined the impact of CSR on financial performance. However, no concrete conclusions can be drawn. Woon Leong Lin in 2019 also pointed at inconsistent and unclear outcomes of the previous study with respect to relationship between CSR and corporate financial performance (CFP). CSR as a concept still lacks the boundaries, conceptual determinants and expectations of CSR–CFP relationship [17].

Previous studies [16] are based on the premise that the relationship between CSR disclosure and earnings management is contextual and depends more on the legal environment than ethical aspects. Stakeholder theory supports a positive relationship between CSR and CFP [18]. The perspective that CSR enhances the reputation of the company due to its low implicit cost, leading to better financial performance, has been put forth by some researchers. Moreover, CSR engagements by companies give them a competitive advantage, paving the way for higher financial performance [19]. Social activities will increase the chances of the firm's long-term survival, which will be positively perceived by the stock market, leading to greater value for firms. Slack management theory supports a positive relationship between CSR and CFP, with causality directing from financial performance to CSR. In other words, CFP has a positive impact on CSR activities. It is argued that those companies that have free resources are the ones that invest more in CSR activities. Thus, CSR quantum depends upon the buffer resources available to the company [20]. Improved employee satisfaction and morale among employees and goodwill of the firm by customers will add to the benefits of CSR more in comparison to cost associated with it, leading to a positive relationship between CSR and CFP [18].

Economic analysis of the competitive markets shows that no relationship or a neutral relationship exists between CSR and CFP. In this model, CSR leads to cost, which is equal to the benefits received due to CSR by companies. Thus, cost and benefit relating to CSR leads to equilibrium, causing no relationship between CSR and CFP.

RESEARCH METHODOLOGY

Nifty 50 is one of the benchmark indices covering companies across 12 sectors and the companies

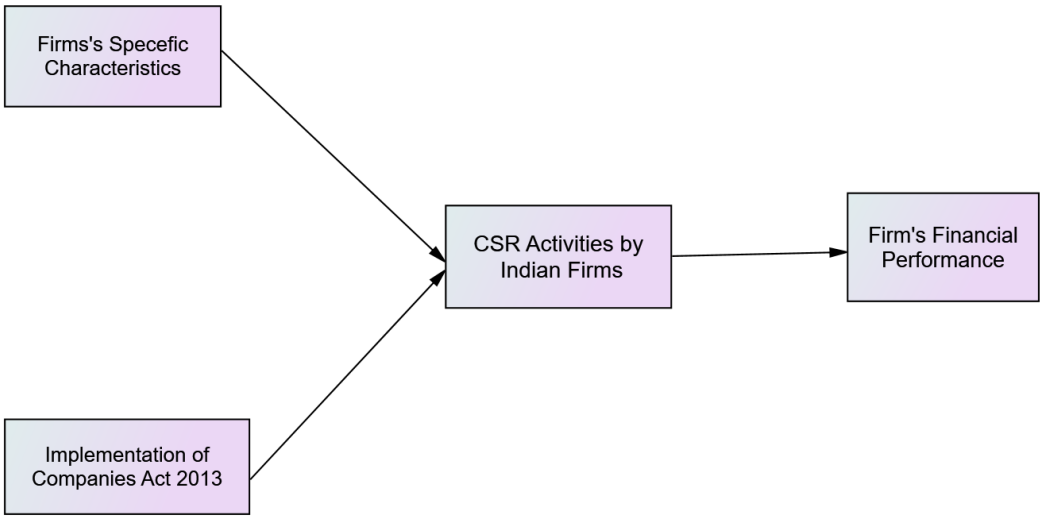

Fig. **Theoretical Foundations of Study**

Source: Compiled by the authors.

included in the indices form the sample of the study. The study period is between 2010–2011 and 2017–2018. This time span is selected as it covers both the pre-mandatory CSR period (2010–2014) as well as the post-mandatory CSR period (2014–2018) in India. In order to study the cause-and-effect relationship between corporate social responsibility and financial performance, Regression analysis was employed.

In order to estimate the impact of CSR on financial performance, the following variables were selected after a thorough review of the literature on the topic. *Table 1* lists the various variables used in the study.

Dependent variables — financial performance. In order to measure financial performance, this study uses both accounting-based measures as well as market-based measures. Accounting-based measures indicate a firm's current financial position and efficiency level of its operations.

Earnings per share. Earnings per share (EPS) is a commonly used measure of the financial performance and profitability of the firm on absolute terms [20]. It has been used to measure financial performance in many previous studies [16–20]. It is defined as the net profit after tax and preference share dividend divided by the number of common outstanding shares. EPS is a measure of firm's efficiency.

Return on assets (ROA). Many previous studies [19–23] have used return on assets (ROA) as a primary measure of profitability and firm performance. It is a common measure to compare the performance of different firms, as it signifies the ability of the firm to generate the required funds to deploy its cost of capital. ROA is a measure of firm's effectiveness. Following previous literature [24–27], ROA is calculated as:

$$\text{ROA} = \frac{\text{Net Profit}}{\text{Total Assets}} \times 100.$$

Market-based measure: Tobin's *Q*. Apart from accounting-based measure of performance, the market-based measure of performance, Tobin's *Q*, is used in the study. Accounting-based measures are more likely to be manipulated, whereas Tobin's *Q* represents the static value of the firm from the investor's perspective. Tobin's *Q* ratio is defined as the ratio of the market value of the firm to the replacement cost of its total assets. Following the existing literature [19–26, 28–30], Tobin's *Q* is used as a market-based measure of performance in this study. The calculation of Tobin's *Q* is a matter of controversy especially for countries like India where companies report assets and value of debt on a book value basis. Thus, following the Indian studies [28, 31–33], Tobin's *Q* is calculated as

Table 1

Description of Variables

Variable	Proxy / Measure	Calculation	Unit
Dependent variables	EPS		Indian rupees
	ROA	Net profit/Total assets × 100	Percentage
	ROE		Percentage
	Tobin's *Q*	Sum of market capitalisation and book value of debt/Total assets	Ratio
Independent variables	CSR Expenditure		Rs. in crore
	CSR Disclosure		Number
Control variables	Advertisement intensity	Advertisement Expenditure/Total Sales × 100	Percentage
	R&D intensity	R&D Expenditure / Total Sales × 100	Percentage
	Size	Natural log of total assets	Natural log
	Risk (debt asset)		Percentage
	Liquidity	Current assets/Current liabilities	Ratio
	Age	Year of incorporation to year of analysis	Natural log
Dummy variables	Sector		
	Ownership		

Source: Compiled by the authors.

$$\text{Tobin's } Q = \frac{\text{Market capitalisation} + \text{Book value of debt}}{\text{Total assets}},$$

where

$$\text{Book value of debt} = \text{Notes payable} + \text{Current portion of long} - \text{term debt} + \text{Long} - \text{term liability}.$$

Independent variables — corporate social responsibility. In order to measure CSR activities performed by Indian firms, in this study, both qualitative and quantitative measures are used. The qualitative measure is based on disclosures by Indian firms and the quantitative measure is based on the quantum of CSR expenditure incurred by the respective corporates.

Corporate social responsibility disclosure (CSR_dis). As this study is based on The Indian Companies Act, 2013, in order to determine CSR disclosure scores, activities mentioned in Schedule VII are considered. Schedule VII mentions 12 themes relating to which activities can be included by Indian firms falling under the ambit of Section 135 of The Indian Companies Act, 2013, under the corporate social umbrella to meet the compulsory 2% spending on corporate social responsibility. On the basis of past literature and common reporting practices followed by Indian firms, a list of 105 initiatives was identified, which were further divided into seven broad dimensions. CSR scores were calculated using content analysis using NVIVO software [18]. Following the literature [34], total CSR scores are calculated as the sum of all seven dimensions, namely, education (ED), health and sanitation (HS), environmental sustainability (ES), minority welfare (MW), livelihood

(L), agriculture and rural development (AR) and other activities (OTH).

Corporate social responsibility expenditure (CSR_exp). The second proxy for CSR used is the amount of funds committed by the firms towards their CSR practices. Firms willing to contribute more funds towards CSR have an inclination towards serving society [25]. The data on CSR expenditure incurred by the firm is easily available from their annual reports for the period 2014–2018 since it is mandatory requirement for companies falling under the ambit of Section 135 of The Indian Companies Act, 2013, to disclose their expenditure in their annual reports. For the period between 2011 and 2014, donations reported by Indian firms were taken as a measure of CSR expenditure. Previous literature [22, 23] has suggested that donations can be used as a proxy for CSR activities. Moreover, while analysing the annual reports of the companies during the period of the study, the authors identified the trend of the companies reporting CSR expenditure under the heading of donations in their annual reports.

RESULTS AND ANALYSIS

In order to examine the impact of CSR on financial performance, Panel regression analysis were performed. The following section explains the results of the Regression analysis.

Regression Analysis Between CSR Expenditure and CSR Disclosure with the Firm's Financial Performance

Regression analysis was performed in order to understand the impact of CSR on financial performance of the Indian firms. The analysis was conducted individually for each variable of financial performance.

Bivariate Pooled Regression

Firstly, bivariate pooled regression is performed on the collected data in order to examine the association between the firm's financial performance and CSR. Bivariate pooled analysis is done to estimate the cause-and-effect relationship between the firm's profitability and CSR. In this analysis, financial performance as measured by EPS, ROA and Tobin's *Q* are dependent variables, whereas CSR expenditure and CSR disclosure are independent variables with advertisement intensity, research and development intensity, size, risk (measured as debt asset ratio), liquidity, age as control variables, and sector and ownership as dummy variables. The regression models used in the study can be stated as:

$$\mathrm{EPS}\left(Y_i\right)=\alpha+\beta_1 * X_i+e,$$

$$\mathrm{ROA}\left(Y_i\right)=\alpha+\beta_1 * X_i+e,$$

$$\text{Tobin's}\,Q\left(Y_i\right)=\alpha+\beta_1 * X_i+e.$$

In this equation, Y_i is a dependent variable, that is, financial performance variable, X_i is a measures of CSR (CSR expenditure and CSR disclosure), α is the intercept and β_1 is the slope. With the help of bivariate pooled regression analysis, the following hypotheses are tested:

Hypothesis 1: "There exists no significant impact of corporate social performance on the EPS of the Indian firms."

Hypothesis 2: "There exists no significant impact of corporate social performance on the ROA of the Indian firms."

Hypothesis 3: "There exists no significant impact of corporate social performance on the Tobin's Q of the Indian firms."

The results of bivariate regression analysis with EPS as the dependent variable (*Table 2*) indicate mixed results. *P* and *t* values were found to be insignificant in the cases of CSR disclosure and CSR expenditure. For control variables, a significant relationship is reported for size, risk (measured as debt/asset ratio), sector and ownership, whereas an insignificant association is reported for advertisement intensity, research and development intensity, risk (measured as beta), liquidity and age. The results of bivariate regression model for ROA are reported in *Table 3*. *P* and *t* values are found to be insignificant in cases of CSR disclosure and CSR expenditure. Moreover, a significant relationship is reported for size, risk and liquidity, whereas an insignificant association is found for advertisement intensity, research and development

intensity, age and ownership. For Tobin's *Q*, the results of bivariate regression analysis (*Table 4*) indicate mixed results. *P* and *t* values are found to be significant in case of CSR disclosure, size, risk and ownership and insignificant in the case of CSR expenditure, advertisement intensity, R&D intensity, liquidity, age and sector.

Multiple Regression Analysis

In this section, we further study the cause-and-effect relationship between CSR and financial performance using the pooled regression model (multivariate regression). The pooled regression model is applied in order to examine the impact of independent variables (CSR expenditure and CSR disclosures) with control variables (advertisement intensity, research and development intensity, size, risk, liquidity, age) on independent variables (EPS, ROA and Tobin's *Q*). The pooled regression models used can be stated as follows:

$$\text{EPS}(Y_i) = \alpha + \beta_1 * X_i + \beta_2 * X_{2i} + \beta_3 * X_{3i} + \beta_4 * X_{4i} + \beta_5 * X_{5i} + \beta_6 * X_{6i} + \beta_7 * X_{7i} + e.$$

$$\text{ROA}(Y_i) = \alpha + \beta_1 * X_i + \beta_2 * X_{2i} + \beta_3 * X_{3i} + \beta_4 * X_{4i} + \beta_5 * X_{5i} + \beta_6 * X_{6i} + \beta_7 * X_{7i} + e.$$

$$\text{Tobin's } Q(Y_i) = \alpha + \beta_1 * X_i + \beta_2 * X_{2i} + \beta_3 * X_{3i} + \beta_4 * X_{4i} + \beta_5 * X_{5i} + \beta_6 * X_{6i} + \beta_7 * X_{7i} + e.$$

In this equation, Y_i is the dependent variable, i.e., financial performance (EPS, ROA and Tobin's Q), X_i are the measures of CSR (CSR expenditure and CSR disclosure), α is the intercept and β_1 is the slope.

The multiple pooled regression model with EPS (*Table 2*), ROA (*Table 3*) and Tobin's *Q* (*Table 4*) as dependent variables and corporate social performance variables as independent variables along with control variables shows an insignificant cause-and-effect relationship. P and *t* values imply an insignificant impact of corporate social responsibility (both CSR expenditures and CSR disclosure) on EPS, ROA and Tobin's *Q*. In other words, with controlling variables that influence financial performance, CSR has no significant impact on ROA. The *F* statistic of the pooled regression model is calculated to be 4.76 in case of EPS, 29.23 for ROA and 24.5 for Tobin's' *Q*, which are significant. Thus, the pooled regression model used is found to be statistically fit. The value of R^2 indicates 59% of the variance in EPS, 58.9% of the variance in ROA and 54.6% of the variance in Tobin's *Q*, which can be explained with the help of the regression model.

Pooled Regression Model Versus Panel Regression Model

The pooled regression model ignores the presence of the cross-sectional effect, i.e., the impact of company-specific factors. In other words, in pooled regression, all the companies are assumed to be homogeneous. In order to understand the impact of CSR on financial performance, considering companies to be heterogenous, panel regression model is applied in this section. Panel regression models are of two types, namely, fixed effects panel regression models and random effects regression models. *F* test and Hausman test is conducted in order to examine whether a fixed effects regression or random effect model is to be used. If results indicate *F* test to be significant, then fixed effects regression model is selected as it indicates the presence of cross-sectional heterogeneity. Hausman test examines the presence of random (out of chance) heterogeneity among the selected companies.

The results of *F* test are found to be significant for all three financial variables, namely EPS, ROA and Tobin's *Q*, indicating the presence of the cross-sectional heterogeneity. Since *F* test is significant, panel fixed effects regression model is selected.

Fixed Effects Panel Regression Model

Fixed effects panel regression is applied with CSR as an independent variable and financial performance as an independent variable with

Table 2

Regression Analysis with EPS as the Dependent Variable

Variable	Bivariate regression model	Multivariate pooled regression model	Fixed/random effect model	*F* test and Hausman test	Remark
CSR expenditure	−0.038 (−1.131)	0.044 (0.647)	−0.015 (−0.443)	*F* test = 61.21** Hausman test = 13.32** Fixed effect model is finalised	Insignificant
CSR disclosure	−0.166 (−0.783)	−0.183 (−0.504)	−0.592 (−3.956) **		Significant
Advertisement intensity	−0.028 (−0.746)	−10.45 (−2.26) **	−12.58 (−1.163)		Insignificant
R&D intensity	−1.833 (−1.065)	−5.97(−2.19) **	−1.183 (−0.248)		Insignificant
Size	−9.225 (−3.436) **	−21.90(−2.127)	24.736 (1.701)		Insignificant
Risk (Debt/ Asset)	−57.318 (−3.068) **	−187.70 (−3.62) **	−85.911 (−1.805)		Insignificant
Liquidity	0.554 (0.154)	−7.24 (−0.867)	3.251 (0.878)		Insignificant
Age	0.020 (0.129)	−0.287 (−1.13)	1.015 (0.646) **		
Sector	17.489 (2.193) **	2.96 (0.111)			
Ownership	26.192 (2.570) **	16.44 (0.782)			
R^2		0.590	0.930		
F Stats		4.766	61.673		
Prob (*F* stats)		0.00	0.00		
Durbin Watson		1.040	1.114		

Source: Author's compilation; E-views.

Table 3

Regression Analysis with ROA as the Dependent Variable

Variable	Bivariate regression model	Multivariate pooled regression model	Fixed/random effect model	*F* test and Hausman test	Remark
CSR expenditure	0.006 (1.486)	0.005 (1.819)	0.002 (0.657)	*F* test =26.862** Hausman test = 20.21** Fixed effect model is finalised	Insignificant
CSR disclosure	−0.005 (−0.196)	−0.014 (−0.540)	−0.001 (−0.022)		Insignificant
Advertisement intensity	−0.008 (−1.688)	1.656 (4.885) **	0.573 (0.719)		Insignificant
R&D intensity	−0.315 (−1.689)	−0.686 (−4.294) **	−1.098 (−4.171) **		Significant
Size	−3.212 (−9.819) **	−2.277 (−2.999)	0.410 (0.258)		Insignificant
Risk (Debt/Asset)	−23.535 (−10.454)	−19.537 (−5.129)	−35.192 (−6.805) **		Significant
Liquidity	3.033 (6.711) **	2.937 (4.772) **	0.589 (1.450)		Insignificant
Age	0.035 (1.644)	−0.0376 (−2.005) **	−0.553 (−2.288) **		Significant
Sector	3.172 (2.997) **	−0.315 (−0.160)			
Ownership	−0.133 (−0.097)	−3.593 (−2.318)			
R^2		0.589	0.922		
F stats		29.239	54.565		
Prob (*F* stats)		0.00	0.00		
Durbin Watson		1.390	1.573		

Source: Author's compilation; E-views.

Table 4

Regression Analysis with Tobin's Q as the Dependent Variable

Variable	Bivariate regression model	Multivariate pooled regression model	Fixed/random effect model	*F* Test and Hausman Test	Remark
CSR expenditure	0.008 (–2.405) **	0.008 (1.540)	0.005 (1.422)	*F* test = 30.538** Hausman test = 39.566** Fixed effect model is finalised	Insignificant
CSR disclosure	–0.100 (–3.068)	–0.036 (–1.282)	–0.033 (–2.033) **		Significant
Advertisement intensity	–0.004 (–0.813)	2.870 (8.082) **	1.057 (1.330)		Insignificant
R&D intensity	–0.219 (–0.831)	–0.352 (–2.100) **	0.403 (1.537)		Insignificant
Size	–4.337 (–11.866) **	–2.771 (–3.483) **	–11.753 (–7.409) **		Significant
Risk (Debt/ Asset)	–11.459 (–3.974) **	–6.368 (–3.356) **	–1.911 (–0.371)		Insignificant
Liquidity	1.051 (1.894)	0.497 (0.771)	–0.102 (–0.251)		Insignificant
Age	0.035 (1.414)	0.008 (0.398)	0.415 (1.722)		Insignificant
Sector	1.029 (0.825)	–4.210 (–2.048) **			
Ownership	7.449 (4.787) **	1.944 (1.197)			
R^2		0.546	0.922		
F stats		24.50	54.571		
Prob (*F* stats)		0.00	0.00		
Durbin Watson		1.488	1.217		

Source: Author's compilation; E-views.

other control variables. *P* and *t* values are found to be insignificant after considering the cross-sectional heterogeneity among the companies for CSR expenditure and significant for CSR disclosure in case of EPS (*Table 2*) and Tobin's *Q* (*Table 4*). Thus, results of the panel fixed effects regression model indicate insignificant impact of CSR expenditure on EPS and Tobin's *Q* and a negative impact of CSR disclosure on EPS and Tobin's *Q*. In case of ROA, *P* and *t* values (*Table 3*) are found to be insignificant after considering cross-sectional heterogeneity among the companies. Thus, results of the panel fixed effects regression model indicate the insignificant impact of both CSR expenditure and CSR disclosure on ROA.

CONCLUSION

In this study, regression analysis of an organisation's performance variables was performed in order to examine the cause-and-effect relationship of corporate social initiatives with financial performance. For these analyses, two variables were studied with respect to corporate social responsibility: CSR expenditure, a quantitative measure, and CSR disclosure, a qualitative measure. With respect to financial performance, three variables were selected, namely EPS, ROA and Tobin's *Q*. Bivariate and multivariate regression analyses were performed and then further analysis was done assuming cross-sectional homogeneity and cross-sectional heterogeneity. The results show no significant

impact of CSR expenditure and CSR disclosure on all the financial performance variables when cross-sectional homogeneity is assumed among the companies. On the other hand, when cross-sectional heterogeneity is assumed, no significant relationship is supported for CSR expenditure and all financial performance variables. For CSR disclosures, no significant impact is found by the results for financial performance variables for ROA. However, a significant negative impact is reported for CSR disclosure and EPS and Tobin's *Q*. Thus, we can conclude that there is no significant influence of CSR on the financial performance of Indian companies. Similar results were also reported in earlier studies [25, 34–36]. One of the reasons for this could be that mandatory CSR provisions are regarded as similar to tax liabilities by corporations. If CSR is mandatory at 2% of the profits, and these CSR investments can't be directly associated with the firm's business, it essentially means the firm does not exercise discretion for the CSR spend. This implies that the relationship between CFP and CSR becomes mechanistic. In the opinion of the authors, the Indian government has shifted the role of public good to the corporates, where CSR expenditure being made mandatory should be viewed as doing good to the public and not providing a strategic advantage to the corporates.

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ABOUT THE AUTHORS

Rameet Kaur Sawhney — Pursuing PhD in Commerce, Research Scholar at Amity College of Commerce and Finance, Amity University, Noida, Uttar Pradesh, India; Assist. Prof., University of Delhi, Delhi, India
https://orcid.org/0000-0001-7630-9045
Corresponding author:
rameetsawhney3@gmail.com

Puneeta Goel — PhD, Prof., Amity College of Commerce and Finance, Noida, Uttar Pradesh, India
https://orcid.org/0000-0002-0563-7671
pgoel4@amity.edu

Sachin Bhardwaj — PhD, Assist. Prof., MIT University, Moradabad, Uttar Pradesh, India
https://orcid.org/0000-0003-0196-9377
sachinmba04@gmail.com

Authors' declared contributions:
R.K. Sawhney —literature analysis, data collection, description of the results of their study.
P. Goel — methodological framework, structuring the article.
S. Bhardwaj — consulting, designing and proofreading the article.

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Comparison of the Efficiency of Overcoming the Crisis of Russian and Foreign Oil and Gas Companies

I.V. Filimonova[a], A.V. Komarova[b], A.A. Angarov[c], A. Yu. Novikov[d]
[a, b] Institute of Economics and Industrial Engineering, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia;
[a, b, c, d] Novosibirsk National Research State University, Novosibirsk, Russia

ABSTRACT

The purpose of the study was to evaluate the performance of large domestic and foreign oil and gas companies based on a factor analysis of the return on equity in the context of financial and economic crises. The **relevance** of the topic is due, on the one hand, to the leading role of the oil and gas industry in the Russian economy, and, on the other hand, to the need develop modern tools for the assessment and prediction of the performance of companies and comparison of the results of economic activity with those of foreign competitors. The **object of the study** was the financial performance of the largest domestic and foreign vertically integrated oil and gas companies. The **subject of the** study is the methods of deterministic factor analysis for assessing indicators in the oil and gas sector. The paper analyzes the main empirical indicators that reflect the degree of efficiency, justifies the choice of the profitability indicator of own assets as the main indicator for research in the oil and gas industry, analyzes approaches to assessing the contribution of various factors to the final efficiency. **Methods** of classification, decomposition, statistical, comparative and factor analysis were used. A five-factor DuPont decomposition of the return on equity was carried out, and the key factors affecting the efficiency of companies were identified: tax burden coefficient, percentage burden coefficient, return on sales, asset turnover ratio, financial leverage ratio. Using the LMDI-1 model, the impact of changes in economic factors on changes in the efficiency of companies in 2013–2017 and 2018–2021 was assessed. It was concluded that domestic companies, on average, slightly outperformed foreign ones in terms of the considered efficiency indicator and coped better with the consequences of financial and economic crises in the periods under review. At the same time, domestic companies have a higher value of the tax burden coefficient with lower values of assets turnover and financial leverage.

Keywords: oil and gas companies; performance evaluation; return on equity; DuPont model; factor analysis

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INTRODUCTION

In modern conditions there is an urgent need to ensure sustainable development of the oil and gas companies, which is due to the system-forming role of this industry for the Russian Federation, its influence on the development not only of the related industries, but also the economy as a whole [1, 2]. Thus, there is a need for continuous improvement of the criteria of companies' performance and tools for its improvement.

There are many interpretations of the term "efficiency", and there is often a lack of a unified approach, which is objectively due to the diversity of public relations, spheres of activity and financial resources. Domestic and foreign researchers also presented a detailed discussion on this issue [3–7].

The efficiency of operational processes, resource use, finance, and investment activities of the company can all be evaluated in the context of methods to evaluate the performance of companies [8].

Indicators calculated on the basis of revenue, production rate, profit, payables and receivables, cash flow, assets and changes in equity are often used [9–11]. However, not all of the above indicators are well applied to the oil and gas industry. The dynamics of sales revenues, characterizing the economic activity and structure of the oil and gas industry, has been unstable in recent years, which is determined by the simultaneous influence of production (oil and gas output and export) and price indicators, as well as macroeconomic indicators (exchange rate, key rate). In recent years, operating costs have steadily increased as a result of the deterioration of the resource and raw material base of hydrocarbons, the relocation of production centers to regions with severe natural and climate conditions, the increase in the cost of production and transportation of hydrocarbons [12, 13].

In order to carry out a comprehensive analysis of the financial and economic effectiveness of the domestic and foreign oil and gas industry, the specifics of the application and calculation of the indicator of economic efficiency — return on equity (*ROE*) — were considered and studied [14–17].

The main methods of statistical analysis were considered to assess the change of the selected indicator over time, compare different objects, and identify the main influencing factors. In particular, econometric analysis is often used by the authors for the analysis of financial indicators [18, 19]. However, in the build-up of regression models, factors that do not correlate with the resulting performance indicator must be selected.

Another common method of assessment is factor analysis. In particular, in this group of methods, the decomposition of the *ROE* indicator into components by the DuPont method is popular [20–22].

The next stage of the study is the choice of methods of factor analysis. In recent years, domestic and foreign researchers have increasingly used the method LMDI-1 (Logarithmic Mean Divisia Index) in the analysis of the influence of economic factors on business activity of companies, as well as in analysis of factors affecting the increase in trade turnover [23–26].

Thus, the purpose of the study is to evaluate of the performance of large domestic and foreign oil and gas companies on the basis of factor analysis of the indicator of profitability of own capital in the context of financial, economic and energy crises. To this purpose, the DuPont five-factor decomposition was chosen, followed by an analysis of the contributions to performance change using the LMDI-1 model.

MATERIALS AND METHODS

In the first phase of the study, the *ROE* was calculated and decomposition was carried out using the DuPont five-factor model. This type of model was chosen for the study because it is the most detailed and more accurately reflects the change of priorities of companies

compared to models with fewer factors [27]. Decomposition was made according to the formula (1):

$$ROE = \frac{NI}{SE} = \frac{NI}{EBT} \times \frac{EBT}{EBIT} \times \frac{EBIT}{R} \times \frac{R}{TA} \times \frac{TA}{SE}, \quad (1)$$

where *NI* — net income; *TA* — assets; *SE* — equity (investment capital); *EBT* — earnings before tax; *EBIT* — earnings before interest and taxes; *R* — revenue.

The ratios obtained in decomposition can be described as tax (*T*) and interest burden (%), return on sales on *EBIT* (*ROS*), assets turnover (*AT*) and financial leverage (*FL*).

The second phase of the study, using the LMDI-1 model, assessed the impact of the change in these five factors on the resulting indicator.

In order for this method of factor analysis to be applied to assess the impact of factors on the change in return on equity, the formulas have been adapted to the characteristics and trends of the oil and gas industry:

$$\Delta D_{x^n} = L\left(ROE_t, ROE_0\right) \bullet \left(\frac{X_t}{X_0}\right), \quad (2)$$

$$L\left(ROE_t, ROE_0\right) = \begin{cases} \dfrac{ROE_t - ROE_0}{\ln(ROE_t) - \ln(ROE_0)} \; for \; ROE_t \neq ROE_0 \\ ROE_t \; for \; ROE_t = ROE_0 \end{cases}, \quad (3)$$

where the factors influencing the change in return on equity (*ROE*) — X_t and X_0, are the components obtained by the DuPont five-factor model.

Thus, for each company and industry, calculated Δ*ROEnT*, Δ*ROEn%*, Δ*ROEnROS*, Δ*ROEnAT*, Δ*ROEnFL* — the contributions of the corresponding indicators to the total change Δ*ROE*.

15 companies (7 domestic and 8 foreign) were selected for comparative assessment of the effectiveness of companies of the oil and gas complex. Assessment of the impact of factors on the change in return on equity was carried out for the periods — 2013–2017 and 2018–2021. The boundaries of time intervals are defined by the extremes of the ROE function, reflecting the beginning and end of financial, economic and energy crises.

Basic data on the activities of oil and gas companies were collected from open sources: annual reports and consolidated financial statements according to IFRS standards.

RESULTS AND DISCUSSION

Dynamics of Return on Equity of Russian and Foreign Companies

Return on equity indicators vary greatly between companies during the period under review (*Table 1*).

Positive results of the *ROE* indicator show the stable position of almost all domestic companies for the period 2013–2021.

Gazprom's *ROE* indicators decreased significantly during the 2014 and 2020 crisis periods. This is due to the fact that the company's net profit declined sharply during these periods. The weakening of the ruble, caused by the sharp fall in oil and gas prices in the second half of 2014, contributed to a decrease in sales of production, which negatively affected the company's final financial results. The quarantine measures imposed for the COVID-19 pandemic in 2020 were accompanied by a decline in global demand for oil and gas and, as a result, a fall in profitability due to the negative dynamics of the net profit of all OGC (oil and gas companies).

The 2014 and 2020 crises negatively affected the financial performance of almost all OGC. Rosneft demonstrated a reduction in ROE in 2014 by 30% and in 2020 by 80% respectively. In 2016, there was also a drop of *ROE* of Rosneft due to the fact that oil prices dropped significantly. Such a phenomenon was caused by the excess of supply over demand, which was due to the established tendency at the time to "overproduction" of oil in the world. At the same time, the reduction in *ROE* was also influenced by the

Table 1

ROE Indicator of Domestic Oil and Gas Companies of 2013 to 2021, %

Companies	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gazprom	12.09	1.55	7.38	8.71	6.38	11.10	8.69	1.09	12.80
Rosneft	17.41	12.15	12.15	5.08	7.10	13.88	15.63	3.03	15.60
Lukoil	24.47	12.92	9.07	6.44	12.03	15.25	16.16	0.41	17.16
Gazprom neft	18.74	11.24	9.29	14.54	16.27	20.13	19.07	5.35	20.45
Surgutneftegas	13.52	30.42	21.27	–1.80	5.40	19.21	2.39	14.40	–
Tatneft	15.48	16.84	16.11	14.95	17.25	27.23	25.64	12.38	21.10
Novatek	29.49	9.56	17.29	40.27	21.39	20.63	53.00	4.82	23.64
Industry	15.57	9.73	10.93	7.75	8.46	14.52	13.17	4.06	15.38

Source: Compiled by the authors.

tax maneuver in the oil and gas industry due to the effect of additional fiscal burden.

Lukoil's return on equity in 2017–2019 was fairly high and stable, but in 2020 there was a sharp decline of the indicator by 98% due to a decrease in net profit.

For "Gazprom neft", the value of the profitability indicator was steadily increasing or decreasing at various times. The ROE fell in 2013–2015, then there was a positive dynamic of the ratio up to the crisis in 2020. In 2021, profitability increased from 5 to 20%, through a five-fold increase in net profit.

The return on equity of the company "Surgutneftegaz" increased from 14 to 30% for the period 2013–2014. The significant foreign exchange financial assets of the company, predominantly dollar deposits, were an important factor. The return on equity company was stable at a high level, but in 2016 the indicator dropped sharply and became negative. The reason for the net loss was the strengthening of the ruble and, as a result, losses on exchange rate differences. The same happened in 2019, when the net profit and the return on equity decreased 8 times.

"Tatneft" showed stable return on equity values for the period 2013–2016, which ranged from 15 to 17%. In 2017, there was a sharp jump in profitability to 27%, due to the growth of the company's net profit, while the Company's equity remained unchanged.

"NOVATEK" has seen a decline in return on equity and net profit in 2014, as a result of the fall in demand and gas prices. In subsequent years, the *ROE* was high, rising to 40% in 2016 and 53% in 2019. This is due to multiple growths in revenue and net profit of the company as a result of the exchange rate differences.

The industry *ROE* declined sharply from 15.6% to 9.7% in 2014. Then there is a sharp jump of the indicator in 2018 to 14.5% due to the rise in the prices of hydrocarbons and doubling of the net profit of companies. ROE of domestic oil and gas industry again falls in crisis in 2020 to 4% and recovers to its pre-crisis values in 2021.

Similar calculations were made for foreign companies (*Table 2*).

The Chinese oil and gas companies Sinopec and PetroChina have a stable return on equity for the entire period under review. However, these values range from 1 to 10%, which can be considered a low level of indicator given that these companies receive some of the highest annual revenues. This is due to the high cost of mining and dividends.

Table 2

***ROE* Indicator of Foreign Oil and Gas Companies for 2013 to 2021, %**

Companies	2013	2014	2015	2016	2017	2018	2019	2020	2021
Sinopec	10.70	7.24	4.13	5.60	6.03	7.21	6.54	3.75	9.43
PetroChina	10.20	8.14	2.64	0.58	1.67	3.76	3.16	1.41	8.16
Saudi Aramco	–	–	–	–	34.50	40.55	31.61	16.67	32.16
Royal Dutch Shell	9.12	8.50	1.34	2.54	6.77	11.77	8.59	–13.52	11.77
BP	18.08	3.36	–6.63	0.12	3.40	9.22	3.96	–23.60	8.54
Exxon Mobil	18.01	17.96	9.15	4.48	10.46	10.45	7.19	–13.66	13.69
Total	10.87	4.47	5.37	6.08	7.54	9.75	9.50	–6.79	14.16
Petrobras	7.45	–6.32	–12.88	–6.15	–0.12	9.86	13.78	1.83	28.43
Average	12.06	7.30	2.06	2.30	10.70	15.35	12.26	–1.15	17.35

Source: Compiled by the authors.

Saudi oil giant "Saudi Aramco" has high returns on equity, ranging from 31 to 40% in non-crisis years. In 2020, the company's profitability decreased by 15% in the pandemic. As oil prices recovered in 2021, the company achieved significant success, with its net profit increasing approximately twice as much as its profitability— from 16 to 32%.

The 2020 crisis, caused by the COVID-19 pandemic, has had a negative impact on all oil and gas companies. In particular, large American and European oil and gas companies suffered the most in these circumstances. These companies were forced to record net losses after 2020. For example, European companies Shell, BP, Total and American Exxon Mobil have negative indicators of capital returns for 2020. Their *ROE* values fell by 22, 27, 16 and 21%, respectively.

By 2020, Shell had a stable *ROE* that ranged from 1 to 11%. The decline is due to the fact that the company spent a significant amount of money on R&D in 2015, primarily in the field of alternative energy sources.

The reasons for the negative return on equity in 2015 and the subsequent low values of the same indicator for BP are the prolonged legal proceedings and payments of high compensation amounts for the drilling platform accident in the Gulf of Mexico.

The Brazilian company Petrobras also participated in the trial, which resulted in net losses for 4 years — in 2014–2017.

Comparison of Russian and foreign oil and gas companies on *ROE* dynamics for the period from 2013 to 2021 showed that Russian companies operated more efficiently, as well as more successfully overcame crisis periods.

FACTOR ANALYSIS OF RETURN ON EQUITY FOR RUSSIAN COMPANIES

In order to determine the impact of each component derived from the DuPont five-factor model, data were prepared for each element and calculations were made according to the LMDI-1 model (*Table 3*).

The calculations showed that for the period 2013–2017 for the domestic oil and gas industry as a whole the greatest negative impact (–4.50%) on the change in return on equity (*ROE*) was the decrease in return of sales (*ROS*) in the industry. A similar outcome was expected because 2014 marked the beginning of the oil crisis, which lasted until 2017 in conjunction with an unfavorable

Table 3

Factor Analysis of Return on Equity of Domestic Oil and Gas Companies of 2013–2017, %

Companies	*ΔROEnT*	*ΔROEn %*	*ΔROEnROS*	*ΔROEnAT*	*ΔROEnFL*	*ΔROE*
Gazprom	–0.36	–0.78	–4.57	–0.76	0.76	–5.71
Rosneft	–1.63	–3.98	–4.33	–2.76	2.40	–10.31
Lukoil	–1.46	0.21	–7.89	–4.64	1.35	–12.44
Gazprom neft	0.07	0.27	–1.30	–3.59	2.09	–2.46
Surgutneftegas	–0.20	–0.34	–5.61	–2.10	0.14	–8.13
Tatneft	–0.35	0.38	0.95	–1.53	2.32	1.77
Novatek	0.71	–0.14	–7.12	2.85	–4.40	–8.10
Industry	–0.62	–1.00	–4.50	–2.16	1.17	–7.11

Source: Compiled by the authors.

geopolitical situation. The economic and technological sanctions imposed against Russia also had a negative impact.

The calculations also indicate that for most of the companies analysed, the most negative factor for *ROE* is the profitability of sales. Positive impact is observed only for the company "Tatneft". In particular, the company's revenue grew at an average rate of about 11% per year, while the earnings indicators, namely *EBIT*, earnings before tax (*EBT*) and net profit, at "Tatneft" grew approximately twice over the period 2013–2017. This growth in the company's profits during the crisis period for the oil and gas industry is due to the fact that the company was able to increase the depth of oil refining to 74% in 2014 and to 99% in 2016 through the efficient operation and modernization of production at the refinery "TANEKO" complex, built at the end of 2011.

ROE was negatively impacted by an asset turnover rate (*AT*) of –2.16% of the total decline over the period, reflecting a 12% increase in the average annual value of assets in the industry, with an average annual growth of 6% in revenue.

At the same time, the financial leverage factor (*FL*) has had a positive impact on the *ROE* of almost all companies except "NOVATEK". In particular, for "Tatneft", the financial leverage factor is a key factor in the growth of capital profitability (2.32%) due to the significant growth of the company's borrowed funds during the period under review.

The rate of interest loads (–1.00%) had a minor negative impact on the decline in the industry's *ROE*. In part, the overall negative effect of the factor was influenced by the decrease in the rate of interest burden of "Rosneft" due to the gradual increase in debts and, as a consequence, an increase in interest payments on them. This growth in liabilities is mainly due to a number of transactions to acquire new assets: the purchase of TNC-BP in 2013, the acquisition of the controlling stake of "Bashneft" in 2015 etc.

Further, a factor analysis of ROE for the period 2018–2021 was carried out (*Table 4*). The distribution of the influence of factors on the return on equity has changed significantly. Thus, the biggest impact on the change in ROE is also the return of sales (*ROS*), but this effect is positive.

For "Gazprom", "Rosneft", "Tatneft" and "Novatek", the factor of the change in sales profitability was the key one. Overall, the indicator had a positive impact on the growth of *ROE* of all companies except for "Tatneft".

Table 4

Factor Analysis of Return on Equity of Domestic Oil and Gas Companies for 2018–2021, %

Companies	ΔROEnT	ΔROEn %	ΔROEnROS	ΔROEnAT	ΔROEnFL	ΔROE
Gazprom	–0.68	0.25	1.93	–0.51	0.71	1.70
Rosneft	0.52	1.53	3.58	–2.38	–1.53	1.72
Lukoil	–0.02	0.31	0.72	–0.32	1.23	1.91
Gazprom neft	–0.38	0.23	1.14	–2.72	2.04	0.32
Tatneft	0.07	–0.02	–9.42	2.53	0.72	–6.12
Novatek	2.69	0.20	9.81	–8.26	–1.42	3.01
Industry	–0.13	0.50	2.35	–1.39	0.32	1.65

Source: Compiled by the authors.

Table 5

Factor Analysis of Return on Equity of Foreign Oil and Gas Companies of 2013–2017, %

Companies	ΔROEnT	ΔROEn %	ΔROEnROS	ΔROEnAT	ΔROEnFL	ΔROE
Sinopec	–1.28	1.64	–0.81	–2.76	–1.46	–4.67
PetroChina	–2.46	–0.84	–4.30	–0.66	–0.27	–8.53
Shell	3.24	–1.24	–0.56	–4.09	0.30	–2.35
BP	–6.37	1.98	–8.36	–3.36	1.43	–14.68
Exxon Mobil	9.14	–0.44	–7.10	–8.20	–0.96	–7.55
Total	5.01	0.28	–3.83	–4.02	–0.77	–3.33
Average	1.19	–1.65	–2.99	–3.08	0.03	–6.49

Source: Compiled by the authors.

The positive impact of the indicator in most companies was due to the improvement of the energy market, the recovery of demand and the strong rise in oil and gas prices after the crisis of 2020.

The asset turnover factor had a major negative impact on "Gazprom neft's" efficiency. Its contribution to the change in the *ROE* of the industry as a whole was –1.39%, and the contribution of "Gazprom neft" to the change of *ROE* was 2.72%.

Finally, the main change in Lukoil's effectiveness is caused by the financial leverage effect. In this case, the ratio characterizing the share of borrowed funds in the overall equity structure has had a positive impact on the *ROE* of Lukoil. Its contribution to *ROE* growth is 1.23% of total growth.

FACTOR ANALYSIS OF RETURN ON EQUITY FOR FOREIGN COMPANIES

It was revealed that during the period 2013–2017 the change in the turnover of assets had the maximum impact on the dynamics of ROE on foreign OGCs, and this impact was negative. (*Table 5*).

The contribution of the asset turnover factor to the reduction in *ROE* in the total amount of the decrease is –3.08%. In particular, the *ROE* of British Petroleum fell by 14.68% due to a 40% decline in revenue

Table 6

Factor Analysis of The Return on Equity of Foreign Oil and Gas Companies of 2018–2021, %

Companies	*ΔROEnT*	*ΔROEn %*	*ΔROEnROS*	*ΔROEnAT*	*ΔROEnFL*	*ΔROE*
Sinopec	1.09	1.29	4.15	–5.15	0.85	2.22
PetroChina	2.59	0.17	1.04	0.44	0.17	4.40
Saudi Aramco	0.96	–0.09	–5.19	–13.22	9.15	–8.38
Shell	0.34	–0.15	2.22	–4.31	1.89	0.00
BP	–1.27	0.22	4.62	–5.61	1.37	–0.68
Exxon Mobil	1.13	0.27	0.00	0.12	1.72	3.24
Total	–0.35	–0.02	4.25	–1.64	2.18	4.41
Petrobras	1.00	2.70	14.25	4.16	–3.54	18.57
Average	1.12	0.01	3.28	–4.11	1.69	2.00

Source: Compiled by the authors.

and a 14% increase in total assets over the period under review.

The decline in capital profitability was also adversely affected by return on sales of –2.99% of the total decline. In 2013–2017, foreign companies' profits declined by 53% while revenue decreased by 32%.

In 2018–2021 the distribution of the influence of factors on *ROE* changed, in particular the *ROE* of foreign companies increased by 2% (*Table 6*).

The biggest contribution to *ROE* growth is the return on sales, which accounts for 3.28% of the total growth. The decline in *ROE* was mostly influenced by the turnover of assets of 4.11% of the total change.

"Total" and "Petrobras" companies were mainly affected by the change in return on sales. The growth in the return on sales of "Petrobras" has had a major impact on the growth of the company's *ROE* of 18.57%.

For "PetroChina", the tax burden effect was the most important. It was positive due to the fact that the company's profit tax in 2018 amounted to 40% of the profit before taxation, while in 2021 this share decreased to 28%.

Sinopec, Saudi Aramco, Shell and BP were mainly affected by changes in asset turnover. The effect of the coefficient was unfavorable, as the revenues of these companies did not have time to recover to the level of 2018–2019.

CONCLUSION

The calculations showed that all domestic oil and gas companies were effectively managing their own funds during the period under consideration. At the same time, average values for domestic companies are superior to foreign ones in most years, including in crisis years.

A quantitative assessment of the degree of sensitivity of return on equity of domestic oil and gas companies revealed that the biggest influence on the change of *ROE* for the industry is the factor of return on sales (*ROS*). The positive or negative effect of the factor depends on market conditions, oil prices and company structures. For the period 2013–2017, *ROS* had a negative impact due to the oil crisis that began

in 2014 and the sanctions imposed against Russia. For the period 2018–2021, *ROS* had a positive impact on *ROE* due to high energy prices and the rapid recovery of the market after the 2020 crisis. Similar analysis showed that the largest impact on the *ROE* of foreign companies is the return on sales and turnover of assets.

The factor analysis of the ROE allowed for the identification of the main variables affecting each business, including those with the greatest impact of sales profitability ("Gazprom", "Rosneft", "Tatneft", "NOVATEK", "Total", and "Petrobras"), the greatest impact of financial leverage (Lukoil and Exxon Mobil), the greatest impact of asset turnover ("Gazprom neft", "Sinopec", "Saudi Aramco", Shell, and BP) and with the maximum effect of interest burden ("PetroChina").

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ABOUT THE AUTHORS

Irina V. Filimonova — Dr. Sci. (Econ.), Prof., Senior Researcher, Institute of Economics and Industrial Engineering, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia; head of the chair of the political economy, Novosibirsk National Research State University, Novosibirsk, Russia
https://orcid.org/0000-0003-4447-6425
Corresponding author:
filimonovaiv@list.ru

Anna V. Komarova — Candidate of Economic Sciences (Econ.), Senior Researcher, Institute of Economics and Industrial Engineering, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia; associate professor of the chair of political economy, Novosibirsk National Research State University, Novosibirsk, Russia
http://orcid.org/0000-0002-5844-1648
a.komarova@g.nsu.ru

Artem A. Angarov — master's student, Novosibirsk National Research State University, Novosibirsk, Russia
http://orcid.org/0009-0002-6040-6195
a.angarov@g.nsu.ru

Aleksandr Yu. Novikov — master's student, Novosibirsk National Research State University, Novosibirsk, Russia
http://orcid.org/0000-0001-9484-6717
a.novikov2@g.nsu.ru

Authors' declared contributions:
I. V. Filimonova — statement of the problem, development of the concept of the article, formation of the conclusions of the study.
A. V. Komarova — literature analysis, problems, approaches and methods for analyzing the effectiveness of companies.
A. A. Angarov — collection of statistical data, decomposition and evaluation of factors.
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Research on Early Warning Model of Financial Report Fraud in China

Yan Yubo, Chen Yumeng
Saint Petersburg State University, Saint Petersburg, Russia

ABSTRACT

At present, financial report fraud is becoming more frequent with the continuous development of the world economy. How to provide early warning before financial report fraud occurs has become more and more important. The **purpose** of this paper is to set up a logistic regression model, namely an ex-ante warning model, which can provide early warning before financial report fraud occurs, by comparing the governance of financial report fraudulent companies and non-fraudulent ones. First, this paper uses the "fraud triangle" theory as a framework to find the relevant proxy variables for fraud opportunities, fraud pressure, and fraud rationalization. Second, the study uses T-test, Mann-Whitney test and chi-square test to identify statistically significant differences among these proxy variables. Hypotheses were made about the relationship between the coefficient values and the presence of false behavior in the reports. Finally, an ex-ante fraud warning model is set up from the indicators with statistically significant differences, meanwhile the hypotheses regarding the behavior of the indicators and their impact on the model are tested. The overall accuracy of the ex-ante fraud early warning model developed in this paper is 70.9%. How to further debug the model to make the screening of fraudulent companies more accurate is the difficulty and further research direction of the article.
Keywords: financial report fraud; fraud triangle; fraud opportunities; T-test; Mann-Whitney test; chi-square test; ex-ante fraud early warning model

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INTRODUCTION

In 1992, China reformed the shareholding system of state-owned enterprises. At the same time, the China Securities Regulatory Commission was also established to manage and supervise listed companies [1].

In this historical context, shares were artificially divided into circulating and non-circulating shares. Non-circulating state-owned shares accounted for over 60% of the total share capital. As a result, the majority shareholder has absolute control over the company [2]. This leads to the board of directors being forced to act in accordance with the views of the shareholders [3]. This shareholding structure reveals the practical urgency of improving the supervision system of Chinese companies. As a result, the Company Law of 1993 regulated the supervisory board system of listed companies. In 1998, the Securities Law came into force, providing regulations for the listing and delisting of companies. 2003 saw the introduction of independent directors in China. In 2006, the Ministry of Finance issued the Code of Practice for Chinese Certified Public Accountants, which laid the foundation for external auditing. In December 2007, the China Securities Regulatory Commission required for the first time that listed companies disclose a summary report on the performance of the audit committee in their 2007 annual reports. As a result, the regulatory system for listed companies in China has basically taken shape [4]. However, in recent years, due to the continuous development of the capital market, financial statement fraud has also emerged and intensified.

Financial statement fraud is the intentional misstatement or omission of figures presented in financial reports or notes to financial statements for the purpose of deceiving users of financial report. It includes: manipulation of the accounting records or supporting documents on which financial reports are based; intentional omission of errors in transactions, events or other material information in financial reports; and intentional misapplication of accounting principles relating to quantities, classifications, presentation or disclosure [5]. Jing Gao believes that financial statement fraud also leads to weak controls and a disorganized corporate governance structure, and deteriorates the quality of its audit function [6].

This paper hypothesises that there is a causal relationship between the corporate governance indicators set up to change as a result of financial statement fraud. This paper first examines the relationship between all independent and dependent variables through univariate analysis (t-test, Mann-Whitney test, chi-square test), and then conducts logistic regression analysis, which ensures more accurate results.

This study takes the special situation of Chinese capital market as the background, takes the basics of corporate governance structure, and uses the relevant proxy variables of the fraud triangle to construct an ex-ante fraud early warning model. The results of the paper can help confirm key companies to observe before fraud occurs. It has theoretical and practical significance for early warning of financial report fraud.

The main objective of this paper is to develop an economic model that can provide early warning before financial report fraud occurs by studying the corporate governance situation. The following are the main goals:

1. Find proxy variables for fraud opportunities, fraud pressure and fraud rationalization in the fraud triangle;

2. Perform statistical tests on the above proxies by T-test, Mann-Whitney test and Chi-Square test;

3. Perform binary logistic regression based on the results of the second step to establish an ex-ante fraud warning model that can provide early warning of financial report fraud.

REVIEW OF THE LITERATURE

Beasley (1996) found that the proportion of outside directors was significantly higher in non-fraudulent firms than that in fraudulent firms [7].

In 1999, the COSO published "Fraudulent Financial Reporting: 1987–1997, An Analysis of U. S. Public Companies", it was noted that only 38% had audit committees composed entirely of outside directors. 65% of audit committee members have no accounting qualifications. In about 60% of the directors are insiders. About two-thirds of the fraudulent companies, CEOs are the same person as the chairman of the board.

Wael Almaqoushi, Ronan Powell (2017) concluded that companies with low audit quality are more likely to have internal accounting problems [8].

Research on the relationship between corporate governance and financial fraud in China started late. Guohong Zhu (2001) concluded that insufficient management incentives and weak accounting controls were the causes of financial statement fraud [9].

Liguo Liu and Ying Du (2003) found that the proportion of corporate shares, the proportion of executive directors, the degree of insider control and the size of the supervisory board are positively related to the likelihood of fraud, while the proportion of outstanding shares is negatively related to the likelihood of fraud [10].

Ning Cai and Lizhen Liang (2003) found that there was a negative relationship between firm size and the likelihood of fraud, while there was a positive relationship between board size and equity concentration and the likelihood of fraud [11].

Wei Yang and Tao Yao (2006) found that the proportion of national shares and the proportion of outstanding shares were positively related to fraud, the likelihood of fraud was higher when the chairman of the board was also the general manager [12].

Qingxiang Yang et al. (2009) found that the shareholding ratio of the board of directors was significantly and positively related to financial fraud, and the frequency of board meetings was gradually increasing the inhibitory effect on financial fraud [13].

Tiesheng Zhang et al. (2011) found that effective internal control can significantly inhibit the possibility of financial fraud [14].

Xin Lu et al. (2015) found that the average age of the executive team and the high proportion of males made them more likely to commit fraud [15]. The findings of Yang Wang et al. (2021) also suggest that female corporate leaders improve the monitoring capacity of the board of directors and reduce the incidence of financial statement fraud [16].

Jianrong Yao et al. (2019) found that more than 50% of the fraudulent companies were concentrated in 2014–2017 [17]. This is indication that financial statement fraud is becoming more prevalent.

Yue Wang, Yue Wang (2021) built a logistic regression model including Benford factors and obtained an overall accuracy rate of 89.31% [18].

Zhelin Liu and Meifang Chen (2021) found that the risk of financial fraud was lower in listed companies with a larger board of directors and supervisory committee, and higher degree of equity checks and balances; and the risk of financial fraud was higher in

companies that were issued with a non-standard audit opinion type two years before the fraud occurred [19].

Chen Xing (2021) found that four indicators, including the proportion of outstanding shares, the number of executives, the total remuneration of the top three executives and the proportion of shares held by the supervisory board, had a positive influence on the company's financial fraud; three indicators, including the proportion of shares held by the largest shareholder, the number of board members and the proportion of independent directors, had a negative influence on the company's financial fraud [20].

Yuming Shen (2021) combined logistic regression models with knowledge graph models. And showed that the relevant information improved the accuracy of logistic regression [21].

The above studies do not present the whole picture of corporate governance in relation to financial fraud. This paper's ex ante early warning model simultaneously looks shareholding structure, board and supervisory board characteristics, the gender and age of management and external auditing, arguably making this study more comprehensive than previous studies. This is the first contribution to this paper. The second contribution is the inclusion of financial variables. It can reflect whether a company will face financial distress prior to fraud. The third contribution is the inclusion of pre-fraud accrual levels and accrual directions in the model, which provide evidence of management's willingness to manipulate financial statement data.

SAMPLE SELECTION AND RESEARCH METHODS

This study utilizes the CSMAR Database[1] to collect 88 listed companies with financial report fraud that were punished for violations from 2010 to 2019. We selected 88 annual data of the first fraud as the fraud sample.

This paper prepares relevant matched samples for each fraud sample:

(1) The same year as the fraud samples;

(2) The same industry as the fraud samples;

(3) Excluding *ST and ST companies;[2]

(4) Excluding companies which have already been punished for financial report fraud;

(5) Excluding companies lack of key data.

According to the criteria above, 249 matched samples were selected for the 88 fraud samples.

In this paper, the binary regression analysis is used to establish an ex-ante early warning model. This paper is a proxy variable for the Pressure, Opportunity, Rationalization of the Fraud Triangle Theory [22] is used to detect the probability of fraud in listed companies.

INDI3CATOR SETTING

(1) Fraud Opportunity Variables

Proportion of outstanding shares (POOS). In China non-tradable shareholders are usually unable to form an effective monitoring system for the management. Therefore, we expect that the POOS is negatively related to the likelihood of fraud.

Percentage of shares present at the annual general meeting (PSAM). Geng Chen et al. found that the higher the PSAM ratio, the stronger the shareholders binding effect on the management [23]. However, shareholders may turn a blind eye to the fraud that has occurred for their own financial interests. Therefore, we cannot expect a relationship between PSAM and the likelihood of fraud.

The number of board meetings during the year (NBMD). There are two contrasting academic views. The first view is that more board meetings indicate more motivated board members, thus it will help to prevent fraud [24]; the other view is that more meetings mean more problems, which increases the possibility of corporate fraud [25]. Considering that boards of directors of listed Chinese companies often act only according to the opinions of shareholders, we expect that NBMD is positively related to the likelihood of fraud.

Board size (BS). Communication and consultation between the board of directors and its functional committees[3] can play a better monitoring role and reduce the possibility of fraud. Therefore, this paper concludes that BS is negatively related to the possibility of fraud.

Size of the board of supervisors (SBS). Yiqi Qi found that the larger of the board of supervisors is,

[1] GTA CSMAR China Listed Company Database [国泰安CSMAR 中国上市公司数据库].(In Chinese). URL: https://us.gtadata.com/ (accessed on 01.04.2020).

[2] ST means a company with two consecutive years of losses or net assets lower than the par value of the stock, *ST means the company is still in loss in the third (yeardelisting risk).

[3] Including audit committee, nomination committee, remuneration committee, strategy committee, etc.

the more fully its supervision performs and the less likely the firm is to engage in fraud [26]. Therefore, this paper expects that the SBS is negatively related to the likelihood of fraud.

The proportion of independent directors (POID). Fangfang Han [27], Jiangkai Zhang et al. [28], and Wenxiu Hu et al. [29] found that people with a larger POID are less likely to commit fraud; Therefore, we expect that POID is negatively related to the possibility of fraud.

The chairman of the board is also the general manager (CPGM). Xiaodan Du 's study shows that companies with CPGM are more likely to engage in fraud [30]. Therefore, we expect that fraud is more likely in public companies with CPGM.

Whether a state-owned holding company (WSHC). When a listed company is a state-owned holding company, it can get support from the state, without committing fraud. Therefore, we expect that fraud is more likely in non-state-owned holding companies.

Herfindahl-Hirschman index (HHI). In this paper, the sum of squares of the shareholdings of the top 10 shareholders of a company is used as HHI. There are different academic findings. Mengying Gu [31], Wei Huang et al. [32] found that HHI is negatively related to fraud likelihood. However, Xuetong Tang et al. [33], Yueying Ren and Guohai Lan [34] found that HHI is positively related to the likelihood of fraud. Therefore, we cannot expect the relationship between HHI and the likelihood of fraud for the time being.

Degree of control of the first largest shareholder (Z). The ratio of the shareholding ratio between the first largest shareholder and the second largest shareholder of the company is used as Z. The higher Z, the more likely it is to implement more effective supervision of the executives of the listed company. However, too high Z may also lead to the behavior of the controlling shareholder not being effectively restrained. Therefore, we cannot expect the relationship between Z and the possibility of fraud for the time being.

Companies audited by large accounting firms or companies are subject to dual domestic and foreign audits (LFDA). Cheng Chen found that auditors from large accounting firms have higher audit quality, thus preventing fraud. Dual audits have a similar effect [35]. Therefore, we expect that LFDA is less likely to commit fraud.

As can be seen from (*Tables 1 and 2*), there are significant differences between the fraud sample and the matched sample in terms of the proportion of outstanding shares, the degree of control of the largest shareholder, whether it is state-owned holding, and whether a large accounting firm is responsible for the audit or the company is subject to a dual audit.

(2) Fraud Pressure Variables

Whether loss before fraud (WLBC). If a listed company loses money for two consecutive years, the trading of the listed company's stock will face the risk of exiting the stock market (ST). Therefore, we expect that listed companies that have already incurred losses before the fraud are more motivated to engage in fraud.

Profitability before fraud (PBC). The profitability of a listed company is critical to its ability to qualify for refinancing; therefore, listed companies with poor profitability before fraud are more likely to commit fraud. We use return on equity (ROE) before fraud as profitability, and we expect that companies with lower ROE are more likely to commit fraud.

Development ability before fraud (DABC). Xiaoqing Zeng and Xiangyong Tang's found that companies with higher development capacity are more likely to commit financial statement fraud [36]. We choose the increase rate of main business revenue in the year before the fraud as an indicator of firm growth and expect that the higher the indicator, the more likely the firm is to be fraudulent.

Solvency before fraud (SBC). Listed companies with poor solvency often have a strong incentive to commit financial statement fraud. We use the net cash flow from operating activities/current liabilities indicator before fraud as a proxy variable for solvency for our sample firms, and we expect that firms with lower indicators are more likely to be fraudulent.

Shares held by management (SRSM). We use the natural logarithm of management's shareholding in the year of fraud as a proxy for management's shareholding. We expect that companies with higher total management shareholdings are more likely to commit fraud.

Change of management (COL). When a company's chairman or general manager changes, the successor often takes drastic steps to clean up old accounts or even resorts to financial statement fraud. Therefore, we expect companies with a change in chairman or managing director during the year to be more likely to be fraudulent.

Table 1

Descriptive Statistical Table of Continuous Fraud Opportunity Variables

Fraud opportunity variables	Fraud or Not	Numbers of observations	Mean	Median	T test (P)	Mann-Whitney Test(P)
POOS	1	88	0.612	0.577	2.874	−1.818
	0	249	0.711	0.772	(0.004)***	(0.069)*
PSAM	1	88	0.504	0.499	−0.923	−0.683
	0	249	0.484	0.499	(0.357)	(0.495)
NBMD	1	88	9.330	9	−0.175	−0.377
	0	249	9.245	9	(0.861)	(0.706)
BS	1	88	8.920	9	0.465	−0.333
	0	249	9.028	9	(0.642)	(0.739)
SBS	1	88	3.591	3	0.985	−1.177
	0	249	3.731	3	(0.325)	(0.239)
POID	1	88	0.352	0.333	0.816	−1.100
	0	249	0.358	0.333	(0.415)	(0.271)
Z	1	88	11.141	2.629	1.292	−2.473
	0	249	18.406	4.398	(0.197)	(0.013)**
HHI	1	88	0.143	0.117	1.530	−1.160
	0	249	0.164	0.123	(0.127)	(0.246)

Source: Guotaian CSMAR database of Chinese listed companies. URL: https://us.gtadata.com/ (accessed on 03.07.2022).

As seen in *Tables 3* and *4*, there are significant differences between the fraudulent and matched samples in terms of profitability before fraud, development ability before fraud, solvency before fraud, shares held by management, change of management, and whether there was a loss before the fraud.

(3) Fraud Rationalization Variables

Accrual level and accrual direction before fraud (ALBC 1, ALBC 2). Accrual level refers to the difference between accounting profit and net cash flow from operating activities. Beneish found that fraudulent firms are more likely to have persistent positive accruals in the year prior to the fraud [37]. We expect that the higher the accrual level, the more likely a company is to commit fraud, and companies with positive accrual direction before fraud are more likely to commit fraud.

Average age of management (AAOM). The findings of Yuehua Xu et al. suggest that as the average age of the board increases, CEOs become less likely to engage in corporate financial fraud [38]. Therefore, we expect that AAOM is inversely related to the likelihood of corporate fraud.

Gender ratio of management (GROM). Liuye Guo suggest that men are more likely to commit fraud than women [39]. Therefore, we expect that the higher the proportion of males in management, the higher the likelihood of corporate fraud.

As can be seen in *Tables 5* and *6*, there are significant differences between the fraud sample and the matched sample in terms of the mean age of management, the accrual level and accrual direction before fraud.

ESTIMATION OF THE EX-ANTE WARNING MODEL

We selected 13 statistically significant variables from the aforementioned descriptive statistical analysis to build an ex-ante warning model by establishing a multivariate analysis model.

Before building the ex-ante warning model, a multicollinearity diagnosis was performed, and the VIF (Variance inflation factor) of all the indicators are less than 10. Therefore, there is no multicollinearity problem between these variables.

Next, we proceed to develop an ex-ante warning model. Since the dependent variable CORRUPTION is a binary variable and the explanatory variables have

Table 2

Chi-Square Test Table of Discrete Fraud Opportunity Variables

Fraud opportunity variables	Fraud or Not	Numbers of observations	Mean	Chi-square (P)
CPGM	1	88	0.284	1.435
	0	249	0.221	(0.231)
WSHC	1	88	0.284	7.400
	0	249	0.450	(0.007)***
LFDA	1	88	0.023	7.230
	0	249	0.120	(0.007)***

Source: Guotaian CSMAR database of Chinese listed companies. URL: https://us.gtadata.com/ (accessed on 03.07.2022).

Note: (1) The number of fraud samples is 88 and the number of matched samples is 249; (2) The significance level of the statistical tests in the table is 5% (i.e., the confidence interval percentage is 95%); (3) T-test is used to test the statistical significance level of the mean of each variable, all two-tailed tests; (4) Mann-Whitney U test for testing the statistical significance level of the median of each variable, all two-tailed tests; (5) ***, **, * represent passing the significance test level of 1, 5, 10%, respectively. *Table 1 – Table 8* are the same as the note.

Table 3

Descriptive Statistics Table of Continuous Fraud Pressure Variables

Fraud pressure variables	Fraud or Not	Numbers of observations	Mean	Median	T test (P)	Mann-Whitney Test(P)
PBC	1	88	0.044	0.059	1.824	-1.716
	0	249	0.079	0.075	(0.071)*	(0.086)*
DABC	1	88	0.749	0.112	-0.992	-1.683
	0	249	0.378	0.164	(0.324)	(0.092)*
SBC	1	88	0.051	0.015	2.407	-4.385
	0	249	0.305	0.136	(0.017)**	(0.000)***
SRSM	1	88	4.460	4.488	2.417	-2.098
	0	249	5.389	6.156	(0.017)**	(0.036)**

Source: Guotaian CSMAR database of Chinese listed companies. URL: https://us.gtadata.com/ (accessed on 03.07.2022).

both dummy and continuous variables, this paper uses a logistic regression model for analysis:

$$\text{Prob}(\text{fraud}) = \frac{1}{1+e^{-z}}.$$

Z is a linear combination of independent variables.

$$Z = \beta_0 + \beta_1 POOS + \beta_2 WSHC + \beta_3 Z + \beta_4 LFDA + \\ + \beta_5 WLBC + \beta_6 PBC + \beta_7 DABC + \beta_8 SBC + \\ + \beta_9 SRSM + \beta_{10} COL + \beta_{11} AAOM + \\ + \beta_{12} ALBC1 + \beta_{13} ALBC2.$$

In this paper, the Enter screening covariate method is used to make all the above 13 independent variables enter the logistic regression equation at once, and the regression results and discriminant rates are shown in the following table.

As can be seen from *Tables 7* and *8*, the estimated ex-ante warning model has a chi-square value of 69.529 with a significance level of 0.000, indicating that the overall test of the independent variables included in the model is highly significant. The Nagelkerke R Square is 0.873, indicating that the model has good explanatory power. The discriminant table shows that the discriminant accuracy of the model is 70.9%, which has a good discriminant effect.

Table 4

Chi-Square Test Table of Discrete Fraud Pressure Variables

Fraud pressure variables	Fraud or Not	Numbers of observations	Mean	Chi-square (P)
WLBC	1	88	0.216	13.722
	0	249	0.072	(0.000)***
COL	1	88	0.398	6.204
	0	249	0.257	(0.013)**

Source: Guotaian CSMAR database of Chinese listed companies. URL: https://us.gtadata.com/ (accessed on 03.07.2022).

Table 5

Descriptive Statistical Table of Continuous Fraud Rationalization Variables

Fraud rationalizationvariables	Fraud or Not	Numbers of observations	Mean	Median	T test (P)	Mann-Whitney Test(P)
GROM	1	88	0.833	0.862	0.140	−0.355
	0	249	0.835	0.857	(0.889)	(0.722)
AAOM	1	88	47.767	47.945	1.627	−1.667
	0	249	48.432	48.538	(0.105)	(0.095)*
ALBC 1	1	88	0.017	0.019	−1.700	−2.463
	0	249	−0.002	−0.002	(0.092)*	(0.014)**

Source: Guotaian CSMAR database of Chinese listed companies. URL: https://us.gtadata.com/ (accessed on 03.07.2022).

Table 6

Chi-Square Test Table of Discrete Fraud Rationalization Variables

Fraud rationalization variables	Fraud or Not	Numbers of observations	Mean	Chi-square (P)
ALBC 2	1	88	0.614	3.986
	0	249	0.490	(0.046)**

Source: Guotaian CSMAR database of Chinese listed companies. URL: https://us.gtadata.com/ (accessed on 03.07.2022).

Specifically for each explanatory variable, the regression coefficient of the outstanding share ratio and the natural logarithm of the number of management shares are negative and statistically significant, which indicates that the lower their numerical value, the higher the possibility of fraud, as expected. The regression coefficients for state-owned holding companies, large accounting firms auditing or undergoing dual audits and whether the firm had a loss prior to the fraud are negative and statistically significant, which indicates that non-state-owned holding companies, small accounting firms auditing and firms with a loss prior to the fraud are more likely to engage in financial report fraud, in line with expectations.

CONCLUSION

The ex-ante warning model before fraud is successfully established in this paper by studying the corporate governance situation. It can effectively provide pre-warning for financial report fraud. This paper uses data analysis methods that cleverly combine financial management with knowledge related to econometrics, thus making this paper's financial indicators better than other papers and the model fit and accuracy

Table 7

Logistic Regression Results of Logistic Regression Model

Variable	Regression Coefficient B	Wald Test Value	Significance (P)
Constant	−0.455	0.046	(0.831)
POOS	−1.852	11.858	(0.001)***
WSHC	−0.914	7.240	(0.007)***
Z	−0.006	1.829	(0.176)
LFDA	−1.653	4.328	(0.037)**
WLBC	1.436	6.374	(0.012)**
PBC	−1.575	0.962	(0.327)
DABC	0.080	1.883	(0.170)
SBC	−0.518	1.551	(0.213)
SRSM	−0.140	8.096	(0.004)***
COL	0.442	2.095	(0.148)
AAOM	0.033	0.528	(0.467)
ALBC 1	3.450	1.312	(0.252)
ALBC 2	0.114	0.076	(0.783)
Chi-Square	69.529		(0.000)***
Nagelkerke R Square	0.873		
Total number of samples	337		
Number of fraud samples	88		
Number of matching samples	249		

Source: Guotaian CSMAR database of Chinese listed companies. URL: https://us.gtadata.com/ (accessed on 03.07.2022).

Table 8

Discriminant Table

			Number of observations		
			Fraud or not		Accuracy
			0	1	
Number of observations	Fraud or not	0	178	71	71.50%
		1	27	61	69.30%
Overall accuracy					70.90%

Source: Guotaian CSMAR database of Chinese listed companies. URL: https://us.gtadata.com/ (accessed on 03.07.2022).

Note: The proportion of fraud samples in the total sample of 26% is used as the discrimination point.

better. The model fills the gap of ex-ante warning model before fraud in China, and provides a theoretical basis for establishing key companies to observe before the occurrence of financial report fraud.

This paper begins by successfully finding the proxy variables of fraud opportunity, fraud motive and fraud rationalization by using fraud triangle theory as a framework. Secondly, this paper uses

T-test, Chi-Square test and Mann-Whitney test to screen out the corporate governance indicators that affect financial report fraud. Finally, based on the results of the above studies, this paper successfully established an ex-ante fraud early warning model using Enter screening covariates. The overall accuracy of the model reaches 70.9%, which has a good identification effect.

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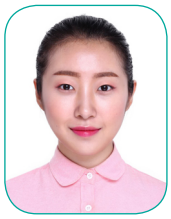
ABOUT THE AUTHORS

Yan Yubo — Postgraduate, Department of Economics, Saint Petersburg State University (SPBU), Saint Petersburg, Russia
Corresponding author:
st073315@student.spbu.ru



Chen Yumeng — Postgraduate, Department of Economics, Saint Petersburg State University, Saint Petersburg, Russia
https://orcid.org/0000-0002-3200-305X
chenyumeng@mail.ru

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Conceptual Approaches to the Formation of a Stable World Monetary and Financial System

A.V. Kuznetsov
Financial University, Moscow, Russia

ABSTRACT

The inclusion of the most dynamically developing countries in global value chains marked a gradual shift in the center of economic gravity in the world economy from the West to the East. In an effort to maintain their leading positions in the global monetary and financial system, today Western countries, led by the United States, create artificial barriers for developing countries to access the global financial architecture, which contradicts the logic and laws of the free market and increases geopolitical tensions. **The purpose** of the paper is to reveal and systematize the main factors contributing to the dysfunctionality of the modern world monetary and financial system and develop conceptual approaches to increasing its stability, taking into account the capabilities and interests of the most dynamically developing countries. The following **methods** were used to achieve the paper's goal: scientific abstraction (to generalize the crisis-generating factors of the modern world monetary and financial system); structural and functional analysis (to justify the need to form a "non-dollar" interregional (transcontinental) monetary and financial space and the possibility of the BRICS countries creating their own payment and settlement infrastructure and international liquidity); deduction and comparison (to identify problems that hinder China's promotion to the role of the leader of the new world economic order and disclosure of contradictions in the monetary and financial regionalization of the single European market). A comprehensive approach has been developed to form and ensure the functionality of the interregional (transcontinental) monetary and financial space of the BRICS countries, including measures aimed at countering the institutional monopolization of the functions of global financial intermediation by defining their own norms, rules and standards for the functioning and regulation of interregional financial markets by the BRICS countries. From a practical point of view, this approach can be used by the government bodies of the Russian Federation and the Bank of Russia to develop a new strategy and tactics for the country's international monetary and financial cooperation in the face of tougher external sanctions, as well as to develop appropriate measures aimed at ensuring Russia's financial and economic sovereignty.

Keywords: world monetary and financial system; world economic order; international financial crisis; financial sovereignty; BRICS countries; China; Economic and Monetary Union

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INTRODUCTION

The crisis-prone of the modern international monetary-financial system (hereinafter — IMFS) is largely related to the speculative nature of the operations of banking and non-banking institutions in the global financial market [1]. Thus, the destabilization of IMFS in 2008–2009 was due to excessive centralization and offshoring of capital, the securitization of low-quality debt liabilities, the revaluation of financial assets, the use of high credit leverage, etc. [2]. The subsequent widespread introduction of financial technology (FinTech) has changed the structure of financial intermediation, leading to a reduction in the total number of credit institutions in the world, while increasing the capital and assets of systemically significant banks, some of which already exceed the budgets and economies of some of the world's largest countries [3, p. 196].

Banking stabilization measures (including Basel III) aimed at increasing capitalization, creating liquidity buffers, reducing borrowing dependence, de-offshoring and clearing portfolios of low-quality assets have generally had a stabilizing effect on IMFS. Meanwhile, the risks inherent in banks are now being replicated in the fast-growing sector of non-bank financial institutions (hereinafter — NBFI), closely linked to the banking sector [4]. According to the Financial Stability Board (hereinafter — FSB), NBFI's financial stability risk assets were estimated at 63.2 trn dollars in 2020.[1] In this context, given the already significant increase in central bank balances, it is necessary to determine the extent to which they would be allowed to intervene in anti-crisis support for non-bank financial institutions in the event of a recurrence of the global financial crisis.

At present, measures to stabilize the IMFS at both the national and international levels are fragmented and low in effectiveness. Financial sector reforms initiated in 2009 by Group 20, including the establishment of the FSB, responsible for monitoring the functioning of financial markets and developing recommendations for their regulation, failed to prevent a sharp capital outflow from developing countries and extreme volatility in the prices of strategic commodities (oil, gas, grain, nickel), which occurred as a result of the impact on the world economy of non-economic factors such as the pandemic and the special military operation of the Russian Federation in Ukraine. Furthermore, the sharp price fluctuations were caused by a significant increase in the profits of large oil and agro-industrial companies, which raised energy and food prices, respectively, far above levels that could be justified by increases in their own costs. The situation was also exacerbated by the excessive speculative activity of hedge funds dominating the stock exchange [5]. In order to increase the effectiveness of the initiated reforms, it is necessary to return to the idea of creating an umbrella supranational regulatory body [6] (for example, in the form of a public-private partnership), which would be given real powers in the areas of regulating international capital movements, deterring financial speculation and controlling the prices of strategic commodities in order to reduce the systemic risks.

The lack of financial sector regulation to protect national economies has resulted in a growth in public debt, which is the most catastrophic impact. Anti-crisis increase in the supply of public debt displaces private investment and does not produce the expected macroeconomic effects. For example, the goals of recovering business, lowering business bankruptcies, and creating employment have largely not been met by quantitative easing programs in Japan, the UK, the US, and the eurozone between 2001 and 2021 [7]. Cycling the inflation spiral, as a side effect of soft

[1] Financial Stability Board. Global Monitoring Report on Non-Bank Financial Intermediation 2021, 16 December 2021. URL: https://www.fsb.org/2021/12/global-monitoring-report-on-non-bank-financial-intermediation-2021/ (accessed on 18.03.2023).

monetary policy, has become an additional challenge that central banks have faced in an environment of already volatile economic growth. As a compensatory measure, the extraordinary expansion of central bank balances requires restrictive measures on the creation of new money in a commercial institution-based economy. This is possible by increasing the number of compulsory reserves of banks, imposing restrictions on trade in financial assets of questionable quality while providing tax and other benefits to attract commercial banks to finance the creation of strategic interregional transport and logistics, energy and industrial infrastructure.

Another problem with the functioning of IMFS is the lack of clear rules governing the value of reserve currencies, which represent the vast majority of global financial market assets. The lack of adequate security of world currencies stimulates their unlimited multiplication, which in turn cause the development of inflationary trends. Under conditions of free movement of goods and capital, this leads to inflation in imports. It is therefore appropriate to initiate at the level of Group 20 the adoption of an international agreement aimed at stabilizing the exchange rates of key currencies and developing clear rules for determining their currency parities.

MONETARY AND FINANCIAL INTEGRATION OF BRICS

Despite the abolition in 1971 of the gold security of the US dollar and the ratification by IMF member countries in 1978 of the Jamaican Agreement on the Transition to the Multi-Currency Standard, the US national currency retained its role as the monetary axis and value benchmark of the IMFS. This not only gives the US "exorbitant privileges" in terms of repaying international debt obligations in its own currency [8], but also discriminates against fuel, energy and raw materials producers, who cannot set prices for their own products on their own [9, p. 97]. In order for the most dynamic developing countries, in particular the BRICS countries, to emerge from the US dollar dependence, it seems inevitable to establish their own interregional (transcontinental) monetary and financial system based on their national currencies or collectively created settlement units [10]. The weakening role of the US dollar in servicing international trade is substantially dependent on the consistent internationalization of the national currencies of the BRICS countries through their more active use in trade and investment transactions, mutual settlement and reserve formation.

In order to the objective of fostering an interregional (transcontinental) monetary and financial space independent of dollar liquidity, maximum control over the movement of financial resources through the channels through which the US broadcasts development cost to the rest of the world should be ensured. These channels, in general, include:

a) mechanisms for savings mobilization and credit allocation (e.g. correspondence accounts linking BRICS countries to the Bretton Woods institutions, as well as US banks — as depositories of their foreign assets);

b) financial intermediation institutions and processes (including, inter alia, financial companies and business support companies issuing external debt obligations denominated in US dollars through international financial centers);

c) creation and management of money itself (e.g. the provision of euro-dollar savings by national credit institutions).

One of the main aspects of the functioning of the modern IMFS is the concept of a reserve asset, which regulates the balance sheets of international trade and manages international financial flows. Given the extreme conservativity of the modern IMFS, due to the inertia of social confidence in the US dollar as a key reserve asset, it is desirable to conduct an information campaign among the participants in the financial markets of the BRICS countries in order to clarify the "toxic"

characteristics of the US dollar as a reserve currency and to justify the need to replace it with liquidity denominated in national currencies or collectively created settlement units of the BRICS countries.

Britain's experience should be used to build confidence in the new international liquidity of BRICS countries.

It is characteristic that the pound sterling became the first in the world full reserve currency due to the fact that at any time it could be converted into gold at a fixed rate and was not focused on the exchange rate as the difference between the internal and external value of money, since both values were expressed in the physical equivalent — of gold. Thus, the internal and external value of the pound was based on the actual gold stocks held in the Bank of England's safes and recorded in coin parities with other currencies. Based on their experience, they should develop their own monetary standard, whereby the value of the international liquidity of the BRICS countries will be tied to physical assets (e.g. strategic raw materials, gold or other types of commodity or resource basket) for which the parity of exchange rates needs to be fixed, while maintaining the international exchange free floating currency regime. Given the differences in the economic structures and labor productivity of the BRICS countries, it is preferable to use a collective monetary unit in inter-State foreign-economic cooperation. This will enable independent national monetary policies on domestic prices, production and employment markets and prevent economic crises.

The formation of demand for a collective currency by investors implies the offer of a variety of financial instruments traded in the secondary markets. At the same time, it is important to link the initial issue of such financial instruments with the financing of the strategic sectors of international cooperation of the BRICS countries. It is about building production chains within the framework of international cooperation, primarily in areas such as agriculture (food security), aerospace (military and transport safety), renewable and non-renewable energy sources (energy security), digital technologies (information and financial security) [11, p. 57–58]. In order to finance these industries, taking into account the current orientation of the actors of the world economy to meet the UN Sustainable Development Goals and the transition to a carbon-neutral base, it is advisable to organize in the BRICS countries a mass release of a line of innovative financial instruments, similar to those already circulating on the world financial market,— green bonds, social bonds and Islamic bonds etc.— in order to attract the widest range of investors in their acquisition, which will contribute to the internationalization of both national and collectively created currencies of the BRICS countries.

When creating a joint currency of the BRICS countries, the following aspects of the functioning of the modern world monetary and financial system should be considered.

Firstly, this system is supported by a strategic alliance between the two world's leading financial powers, the US and the UK, thanks to which, since 1944, the US has had the right to veto decisions on the most important issues in the Bretton Woods institutions.

Secondly, the modern IMFS is guided by the neoliberal postulates of open markets and global competition, in which the free international movement of capital as a source of global imbalances appears irreversible. The global reproduction of the neoliberal model is supported by the activity of universal international organizations such as the IMF, the World Bank Group and the WTO, as well as the FSB since 2009 as the "fourth pillar" of global economic governance [12].

Thirdly, the functioning of the global financial market is mediated through institutional monopolies controlled by the US and the UK, which set norms, rules and

standards for sovereign and private borrowers' access to the global capital market [13].

Thus, taking into account the above-mentioned features of the organization of the modern IMFS, in order to ensure the functionality of the interregional monetary and financial system of the BRICS countries, it is necessary to elaborate on a conceptual level the possibility of implementing the following measures:

Firstly, the nomination of most of the financial instruments traded on the BRICS stock exchanges in their national (collective) currencies.

Secondly, the establishment of price benchmarks in national (collective) currencies for all key commodities (oil, gas, cereals, metals) and their use in the conclusion of contracts on national commodity exchanges.

Thirdly, the listing of BRICS system-building national banks as key market makers on foreign exchanges to maintain a high level of liquidity of traded instruments.

Fourthly, the development of the BRICS benchmark interest rates to be targeted for issued financial instruments to monitor the refinancing processes of financial markets.

Fifthly, to legally require institutional investors to form their portfolios using only those securities that will receive investment ratings from the BRICS international credit agency and, in the period prior to the establishment of such an agency — from the leading national agencies of the BRICS countries [14].

Sixthly, the transfer of all BRICS offshore capital into their national jurisdictions to ensure that offshoring capital is regulated within national legal systems.

Seventhly, implementation of the emission of financial instruments denominated in national (collective) currencies exclusively in accordance with the national legal systems of the BRICS countries.

Eighthly, conducting audits of companies that issue securities and other financial instruments only by BRICS national companies to fully manage their financial statements and avoid having these companies sanctioned by unfriendly nations.

Ninthly, the creation of legislative conditions for the accumulation in the portfolios of investment holdings of BRICS countries of at least two thirds of the total volume of corporate securities issued in the national (collective) currencies of the BRICS countries and in free circulation, in order to prevent the acquisition of operational control over the companies of the BRICS countries by banks and financial companies of unfriendly countries.

Tenth, ensuring that all foreign exchange conversion transactions are conducted through financial entities under the jurisdiction of BRICS countries.

Interregional cooperation must be built on a fundamentally new economic model to prevent the reproduction of global imbalances within the framework of BRICS cooperation. Conceptually, this model could be based on the principles of centralized planning, market self-organization, security of money and regulation of international capital movements [15, p. 22–24].

IMPROVED CHINESE LEADERSHIP

Thus, the crisis-prone of the modern IMFS is associated with the absence of stabilizing supranational mechanisms aimed at preventing imbalances between developed and developing countries in the process of international movement of goods and capital. The development and implementation of such mechanisms are within the scope of global macroeconomic policy and should therefore be carried out at the level of global institutions of the Jamaican monetary system, such as the IMF, the World Bank and the WTO (until 1995 — GATT).

It is characteristic that, after World War II, the US played a leading role in the activities of these universal international organizations as a country that issued key reserve currencies and was the main donor

of financial resources. Meanwhile, as the importance of developing countries, China, increases in the world economy and world finance [16], there is an objective need to revise the key role and influence of the US in international financial institutions. Given the continued political support of Western leaders in the Bretton Woods institutions, it is unlikely that in the near future the latter will agree to hand over the governance of these institutions to China to promote the internationalization of the yuan as the successor to the US dollar as a key reserve currency. Hence, in order to implement real transformations in the IMFS, developing countries should act as a united consolidated front, acknowledging China as their unqualified leader in the emerging new world order, and with coordinated efforts to demand that recognition at the level of global institutions.

Developments in international economic relations over the past decade have revealed the low effectiveness of the US-centric IMFS in addressing global problems. The disagreement of other major players — China, the EU and Russia — with their secondary role in the modern international financial architecture is one of the main reasons for increasing geopolitical tensions in the world. It is clear that the global economy cannot function effectively without global leadership [17]. China's involvement in the management of global economic and financial processes seems quite logical, given the size of its GDP, exports and international reserves. However, despite its indisputable economic power, China has not yet been able to offer the world a unique (different from the Western) system of values shared by most other countries. "China does not have a stable and reliable system of partnership and allied relations; it does not set a tone in international discussions and it has no structural power in international organizations." [18]. The cautious attitude towards forming strategic alliances with the world's leading economies may be explained by the Chinese leadership's reluctance to be dependent on the more developed countries in the process of modernizing the national economy. From this perspective, in 2009, the Chinese government rejected the proposal of the Obama administration to establish a strong and long-term relationship with the United States as part of the G2 concept [19]. Meanwhile, the Chinese yuan's share in the global monetary and financial system is still significantly inferior to China's stake in the world economy and world trade. "China cannot challenge the US dollar's hegemony and conduct its currency's internationalization without the support of other countries" [20, p. 278]. Consequently, the full internationalization of the Chinese yuan requires greater use of the potential of Asia-centric international financial institutions.

THE EU — THE COURSE TO STRATEGIC AUTONOMY

Along with the creation of an interregional monetary and financial system within the BRICS countries, the EU should make greater efforts to promote its own interests in the IMFS [21].

The key change in the European financial architecture after Britain's exit from the EU is that London City is no longer the EU's specialized financial center for providing multidisciplinary services in banking, insurance, investment, legal, audit and consulting activities. To create a European alternative that is adequate in quality to the British financial services sector, Europe will have to make considerable efforts.

London's preservation of its position as a leading global financial center also depends on how much British financial services will continue to be in demand on the European continent in the future. Following the UK's withdrawal from the EU, the issues relating to the regulation of bilateral interaction in the financial sector remain open. From

1 January 2021, British financial companies lost their so-called "European passports", which provided them with unhindered access to European financial markets. Interaction between the UK and the EU in the financial sphere is based on the provision of "equivalence".[2]

By mid-2022, the UK Treasury has taken positive decisions to give EU and European Economic Area member countries equivalence in 28 of the 32 areas of the financial services sector.[3] In turn, since the signing of the Trade and Cooperation Agreement, the EU has taken only two positive equivalence decisions in favor of the UK, one of which has already expired. This contradicts the EU's position towards other jurisdictions. Thus, by October 2022, the EU had made 18 positive equivalence decisions for the US, 14 for Singapore and 10 for Switzerland.[4] Such a position is due to the desire of European politicians in the future to build relations with Britain in accordance with the concept of "open strategic autonomy". This concept aims to reduce the EU's dependence on London's market liquidity and entails the development of a Capital Market Union that will allow the EU to compete directly, without British intermediation, with the US financial markets.[5]

However, according to the New Financial analytical forum, the EU's share of the global capital market has fallen from 22% before Brexit (the second place in the world after the USA) to just 14% now. On average, the size of capital markets per GDP in the EU-27 is twice as small as that of the UK, which, in turn, is about half as large as the US. The financing of most companies in EU countries remains heavily dependent on bank loans. The starting point for the creation of deep and efficient capital markets in the EU-27 is large long-term capital pools, including pensions and insurance assets, as well as direct retail investment. However, the size of pension assets relative to GDP in the EU-27 is three times smaller than in the UK. Therefore, large-scale transformations of bank savings into investment are needed to ensure a more sustainable long-term recovery in the EU.[6]

CONCLUSION

Thorough conceptual consideration of the possibility of implementing the following activities is necessary to ensure the sustainability of the operation of the global monetary and financial system in contemporary conditions:

- establishment of a supranational body to monitor international capital movements, financial transactions and prices of strategic commodities;
- conclusion of a multilateral international agreement on the regulation of exchange rates and security of the internal value of key reserve currencies;
- ensure maximum control over the flow of financial resources through channels which the US broadcasts its own development costs to the rest of the world;
- development by BRICS countries of their own monetary standard, within which international liquidity will be linked to physical assets;

[2] In making equivalence decisions, the UK Government or the European Commission confirm that the rules and supervision of a foreign jurisdiction in a particular area of financial services are equivalent to their own. Thus, financial service providers of each party are given equal access and opportunities to profit from each other's markets, similar to those of national financial services providers.

[3] HM Treasury. HM Treasury equivalence decisions for the EEA States, 9 November 2020. URL: https://www.gov.uk/government/publications/hm-treasury-equivalence-decisions-for-the-eea-states-9-november-2020 (accessed on 18.08.2023).

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[6] New Financial. Report: A new vision for EU capital markets, February 2022. URL: https://newfinancial.org/report-a-new-vision-for-eu-capital-markets/ (accessed on 18.03.2023).

• organization of a range of innovative financial instruments denominated in BRICS national or collectively created currencies to promote their internationalization;

• revitalization of China's use of the capacity of Asia-centric international financial institutions to internationalize the yuan as a systemic counterbalance to the US dollar;

• concentration of EU efforts to form deeper and more efficient capital markets to reduce London's dependence on international financial markets and create real competition of the US in IMFS.

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ABOUT THE AUTHOR

Aleksei V. Kuznetsov — Dr. Sci. (Econ.), Senior Researcher, Prof. of the Department of World Economy and World Finance, Financial University, Moscow, Russia
https://orcid.org/0000-0003-3669-0667
kuznetsov0572@mail.ru

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Formation of Integration Cores as a New Direction of Globalization: Asian and Latin American Cores

F.I. Arzhaev[a], V.A. Turko[b]
[a] Financial University, Moscow, Russia;
[b] Research Institute of Labor of the Ministry of Labor and Social Protection of the Republic of Belarus, Minsk, Belarus

ABSTRACT

The hypothesis that globalization does not stop, but becomes regional, in connection with which integration cores are formed in each region. The **purpose** of the paper is to identify the characteristics of "new globalization" and the nature of the study of integration cores. A number of **tasks** are given in order to achieve the goal: analyze the integration processes in the Asian and Latin American regions using econometric methods, check the presence of prerequisites for the formation of integration nuclei in the studied regions, and highlight the characteristics of these processes. The methods of dynamic standard, statistical and correlation analysis are used in the paper. The hypothesis is proved through the system of developed tools in the part of formation of the integration core in Asia and refuted for Latin America. The following characteristics of integration cores have been identified: opposition to neocolonialism; promotion of export-oriented model; technical collaboration; the ability to surpass the countries of the Anglo-Saxon world-system core in economic development; indicate a new aspect of globalization — growing costs of interaction between countries and cores; detect of conflict and fragmentation of the globalization process itself and indicate potential cross-nuclear interactions. The key conclusion of the study was the proof of the hypothesis about the formation of globalization cores and the change of the globalization process towards fragmentation.

Keywords: globalization; integration; Asian countries; Latin America; center of power; interaction

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INTRODUCTION

In the modern world there have been and continue to be significant transformations of the world order, which inevitably lead to changes in the systems serving the main processes of international interactions. Globalization, often seen as a comprehensive process, is changing and becoming more region-specific. In addition, many researchers talk about globalization's decline or its transformation into another phenomenon — regionalization.

Nevertheless, there is no definitive understanding of the processes taking place. In this regard, the research hypothesis is put forward: globalization does not stop, but becomes regional, in connection with which the integration cores are formed in each region. The purpose of the paper is to verify the hypothesis and identify the characteristic features of globalization processes at the present stage. This is relevant in view of the beginning of structural shifts in the world order, caused by the intensification of Russian foreign policy, which has led to an open confrontation with Western countries, in particular, the Anglo-Saxon world-system core.

In order to the objective of the study, a number of challenges have been addressed: the characteristics of globalization and regionalization as phenomena have been identified; the integration processes in the Asian and Latin American regions have been analysed; whether the developing countries of these regions have formed sustainable institutional systems, within which new systems of international relations and globalizing processes have been created; the features of these relations and processes are highlighted; the new role of regional leaders has been indicated.

The novelty of the research is justified by a number of provisions and results of paper: firstly, the study of globalization processes in terms of the similarity of the economic systems of individual countries by the method of dynamic normative has not been conducted before; secondly, proved the hypothesis of the formation of globalization core — this is a new direction of globalization, highlighted in the study; thirdly, it has been proved that the Asian economic model with all its features allowed to form the integration cores in the region; fourthly, the features of the globalization at the present stage through the prism of the presence and formation of integrational core.

The theoretical significance of the study is to prove the existence of a new direction of globalization — integration cores. The concept developed allows to explain the high pace of integration processes in the Asian region and highlight the most significant features of the globalization core.

The practical significance of the paper includes the availability of a methodology for calculating the quality of integration processes, which can be applied to assess the integration effects of supranational bodies of international institutions in their activities. The results obtained can be used to identify forms of cooperation with certain countries for the formation of state bodies of foreign economic policy.

MATERIALS AND METHODS

We cannot fail to acknowledge that the theme of globalization is very well developed. There are over a thousand articles on this topic in Scopus. Domestic researches are also quite common, but in a more specific context, it is more proposed to consider the link between globalization and other processes and phenomena. Similarly, in all the diversity of sources, there are a number of unresolved problems: difficulties in defining terms and approaches to their consideration; the inconsistency of globalization, regionalization and integration as processes and the existence of different concepts on the subject; a small number of studies based on statistical data; the significant political context of the studies.

Western researchers tend to regard globalization as a long historical process,

seeking its roots in the XVI century or at least in the middle of the XX century, pointing to its inevitability as a result of cooperation between countries [1]. The emphasis is placed on the fact that globalization is a semantic-logical construction designed to characterize the comprehensive nature of the growth of interactions between countries, companies, people and cultures [2]. Globalization in the Western sense is a process that encompasses all spheres of life: from politics, which is quite obvious, to the development of municipalities [3] and the fight against HIV [4].

In domestic literature, on the contrary, the idea is promoted that globalization, although it emphasizes the economic homogenization of the world community, is actually seen as a political and ideological imperative for the development of capitalist society and a necessary condition for the preservation of the Anglo-Saxon core of dominant status in world politics and economy [5]. At the same time, significant emphasis is placed on semantic-logical and philosophical approaches to this phenomenon, for example, parallels are carried out between globalization and the security of the development of human society, the relationship between the terms of globalization, transnationalization and neocolonialism is discussed [6]. Often, the process of globalization is generally viewed by domestic researchers as a socio-cultural consequence of the domination of Western countries on the world economic arena, reinforcing this domination [7].

We cannot fail to ignore a set of absolutely identical domestic and foreign ideas regarding globalization, namely:

- globalization primarily affects the economy and international cooperation;
- recognition of the importance of globalization as a political construction in the development of society;
- understanding that globalization has not yet been sufficiently characterized from a scientific point of view.

An entirely separate area of research concerns the topic of regionalization. Several approaches to regionalization have been developed: the first is that regionalization appears to be a rollback of globalization. This position is based on the formation of regional value chains as evidence of the failure of the global division of labour [8], especially in the agro-industrial complex (AIC) and services. A second view of the relationship between these phenomena is that globalization is transforming and becoming more a regional phenomenon [9], which defines the development of the world community through the remaining relevant global institutions.

The question of globalization, its relationship with regionalization and the semantic aspects of these phenomena are not clearly defined, which gives rise to a considerable number of possible interpretations and hypotheses regarding their interdependence and future.

In order to avoid the same errors as in previous studies, based on the self-evident nature of globalization and the phenomena that accompany it and their weak measurability, we will limit the scope of the study to processes in two regions — the wider Asian region (including Southeast, South and North Asia) and the Latin American region (South American countries). The simplified model of globalization as a set of parameters is presented in *Table 1*.

This paper compares global trends and observed trends in the surveyed regions on the basis of the dynamic normative model (*DNM*) on a set of indicators from *Table 1*. However, if the measure of similarity is low, then the processes in these regions are not globalization, they are distinct in essence from the process, countries use economic models and obtain the corresponding results without trying to obtain synergistic effects with their partners in the region. If the measure of similarity is high, then the economies of these regions operate in the framework of the general concept of globalization, but the

Table 1

A Set of Indicators in the Dynamic Normative Models

Trade	Volume of mutual trade in goods
	Volume of mutual trade in goods
Investment cooperation	All forms of capital inflow and outflow
	Capitalization of companies in world markets
FOREX and reservation	Volatility of national currencies against the dollar
	External debt
Scientific and technological development	Quantity of patents
State revenues and labour market structure	Share of the working-age population
	GDP growth rate to PPP

Source: Compiled by the authors.

processes themselves are regional and it is necessary to identify whether the formation of globalization cores or the traditional concepts of regionalization are preserved. For preference growth rates, global rates are taken for allocated indicators, a measure of conditional gradation, measure of similarity (MS) is as follows: MC < 0.25 — low; 0.25 < MC < 0.5 — average; MC < 0.5 — high. Within the dynamic normative model, correlation values have nothing to do with the correlational values in the traditional understanding and confidence intervals of values, as they are rank correlations.

Integration cores are a separate category of paper. Regional integration can take place in different ways, firstly, integration processes are extremely diverse in their importance, and secondly, the beneficiaries of integration are also different. [10]. Let us propose a definition of the globalization core: it is a form of integration in which there is an integration with a clear center of attraction in the region, enabling to coordinate the economic policy of the region as a whole and to engage new actors in cooperation. At the same time, the globalization core forms the conditions for cooperation for others and countries relatively independent of them. The core of globalization should not be confused with the center of power. In the common sense, the center of power — is a country or political association that has control or influence over a particular geopolitical area, which, of course, affects the economy, but relates to the political aspects of international relations to a greater extent.[1]

To identify the formation of globalization core, a DNM analysis is carried out within regional aggregates, as well as multiple regional integration institutions and participation in them of countries of the region. Possible results are reflected in *Table 2*.

The conclusions from *Table 2* are also limited by the analysis of country participation in integration associations in the region according to the following methodology. If the same country has a significant measure of similarity to several centers, it is counted at the center of strength where the absolute value of the quadratic average of the similarity of the Kendall and Spearman coefficients is higher. If one of the

[1] Power Centers in the Modern System of International Relations (International Conference). Modern Europe. 2004;1(17):47–85. URL: https://cyberleninka.ru/article/n/tsentry-sily-v-sovremennoy-sisteme-mezhdunarodnyh-otnosheniy-mezhdunarodnaya-konferentsiya (accessed on 21.06.2023).

Table 2

Analysis of Similarity Measure and Possible Globalization Scenarios

Scenario	Similarity measure on global-regional scale	Similarity measure on regional-national scale	Result
1	High	High	The region has developed a generalization process (classical globalization)
2	High	Average	The region forming several globalization tracks
3	High	Low	The region exists in the context of "Fukuyama's globalization"
4	Average	High	Western-centric globalization in the region
5	Average	Average	Globalization is rollback to regionalization for a single region
6	Average	Low	The region is poorly integrated into global processes
7	Low	High	The region with a clearly traceable globalization core/ cores formation process
8	Low	Average	The region is poorly integrated into global processes, but with an intra-regional policy
9	Low	Low	The region is poorly integrated into global processes

Source: Compiled by the authors.

Table 3

Potential New Centers of Power

Type	Countries	Motive for getting a center of power
Superpower	Russia, USA, China	Promotion of universal ideology, large population, rich resource potential, membership in authoritative international organizations (UNSC), core potential, etc.
Asian superpower	China, India	Huge population and economic potential, developing powers, underrepresented in global regulation
Anglo-Saxon world	UK, USA, France, Finland, Germany, South Korea, Australia, Canada	They have the ability to dictate the rules of international relations, have the capacity to regulate global finances
"Asian Tiger" a new wave and new regional leaders	Indonesia, Brazil, Turkey, Mexico, Saudi Arabia, Egypt, South Africa, Argentina	They have significant GDP, economic potential, can be cultural centers

Source: Compiled by the authors.

Table 4

Closest Links Between the Studied Countries and the Cores of Integration

Anglo-Saxon core			
EU core		**SC**	**KC**
	Argentina	0.81	0.66
	Uruguay	0.66	0.5
	Columbia	0.58	–0.27
	Paraguay	0.5	0.27
	Bolivia	0.4	0.27
USA core		SC	KC
	Ecuador	0.61	0.5
	Malaisia	0.43	0.44
Japan core			
	South Korea	0.45	0.33
Asian core			
China core		SC	KC
	Singapore	0.95	0.88
	Philippines	0.43	0.33
India core		SC	KC
	Vietnam	0.71	0.5
	Mongolia	0.66	0.5
	Thailand	0.63	0.5
	Laos	0.48	0.44
	Indonesia	0.41	0.33
Latin American Core			
Brazil core		SC	KC
	Paraguay	0.8	0
China	Ecuador	0.95	0.88
India	Venezuela	0.4	0.27
India	Peru	0.4	0.27

Source: Compiled by the authors.

non-regional countries has a significant degree of resemblance to a center of attraction, then the current model of globalization — the west-centric one — is considered to be a priority.

Based on the results of the analysis, conclusions can be drawn about the nature of the processes taking place in a particular region. In the future, the use of the results obtained allows to identify the main features of economic interactions in the core of globalization or within the framework of the new globalization.

RESULTS

For the purposes of the study, regional leaders of economic development were adopted as countries — centers of integration. Obviously, the potential choice of such powers can be quite varied, the main approaches are presented in *Table 3*.

Table 3 shows an idea of which countries can be perceived as centers of power, but only the most economically developed countries can become integration cores. It should be noted here that the countries relating to the centers of power and the integration core differ in fact in that the latter can shape the rules of regional regulation, whereas the former are forced to submit to global regulation. We cannot ignore the fact that in Asia, China is advancing its economic model, which is significantly different from the market model [11], but is integrated into a global market economy. It is very important to note that there are several centers of attraction in Asia, a multipolar economic and policy model has been formed in the region [12]. In this regard, it is equally important to consider the possibilities of other countries to establish integration centers. To that end, the calculation was made for India, which is the natural counterweight of China's aspiration to dominate Asia. The ASEAN model has also been reviewed, but due to the high degree of dependence of Indonesia and India adopted by the regional economic centers, the ASEAN model has been incorporated into the centripetal processes led by India.

The Latin American integration model is initially bivalent — on the one hand, it is developing countries that are trying to form their own integration institutions, and they succeed, and on the other — the countries of Central and Latin America are historically under considerable influence by the USA and its allies [13], which does not allow to speak of absolute independence of integration processes in the region.

Anglo-Saxon influence also cannot be excluded from the study, as the modern world monetary and financial architecture is based on the post-Breton Woods world order, the dominant influence under which belongs to the US and its allies — first of all the UK and its individual former colonies. In fact, a world order has been formed in which the G7 countries create the rules of the game in the world economy.

The results of the analysis with the Spearman (SC) and Kendall (KC) rank correlation coefficients with the sampling and division of countries by the closest links to the centers of attraction are presented in *Table 4*.

As *Table 4* demonstrates, the transformation of globalization is most clearly seen in the Asian region. In Asia as a whole, two regional attractions have been formed — China and India, with the Indian center offering a more versatile economic model, while the Chinese model is more planned and specific, which makes it more suitable for the main financial partners of the China. ASEAN is not a center of attraction from an economic system point of view, most Southeast Asian countries tend to the Indian model.

The features of the Chinese economic model are described many times [15]: it is important to mention only some of them, important for further analysis. China's economy is based on medium-term development planning, renunciation to the liberalization of the monetary and financial system, development of industrial capacity with a gradual transition to export not only goods but also services, preservation of investment in the national economy and the creation of conditions for reinvesting profits [16]. It is quite clear that the Chinese model is suitable for those countries that are willing to focus on investment, planning and industrial development.

The Kerala model of India, on the other hand, is more liberal, it is also based on the significant influence of the state on the economy, although with a strong influence by market mechanisms on the development of the country as a whole, is export-oriented,

with considerable attention being paid to the social development of regions within the framework of public-private partnership in the economic sphere [17, 18]. Despite the differences between the Chinese and Indian economic models, there are no serious contradictions in the present circumstances between them.

Equally interesting is the situation in the Latin American region, which is significantly different from the Asian integration model. Brazil, as a regional center, does not have a significant centralization potential, as all countries, except Paraguay, either lean on the Anglo-Saxon model of globalization or in many ways replicate the economic decisions of Asian countries. This process is achieved not only through US policies (rather, contrary to the actions of American TNCs exploiting Latin American resources), but also through clear actions by EU countries, which also make significant profits from the Anglo-Saxon world-system core.

CONCLUSION

As part of this research, the hypothesis is proven that new forms of globalization are developing in the form of integration cores. At the same time, the hypothesis is partially proven: the integration core in Asia does exist, while the Latin American integration kernel has not yet been able to independently create conditions for the development of the regional economy, while in Latin America there is a regional center of power.

There has been active interaction between the integration core and power centers along the line China — the USA and EU — Brazil. In addition, the important role of transregional projects in the formation of inter-core interactions was pointed out.

Not every power center is an integration core. Integration cores must have a set of specific characteristics for sustainable operation. Among them: the struggle against neocolonialism; the export-oriented model of the economy; the abandonment of the neoliberal model in its radical understanding; the ability of the centers of attraction of the integration cores to develop faster than the countries of the "collective West" in conditions dictated by the Anglo-Saxon world-system core; the presence of prerequisites for socio-cultural and regulatory integration; cooperation in the technological sphere.

In the context of new globalization, the political nature of the globalization model has been inferred. It was pointed out that, in the new context, globalization would be a process of developing relationships between integration cores and would consist of tools to facilitate the achievement of collective agreements between integrating cores and power centers. The world is becoming irreversibly multipolar and diverse.

At the initial stage of the transformation process, the transaction costs of international relations in all their forms should be expected to increase, in particular, the strengthening of the process of regional regulation. Thus, a temporary rule-based dominance of intra-regional relations in the interests of all regional actors is also seen as the most likely option.

The results of the research are complementing scientific insights on globalization processes, expand the possibilities of research of globalization and regionalization, allowing to combine these two processes within the framework of a single concept.

The conclusions point to conflict-generation as a distinctive feature of modern globalization. In this regard, the relationship between globalization cores and sources of international conflict could be identified to better support conclusions about the desire of Anglo-Saxon world-core countries to trigger instability in developing countries in order to maintain their dominance.

Research methods are multiplicative and can be used to study other integration processes, such as Eurasian integration or integration in the Middle East.

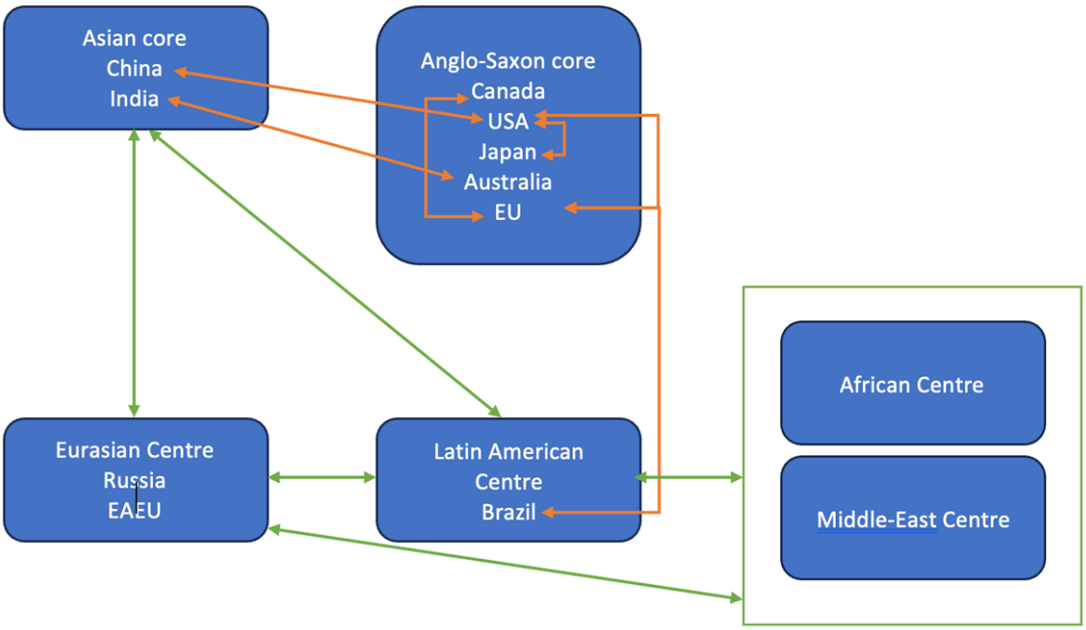

Fig. **The System of Connections Between the Integration Cores and Centers of Power**

Source: Compiled by the authors.

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ABOUT THE AUTHORS

Fedor I. Arzhaev — Cand. Sci. (Econ.), Senior Research Fellow, Institute for Research in International Economic Relations, Financial University, Moscow, Russia
https://orcid.org/0000-0002-2986-3235
Автор для корреспонденции / Corresponding author:
fedor.arzhaev@bk.ru

Vladimir A. Turko — Senior Researcher, Research Institute of Labor of the Ministry of Labor and Social Protection of the Republic of Belarus, Minsk, Belarus
https://orcid.org/0000-0003-0992-2063
magreg76@yandex.ru

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Heterogeneity of Mortgage Refinancing Channel in Russian Regions

E.A. Gafarova
Bank of Russia, Ufa, Russia

ABSTRACT*

During the period of monetary policy easing in Russia, mortgage refinancing became popular, which involves the issuance of a new mortgage housing loan to repay an earlier loan on more favorable terms. There is a regionally heterogeneous refinancing of mortgages at lower mortgage rates. The **purpose** of this paper is to quantify the impact of monetary easing on mortgage refinancing and household consumption for groups of Russian regions. Econometric methods (vector autoregression models on panel data, estimated by Bayesian methods) and multivariate clustering (hierarchical analysis, k-means method) were used in the paper. Based on the impulse response functions, it is shown that during the period of monetary policy easing, the greatest effect of lowering mortgage interest rates on refinancing is typical for groups of regions with high- and middle-income levels, a liquid housing market, and a developed mortgage market. It is proven that refinancing is involved in the transfer of the effects of monetary policy to consumer spending and consumer lending, and this transfer is heterogeneously. Refinancing in low-income regions stimulates consumption and consumer borrowing. In regions with an average and high level of per capita cash income, after refinancing, consumer spending and consumer loans are temporarily reduced. The obtained **results** can be explained by the different types of financial behavior of borrowers in the use of top-up mortgage refinancing, depending on the level of their cash income. Based on the results of the study, the hypothesis about the heterogeneity of the refinancing channel in the Russian regions was confirmed. The **scientific novelty** of the study consists in the development of a methodological approach to the study of the refinancing channel and its approbation on Russian regional data.

Keywords: mortgage refinancing; mortgage; mortgage refinancing channel; monetary policy; consumption; regional heterogeneity; Bayesian vector autoregression; panel data

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INTRODUCTION

In the market of Russian bank lending during the period of monetary policy (hereinafter — MP) popularity has gained mortgage refinancing, which involves the issuance of final borrowers a new loan on more favorable conditions to repay previously granted. Most favorable conditions for mortgage refinancing were 2020 (*Fig. 1*). Since the second half of 2021, the change in mortgage interest rates following the increase in the key interest rate of the Bank of Russia has limited the growth of refinancing.

MP tightening in 2022 against the background of increased geopolitical risks has made mortgage refinancing economically unprofitable for most borrowers. As a result, the volume of mortgage refinancing in the country in 2022 decreased by 78.8% compared to the previous year. Following the decline of interest rates to the "pandemic" level in the third quarter of 2022, there was a slight revival in demand for refinancing, primarily among borrowers who signed contracts under market programs at ultra-high interest rates, as well as for borrower under "Family Mortgage".[1]

Mortgage refinancing is also limited in the period 2020–2022 due to the introduction of preferential federal programmes without further interest rate change (with the exception of "Family Mortgages"). As a result of their active implementation, the structure of mortgage liabilities has changed,[2] the average rate on the Mortgage portfolio has formed significantly below the rate on refinancing of the mortgages, which deprives some borrowers of the feasibility of refinancing the mortgage. However, given the high debt of the population, which is usually long-term, it is reasonable to expect a resumption of the demand for refinancing during the further MP mitigation cycle.

Analysis of mortgage in the regional segment revealed the heterogeneity of the refinancing response to the decline in mortgages during the MP mitigation period. The high share of mortgage refinancing in the volume of Mortgage is observed in the Moscow region (17.1% in 2020), Moscow (17.3%), St. Petersburg (16.5%), Leningrad (14.7%) and Kaliningrad district (14.7%), low — in Republic of Chechen (2.3%), Republic of Ingushetia (2.4%), Republic of Karachay-Cherkessia (4.0%)), Republic of Kalmykia (4.2%) etc.

The analysis of foreign papers on the subject of the study shows an extensive evidence base, first, the effects of mortgage refinancing on consumption in response to monetary incentives within the so-called MP transmission mechanism refinancing channel and, second, the spatial heterogeneity of these effects. In view of the high heterogeneity of regional development, there is a hypothesis that the transmission in the refinancing channel among the regions of the Russian Federation is heterogenic.

As far as we know, there is no Russian study of the refinancing channel, which can be explained by the later formation of the Russian mortgage market and it's lagging behind in development compared to the countries of Europe and the USA. This paper seeks to fill the gap in scientific literature.

Thus, the purpose of this study is to quantify the impact of the MP mitigation on mortgage refinancing and further on population consumption for regions of the Russian Federation. To this goal, the following objectives have been set and resolved:

- distribution of homogeneous groups of regions of the Russian Federation by the level of average cash income of the population, taking into account the average prices on the secondary housing market;

[1] According to the Dom.rf service, more than 10.2 thous. mortgage housing loans amounting to 32.2 bln rubles were refinanced under this programme in 2022, which is about a third of all loans refinanced during this period. URL: https://дом.рф (accessed on 06.02.2023).

[2] According to Frank RG, the share of subsidized mortgage housing loans in total in cash amounted to 28% in 2020–2021 and 48% in 2022 (less than 2% in 2019). As of 1 January 2023, the portfolio of mortgage housing loans has a government-supported program debt of approximately 29%. URL: https://frankrg.com (accessed on 06.02.2023).

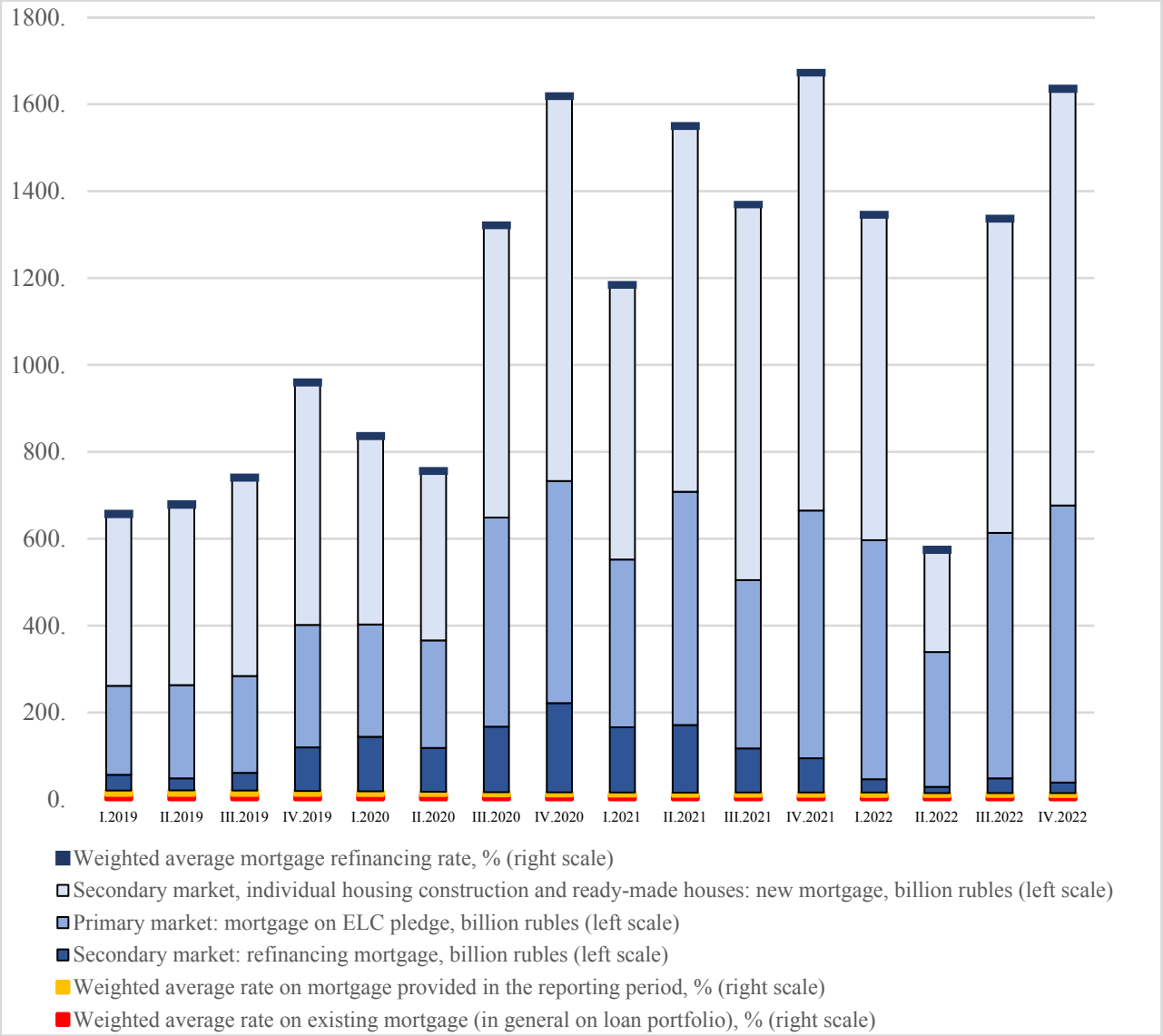

Fig. 1. **Dynamics of Issued Mortgage Housing Loans in Rubles to Resident Individuals (Billion Rubles) and Average Mortgage Rates for Existing Loans and Extended Loans (% Per Annum) in 2019–2022**

Source: Author' calculations based on data from the Bank of Russia.

- development of econometric models for groups of regions, allowing to obtain estimates of the growth of refinancing volumes in regions of the Russian Federation in response to the decrease of average mortgage interest rates;
- establishment of the heterogeneity of the change in mortgage refinancing in the conditions of MP mitigation and further transfer of it to consumer expenses and consumer credit in regions of the Russian Federation.

The achievement of the objective required the use of methods of econometrics and multidimensional clustering.

THE CHANNEL OF MORTGAGE REFINANCING AND ITS RESEARCH

In order to target inflation, the central bank affects market interest rates, including mortgage rates, by modifying the base interest rate. In the framework of the interest channel of the MP transmission mechanism, which has been studied to the greatest extent,

the reduction in the interest rate of the national bank is transmitted to a decrease in mortgage rates to the final borrowers.[3] Mitigation of credit conditions encourages borrowers to refinance existing mortgages at a fixed interest rate, while improving the terms of the contract and possibly increasing the size of the mortgage debt[4] ("top up"). After refinancing a mortgage, the borrower's consumption or investment increases. The study of this impact has been developed in foreign studies within the refinancing channel [8–11], which assumes the impact of mortgage refinancing on consumption in two ways.

Firstly, additional mortgage refinancing loans, which can be viewed as an alternative to consumer credit, but on more favorable terms, are mainly spent to finance temporarily increased consumption, to cover more expensive consumer loans or savings. According to H. Y. Andersen et al. [12], additional borrowed funds for refinancing account for about 55% of the available annual income of borrowers, which are spent on consumption (including home improvement and repair, long-term goods), deposits, investment in shares and bonds, as well as bank debt repayment (55, 22 and 18% of the "top up" amount, respectively). Earlier estimates of G.B. Canner et al. [13] find a generally similar distribution of the use of additional credit.

Secondly, changing the terms of the mortgage contract in the context of refinancing usually reduces monthly payments and thus increases the borrower's monthly disposable income, which in turn also stimulates consumption.

It should be understood that the transfer of mortgage refinancing incentives to borrowers' consumption will not be carried out immediately and in full due to the tendency of some borrower to postpone decisions on refinance, as well as the uncertainty of the choice of the option of using additional funds. This makes it difficult to assess the causal effects of refinancing on consumption.

In applied research [8–11, 14, 15] provide evidence based on unique microdata sets of increased consumer costs for long-term goods, most commonly measured by debt on car loans, after refinancing. It was found that less creditworthy borrowers with high debt burden significantly increased consumer expenses and car loans [8, 10, 14]. The spatial heterogeneity of mortgage refinancing is promoted by the positive relationship between refinancing and housing prices [8–10], financial literacy [16] and credit ratings [17] of borrowers, and a negative relationship — with the number of unemployed [18]. These proven facts led to the conclusion that MP incentives did not have any effect in the depressed regions that needed them most.

The above-mentioned analysis of the papers on the study of effects within the refinancing channel indicated the need to include in the model to study the heterogeneity of mortgage refinance indicators characterizing the development of the credit market, housing market, well-being of the population, etc.

ORIGINAL DATA

The analysis of the survey was based on the official annual data of Rosstat and the Bank of Russia for the period 2008–2019 in the region of the Russian Federation. The choice of the temporary period is due, firstly, to the relative stability of the MP mitigation and, secondly, the low mortgage ratio of state-supported programmes. The choice of periodicity is due

[3] Issues of the influence of interest rate on the money market on interest rates for final borrowers are well studied in foreign literature. For example, this papers that quantifies the extent and speed of the reaction of mortgage interest rates to changes in US federal fund rates [1], the Bank of England rates [2], the official monetary rate of New Zealand [3]. In Russian literature, the transmission from the key rate to the interest rate under the mortgage housing loans remains insufficiently studied, but the effect of transferring interest rates from the interbank credit market, for example MIACR or RUONIA, to bank interest rates on loans [4–6], is well studied. Evidence of regional heterogeneity of the impact of the key rate on bank interest rates on loans is presented in the paper [7].

[4] In Russia, in 2020, mortgage debt after its refinancing increased on average by 4–6%, in 2019 — by 4–10%. URL: http://www.cbr.ru/collection/collection/file/31945/review_03022021.pdf (accessed on 06.02.2023).

to the fact that information on population expenditure in the regions of the Russian Federation is published only once a year. Thus a panel data set is collected. The following indicators were considered as endogenous variables: 1) deposits of individuals in rubles; 2) mortgage liability granted to resident individuals in rubles; 3) consumer credit liability in rubles; 4) the amount of early repayment of newly issued mortgages in rubles; 5) average interest rate on mortgage granted to resident individuals in rubles[5]; 6) average income of the population; 7) average consumer expenditure per capita; 8) average prices on the primary housing market (rubles per square meter); 9) average prices in the secondary houses market (rubles per square meter); 10) consumer price indices (%, December to December of the previous year). For the correctness of interregional comparisons in dynamics, the source data in the region of the Russian Federation are converted: 1) corrected for consumer price indices and the value of a fixed set of consumer goods and services in regions of the Russian Federation; 2) reduced to average values (if necessary). Socio-demographic and economic indicators were used as exogenous.

METHODOLOGY OF RESEARCH

A panel vector auto-regression model[6] is chosen, in which the value of each endogenous variable for the region is described by the previous all endogenic variable values[7]:

$$y_{it} = A_0 + A_1 y_{it-1} + A_2 y_{it-2} + Bx_{it} + u_{it},$$

where y_{it} — endogenous variable vector; A_0, A_1, A_2, B — coefficient matrices; x_{it} — exogenous variable vector; u_{it} — residuals; i — region index; t — time index.

In the preliminary phase, the source panel data was collected and converted. The first phase involved the methods of multidimensional clustering of homogeneous regions of the Russian Federation, since the description of the dynamics under investigation for all regions of the Russian Federation in one equation did not bring satisfactory results.

In the second phase, a panel vector autoregression model [PBVAR(2)] for each group of regions was evaluated by Bayesian methods. In the third phase, a substantive analysis of models based on pulse response functions is carried out.

RESULTS AND DISCUSSION

In accordance with the logic of the study, in the first phase, the *k*-average method was divided into five[8] groups of average income of the population. The second group was further divided into subgroups, taking into account the average prices on the secondary housing market due to the high heteroscedasticity of balances in further simulation. In addition, the Kaliningrad and Leningrad regions were expertly classified in the higher group given the high demand for residential real estate. On the contrary, Republic of Chechen, Republic of North Ossetia — Alania, and Adygea were placed in the lower income group in the simulation. The Republic of Dagestan was excluded from the analysis because of a significant decline in the quality of the model. The subgroups presented in the table of the regions of the Russian Federation are ordered according to the growth of average per capita monetary income of the population, subgroup (IIa, IIb, IIc) — in the order of the increase of average prices of housing.

[5] When modeling on panel data, the inclusion of a key rate, the same for all regions of the Russian Federation, is impossible. We assume the transfer from the key rate to the mortgage interest rate as a proven fact and we analyze the effects of the change in the interest rate on mortgages and their refinancing.

[6] Analysis of foreign and domestic literature devoted to the study of the transmission mechanism monetary policy [19–21], as well as the influence of monetary policies on the prices of residential real estate [22] based on vector auto-regression models was carried out for the selection of econometric tools.

[7] In the course of modeling based on econometric tests (to determine the order of lag, as well as the exclusion of logs for each equation separately and all equations in aggregate) the second order of the model was established.

[8] Number of clusters determined by hierarchical (tree) analysis.

Table

Groups of Regions of the Russian Federation

Group number	Regions group
I	Republic of Adygea, Republic of Kalmykia, Republic of Ingushetia, Republic of Kabardian-Balkar, Republic of Karachaevo-Cherkesskaya, North Ossetia — Alania, Republic of Chechen, Republic of. Mari El, Republic of Mordovia, Republic of Chuvash, Kurgan region, Republic of Altai, Republic of Tuva, Republic of Khakassia, Jewish Autonomous District
IIa	Bryansk region, Vladimir region, Ivanovo region, Smolensk region, Vologda region, Pskov region, Stavropol region, Orenburg region, Saratov region, Ulyanovsk region, Chelyabinsk region
IIb	Kostroma region, Orel region, Ryazan region, Tver region, Novgorod region, Volgograd region, Kirov region, Altai region, Kemerovo region, Republic of Korea, Republic of Buryatia
IIc	Tula region, Yaroslavl region, Republic of Karelia, Astrakhan region, Republic of Udmurt, Penza region, Irkutsk region, Tomsk region, Trans-Baikal region
III	Kaluga region, Tambov region, Arkhangelsk region, Rostov region, Samara region, Krasnoyarsk region, Novosibirsk region, Omsk region, Kamchatka, Primorsky Territory, Amur region
IV	Belgorod region, Voronezh region, Kursk region, Lipetsk region, Republic of Komi, Murmansk region, Krasnodar region, Republic of Bashkortostan, Perm region, Nizhny Novgorod region, Republic of Sakha (Yakutia), Khabarovsk region
V	Moscow region, Moscow, Kaliningrad region, Leningrad region, St. Petersburg, Republic of Tatarstan, Sverdlovsk region. Tyumen region, Magadan region, Sakhalin region, Chukotka

Source: Compiled by the author.

In the second phase for each group regions of the Russian Federation evaluated PBVAR(2). As endogenous variables in all models were the first differences of the variables described above.

The model for each group of regions represents a system of ten interrelated equations.[9] The list of exogenous variables models varies for different groups of regions and includes: the share of the population with monetary incomes below the subsistence minimum in the total population, the coefficients of demographic burden, the level of unemployment in the working age, the rates of migration growth, the share of the urban population in the overall population, housing operation, the total area of housing per inhabitant, etc.

In the third phase, the response of the mortgage refinancing to the shock of interest rate growth on the basis of the analysis of the impulse response functions was assessed for each model. To make it possible to compare estimates for different groups of regions, a single scenario of reducing mortgage interest rate by 0.5 p.p. was considered.

The low-impulsive response of per capita refinancing to the lower mortgage rate is characteristic of the regions of Group I (*Fig. 2*), dominated by the Southern and Northern Caucasus regions. The greatest impulsive response of refinancing to the reduction in mortgage rates is characteristic of regions with medium and high average per capita cash income combined with affordable liquid

[9] The developed models have passed all essential diagnostic tests, indicating their stability, lack of auto-correlation and heteroscedasticity in residues, the significance of each lag in each model, the correctness of selecting variables as endogenous. Vector autoregression coefficients do not allow usual interpretation, pulse response functions are used to assess impact.

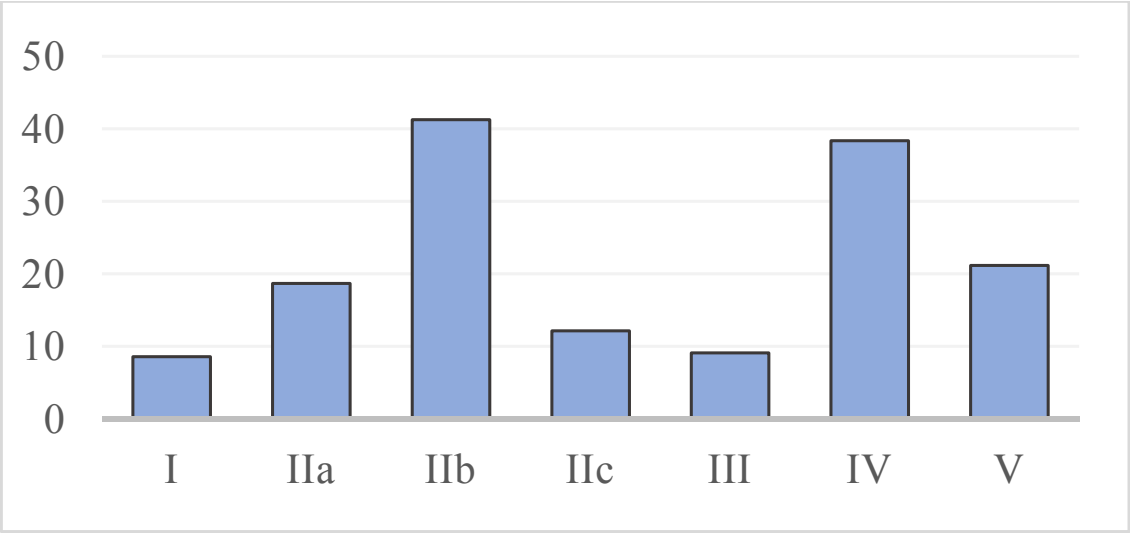

Fig. 2. **Impulse Responses of Changes in Mortgage Refinancing (Rubles Per Capita, in 2018 Prices) to a Decrease in the Mortgage Interest Rate 0.5 p.p.**

Source: Compiled by the author.

housing. A substantial increase in average mortgage refinancing gains per capita with a decrease in the interest rate on mortgages has been observed for two groups: IIb and IV. The composition of these groups includes the subjects primarily of the Central Federal District, North-Western Federal District and the Volga Federal District which are characterized by a high and medium level of socio-economic situation and the availability of liquid housing, as well as the development of the banking sector.

After applying the positive shock of mortgage refinancing, which corresponds to a reduction of the mortgages rate by 0.5 p.p., for each group of regions, an estimate of the momentum responses of consumer expenditure and consumer credit per capita for the first year is given, as well as the cumulative result for two years (*Fig. 3*).

For all regions, a decrease in consumer costs is characteristic in response to a one-minute reduction in the mortgage rate by 0.5 p.p. (*Fig. 3a*). For the first year, there has been an increase in consumer expenditure in response to a given positive shock of mortgage refinancing for low-income groups of regions. Over the two-year period, the effect of increased refinancing under the conditions of MP mitigation on consumer expenditure is becoming more significant and its heterogeneous nature is clearly manifested (*Fig. 3b*).

This may mean that low-income regions are characterized by the use of refinanced mortgages to finance current consumer expenses. For the population of high-income regions, there is a decrease in average cash costs per person, presumably due to lower mortgage payments after refinancing. For other regions, the response of consumer costs to the increase in average mortgage refinancing per capita could be considered insignificant.

Consumer lending is more responsive to the reduction in mortgage rates compared to consumer expenses (*Fig. 3*), but there is also a heterogeneity of reaction for different groups of regions. For example, in low-income regions there is a positive short-term increase in consumer credit after mortgage refinancing.

Regions with high average monetary income are characterized by a decline in consumer credit in response to the MP incentives. This can be explained by the fact that borrowers in these regions are using additional refinancing mortgages to repay less favorable consumer loans. Furthermore, the overall decline in population interest in consumer credit in prosperous regions (*Fig. 3b*) in the context of

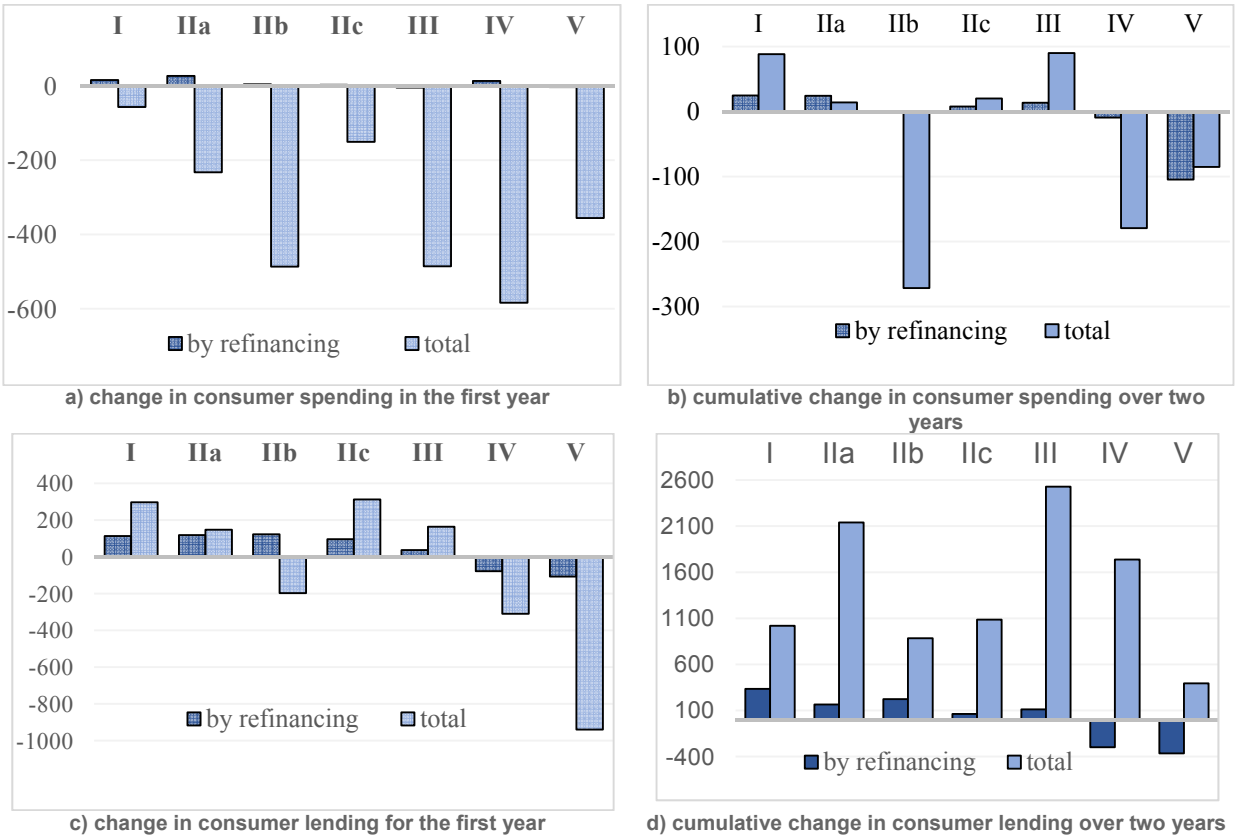

Fig. 3. **Impulse Responses of Changes in Consumer Spending of the Population and Consumer Lending (Rubles Per Capita, in 2018 Prices) to a Decrease in the Mortgage Interest Rate by 0.5 p.p. (by Refinancing and Everything)**

Source: Compiled by the author.

MP easing and rising housing market prices may be due to increased demand for real estate mortgages for investment purposes. The empirical results obtained are consistent with foreign empiric studies, in which the heterogeneous nature of refinancing is noted [8–11, 14, 16, 18].

Interregional differences in the impact of the refinancing channel on consumer consumption, in our view, can be explained by different financial behaviors on the use of additional mortgage loans after refinance for different income groups of the population.

CONCLUSION

The empirical results obtained indicate that the average per capita increase in mortgage refinancing at a decrease in the average mortgages rate varies for groups of regions in terms of the level of average per capita monetary income of the population, as well as the cost of residential real estate.

At the same time, the greatest effect of MP easing on refinancing operations was obtained for groups of regions of the Russian Federation with high and medium levels of cash income and liquid housing market. Low-income regions most in need of MP incentives have been found to benefit less from refinancing. These regions are characterized by a low level of socio-economic development and a weak level of development of mortgage services and housing real estate markets, and the population has low levels of financial literacy and credit rating.

It was also shown that the heterogeneous impact of mitigation of mortgage lending conditions on refinancing operations was then transmitted to population consumption. In low-income regions, mortgage refinancing stimulates both consumer spending and per

capita consumer lending. For the population of high- and middle-income regions, the incentives for mortgage refinancing are reflected in lower consumer spending and consumer lending. The result can be explained by different types of behavior of borrowers to use additional funds of the refinanced mortgage depending on the level of their monetary income.

The research conducted confirmed the hypothesis of the heterogeneous nature of the operation of the refinancing channel in regions of the Russian Federation. A more in-depth study of the impact of mortgage refinancing on the financial behavior of the population may be a new study that, as a review of foreign sources has shown, is more appropriate to conduct on the basis of micro-data borrowers obtained from the credit history bureau.

The results of the research indicate how important it is for the regulator to do a regional analysis before settling on the key rate level.

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ABOUT THE AUTHOR

Elena A. Gafarova — Cand. Sci. (Econ.), Assoc. Prof., Chief Economist, Division – National Bank of the Republic of Bashkortostan of the Ural Main Branch of the Central Bank of the Russian Federation (Bank of Russia), Ufa, Russia
https://orcid.org/0000-0003-0798-7111
gafarovaea@mail.ru

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The Impact of the Development of E-Commerce on Inflation in Russia

A.M. Grebenkina[a], M.N. Kuznetsova[b], E.V. Sinelnikova-Muryleva[c]
[a, b, c] Russian Presidential Academy of National Economy and Public Administration (RANEPA), Moscow, Russia;
[a] Lomonosov Moscow State University, Moscow, Russia

ABSTRACT

Over the past few years in Russia and the world there has been a rapid development of goods and services e-commerce. Therefore, an issue of inflationary consequences of the process of e-commerce growth is **topical**. The **subject** of this research is the impact of the development of e-commerce on inflation. The **purpose** of the paper to identify key theoretical mechanisms of e-commerce development influence on inflation, in addition to empirically verify the presence of the de-inflation effect on Russian data. The paper bases on **methods** of systematization, descriptive analysis, panel data econometric analysis. Also systematize basic mechanisms of e-commerce influence and provide empirical evidence for the disinflationary effect of e-commerce in Russian regions as a **result** of the study. The study **concludes** that e-commerce causes predominantly downward pressure on prices and inflation. Econometric analysis confirms this effect on Russian regions data in 2014–2020. The **scientific novelty** of the research lies in systematization of channels of e-commerce influence on various spheres of economy and confirmation of disinflationary effect of e-commerce using Russian data. The study's **recommendation** is to consider the aspect of price reduction pressure in Russia's monetary policy during the further spread of e-commerce.

Keywords: e-commerce; inflation; monetary policy; disinflationary effect; downward pressure on prices

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INTRODUCTION

The sector of e-commerce in consumer products and services is rapidly developing in Russia and around the world. According to the *Fig.* in 2021, the volume of Internet trade in Russia reached 3.6 trn rubles[1] and 4.3% of the total trade turnover in Russia.[2] Potential of e-commerce expansion not exhausted. As of 2021, about 88% of the population of the Russian Federation have access to the Internet,[3] but only 46.6% on average in Russia use the Internet to order goods and services.[4] The impact of the growth of e-commerce on inflation and pricing is a significant problem for the future growth of e-commerce in Russia.

MECHANISMS OF E-COMMERCE IMPACT ON PRICES

There are several mechanisms to influence the development of e-commerce on prices (*Table 1*). Most mechanisms suggest a downward pressure on prices from e-commerce: as a result of increased factor productivity and reduced factor costs; reduced cross-border barriers to trade and transport costs such as "iceberg costs" [1]; increased price elasticity of demand and firm economies at scale; increasing consumer power and reducing consumer search costs. Some mechanisms imply an upward pressure of e-commerce's distribution on prices: as a result of price arbitrage; the actions of firms to "confuse" the consumer through differentiated supply; into force more than high effect of the exchange rate transfer in the prices of online goods. The overview of the mechanisms in *Table 1* will probably result in downward pressure on prices from e-commerce.

IMPACT OF E-COMMERCE ON INFLATION IN COUNTRIES

A study on the impact of e-commerce on inflation is being conducted for selected countries and for groups of countries. The overview of studies for countries presented in *Table 2*. The majority of research analyzed show that the rise of e-commerce has a negative impact on inflation, which supports the theoretical arguments presented in *Table 1*. An exception is the paper (Goyal, 2010) for India identifying increases in agricultural producer prices due to the emergence of internet price terminals. The result, however, is consistent with past theoretical explanations, since the rise in producer prices is driven by the reduction in market power of intermediate businesses and the redistribution of products margins to producers.

Research for groups of countries may also be of interest, for example, in testing the hypothesis of greater impact of e-commerce on prices in developing countries than in developed countries. However, such studies are difficult because of limited comparability and incomplete data sets. In particular, country-comparable e-commerce indicators are available only for OECD countries.[5] Other, more universal variables are therefore possible. For example, this variable can be the percentage of Internet users. A good argument for using this variable as a proxy for e-commerce is given in the paper on inflation factors.[6] This paper analyses 11 factors for

[1] Association of the Companies of Internet Trade (ACIT) website. URL: https://akit.ru/analytics/analyt-data (accessed on 14.05.2022).

[2] Unified interdepartmental information and statistical system (EMISS) website. Share of sales through the Internet in the total turnover of retail trade. URL: https://www.fedstat.ru/indicator/50236 (accessed on 14.05.2022).

[3] EMISS website. Share of population using Internet information and telecommunications. URL: https://www.fedstat.ru/indicator/58465 (accessed on 14.05.2022).

[4] EMISS website. Share of the population using the Internet to order goods and (or) services, in the total population. URL: https://www.fedstat.ru/indicator/43565 (accessed on 14.05.2022).

[5] Eurostat. E-commerce sales. URL: https://ec.europa.eu/eurostat/databrowser/view/ ISOC_EC_ESELN 2__ custom_1127925/settings_1/table?lang=en (accessed on 30.10.2021); OECD. ICT Access and usage by business. URL: https://stats.oecd.org/viewhtml.aspx?datasetcode=ICT_BUS&lang=en (accessed on 30.10.2021).

[6] Barme A., Tamayo S., Gaudron A. What economic indicators influence e-commerce? 20th International Conference on Urban Transportation and City Logistic (conference paper). 2018, 8 p. URL: https://www.researchgate.net/publication/325217803_What_economic_indicators_influence_e-commerce_Approach_through_statistic_regression_and_open_data

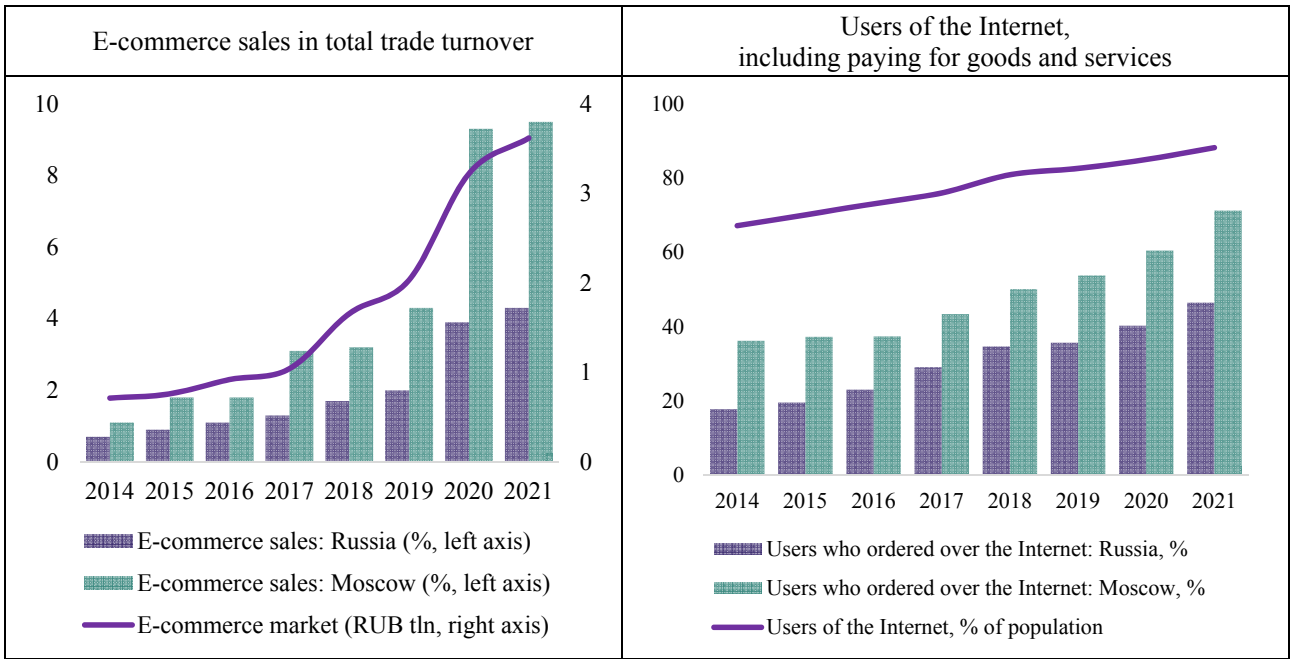

Fig. **E-Commerce Development in Russia**

Source: Compiled by the authors according to Fedstat and Akit.

the development of e-commerce, such as high-tech exports, gross capital accumulation and others, for a sample of 24 countries. The "share of Internet user" factor was second in the power of influence on the development of e-commerce (after the volume of output).

To test the hypothesis of the decreasing pressure of the Internet spread on inflation in countries, the authors developed a model (1) with fixed effects. The selection of regressors model (1), forms of functional dependency and method of assessment of analysis of factors of inflation is based on earlier relevant studies, namely [2] and [18] papers.

$$Infl_{it} = \gamma_i + \beta_1 Economy_{it} + \beta_2 Money_{it} + \\ + \beta_3 NER_{it} + \beta_4 Internet_{it} + \varepsilon_{it}, \quad (1)$$

where $Infl_{it}$ — annual inflation on country i in the period t; $Economy_{it}$ — one of the variables $rGDP_{it}$ (real GDP growth rate), IPI_{it} (industrial growth rate), $Unemp_{it}$ (unemployment rate) of the i country's economic activity in the period t; $Money_{it}$ — money supply growth rate in country i in the period t; NER_{it} — share of nominal exchange rate of a country's national currency i to the USD in the period t; $Internet_{it}$ — share of Internet users in the country i in the period t; i — fixed country effect i; it — random model error.

Information on model (1) regressors, data sources and expected inflation impact is presented in *Table 3*. The base data set contains information for 194 countries from 1990 to 2020, including 37 developed countries and 22 emerging markets (frequency of observations — annual). A substantial portion of the base data has not been used in the regression assessment, as comparable country-specific data on the money supply has only been available since 2002.

When the NER variable is formed, the exchange rates of national currencies against the USD are calculated in a direct quotation (number of units of national currency per USD). For the US and euro zone countries, the annual share of the nominal effective exchange rate index calculated by the IMF (NEER index in direct quote) is used as the NER variable. Thus, the authors use the "hybrid" variable NER: on the one hand, the data of the nominal effective exchange rate index allow to take into account information

(accessed on 14.05.2022).

Table 1

Theoretical Mechanisms of E-Commerce's Impact on Prices

Source	Mechanism of e-commerce impact	Paper
Factor productivity	Growth of factor productivity → lower production costs → downward pressure on prices	[2, 3]
	Reduction the input prices → lower production costs → reduction the price of goods	[4, 5]
Volume of international trade	Reduction the cross-border restrictions → price arbitration implementation → lower prices in the exporting country, higher prices in the importing country	[6, 7]
	Reduction the transport costs of international trade (iceberg costs) → decline in prices	[8, 9]
Firm's monopoly power	Growth of food variety → growth of elasticity of demand for goods by price → reduction of the mark-up of the company → decline in prices	[5, 10]
	Emergence of large internet firms → implementation of economies of scale and network effects → decline in prices	[11]
Costs of searching for information	Reduced costs of search frictions by the consumer, growth of consumer market power → decline in prices	[10]
	Incentives for firms to differentiate supply and allow search costs → strategy of obfuscation → price variance	[12, 13]
Pass-through effect of the exchange rate to prices	Greater and faster effect of exchange rate into online prices → downward pressure on prices	[14]

Source: Compiled by the authors.

about the euro zone and the USA; on the other hand, the nominal exchange rate of national currencies to the USD allows for the inclusion of information on a large number of developing countries for which the IMF does not calculate the NEER index. The use of the "hybrid" NER variable allowed the authors to increase the number of available observations by about 1.5–2 times compared to the sample available when using only NEER index data.

The *Appendix* presents the results of the model evaluation (1). Model specifications (1) differ by control variable "*Economy*". Calculated for three periods (total available period; 2002–2009 — before the global financial crisis; 2010–2020 — after the global financial crisis) and for four samples of countries (all countries; developed countries; emerging economies; developing countries).

Table 2

Impact of E-Commerce on Inflation in Countries

Country, paper	Principal conclusion of the study
Spain [16]	The increase in the share of Internet sales by 10 p.p. leads to a decrease in the company margin by 4 p.p. and a slight decrease in inflation
Euro area countries (Kulakov & Vinogradov, 2020)	Development of e-commerce has disinflationary impact in 19 euro-zone countries, but the effect will be exhausted as e-commerce growth rates stabilize
Japan [6]	Development of e-commerce reduces price dispersion and inflation by 0.9% in cities with high levels of education
Canada [11]	Development of e-commerce has no significant impact on inflation, while its share is statistically small
India [15]	The introduction of Internet terminals reduces the power of intermediaries in agricultural markets and increases producer prices

Source: Compiled by the authors.

Table 3

Data Source and Description of Regressors in Model (1)

Variable	Variable identification	Data source, range of values	Expected sign of impact
Inflation, annual %	$Infl$	IMF, 1990–2020	Dependent variable
Variables of the business environment ($Economy$)			
Real GDP, annual %	$rGDP$	IMF, 1990–2020	– *
Industrial production index, annual %	IPI	IMF, 1990–2020	+
Unemployment, annual %	$Unemp$	IMF, 1990–2020	–
Traditional inflation factors			
Money supply, annual %	$Money$	IMF, 2002–2020	+
Nominal exchange rate against the USD (in direct quotation) or nominal exchange rate index (in direct quotation), annual %	NER	IMF, 1990–2020	+
Variable of research interest			
Share of Internet users, %	$Internet$	World Bank, 1990–2020	–

Source: Compiled by the authors.

Note: * According to the quantitative theory of money, under other equal conditions, positive growth rates of real output have a decreasing effect on inflation. At the same time, in a longer period, when the condition "at other equal" is not performed, a positive sign of influence is possible, which is explained by the growth of aggregate demand, demand for money and nominal money supply.

Table 4

Influence of Internet Spread on Inflation in Country Groups [Evaluation Results for Model (1)]

Group of countries	Period	Inflation sensitivity to the percentage of Internet users, p.p.	Specification of the model (1) with the result
Developed countries	2010–2020	–0.09**	1
		–0.12***	2
		–0.09**	3
Developing countries	2002–2009	–0.25*	3
Total	2002–2020	–0.04*	2

Source: Authors' calculation.

Note: *, ** and *** indicate the value of model coefficients at 1%, 5% and 10% of significance levels respectively.

According to the results the models and specifications are characterized by the expected sign of the influence of the regressors on the dependent variable: significant positive impact of nominal exchange rate depreciation and unemployment reduction on inflation, as well as negative impact of growth of real output,[7] industrial production and money supply on inflation was found. These results are consistent with the assumptions described in *Table 3*.

Five of the reviewed model specifications (1) found a significant negative impact of the Internet on inflation. Coefficients of significant results of influence of variable interest on inflation are presented in *Table 4*.

If the Internet penetration variable is significant, it puts downward pressure on inflation in the group of developed and developing countries. The result obtained does not contradict the theoretical conclusions presented earlier in *Table 1*. Greater quantitative impact achieved for a group of developing countries (at the time of the highest Internet penetration) and less for a group of developed countries (2010–2020). The difference in quantitative estimates may be due to higher inflation in developing countries. It should also be noted that in the overwhelming number of specifications presented in *Appendix*, the significant impact of the variable interest on inflation have not been identified. For the all sample of countries, only the quantitatively small downward pressure of Internet penetration on inflation was found throughout the time horizon.

Thus, the panel data study for groups of countries reveals only some circumstances in favor of the downward pressure of Internet users on inflation. One possible explanation for this is the high institutional heterogeneity within the groups.

IMPACT OF E-COMMERCE ON INFLATION IN RUSSIA

As shown in *Table 2*, a number of countries do have significant negative effects on inflation. To verify this hypothesis on the data of the regions of Russia, a model (2) of the following type has been constructed:

$$Infl_{it} = \gamma_i + \beta_1 External_t + \beta_2 Ecommerce_{it} + \\ + \beta_3 Economy_{it} + \beta_4 ExpGRP_{it} + \varepsilon_{it}, \qquad (2)$$

where $Infl_{it}$ — annual inflation in the region i in the period t; $External_t$ — one of the variables $Brent_t$ (Brent price), $Dollar_t$ (ruble to dollar exchange rate) with macroeconomic

[7] Real GDP growth has had a negative impact on inflation for the group of developing countries and for countries as a whole. For the group of developed countries, a positive sign was obtained at real GDP ratio, which is due to a small number of observations and some short-term trends [including the "period of great moderation" (Great moderation)].

Table 5

Data Source and Description of Regressors in Model (2)

Variable	Variable identification	Data source, range of values	Expected sign of impact
Regional consumer price index, annual %	*Infl*	Rosstat, 2014–2020	Dependent variable
Share of budget expenditures of GRP, %	*ExpGRP*	Rosstat, 2014–2020	+
Variables that describe the state of the economy (*Economy*)			
Unemployment, annual %	*Unemp*	Rosstat, 2014–2020	–
Wage growth rates in the regions, annual %	*Wages*	Rosstat, 2014–2020	+
Variables that describe the external conditions (External)			
Ruble against the USD, annual % (in direct quotation)	*Dollar*	Bank of Russia, 2014–2020	+
Brent oil price, annual %	*Brent*	Investing.com, 2014–2020	–
Variable of research interest			
Share of Internet sales in total retail sales, %	*Ecommerce*	Rosstat (EMISS), 2014–2020	–

Source: Compiled by the authors.

impact from the outside world in the period t; $Ecommerce_{it}$ — share of Internet sales in total retail sales in the region i in the period t; $Economy_{it}$ — one of the variables $Wages_{it}$ (salary growth rate), $Unemp_{it}$ (unemployment rate) with economic activity in the region i in the period t; $ExpGRP_{it}$ — share budget expenditures in GRP in the region i in the period t; i — fixed region effect i; it — random model error.

Information on model regressions (2), data sources and the expected impact of regressions on inflation is presented in *Table 5*.

As a variable that characterizes the development of e-commerce, the indicator of the share of sales via the Internet in the total volume of retail trade, calculated by Rosstat for the regions of Russia. The set of explanatory variables is formed on the basis of economic assumptions about the relationship of variables, as well as based on publications of domestic researchers devoted to the analysis of the peculiarities of inflation processes in regions [19, 20].

The data being analyzed has a panel structure and consists of 82 objects (subjects of Russia) over 7 time periods (2014–2020). Assessment of the model (2) is carried out both using the pool model and using fixed effects. In the course of the implementation of the empirical strategy, estimates of the coefficients presented in the *Table 6*. Specifications 1–4 are assessed using a combined MNC, specifications 5–8 are fixed-effect models.

Assessment of model (2) has shown a significant impact of the indicators set out in *Table 5* on inflation in the regions of Russia. Rise in the dollar exchange rate leads to higher prices for imported goods and

Table 6

Influence of E-Commerce Spread on Inflation in Russian Regions [Evaluation Results for Model (2)]

	Specifications assessed by MNCs				Specifications of models with fixed effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dollar	0.16*** (0.004)		0.16*** (0.004)		0.15*** (0.006)		0.14*** (0.004)	
Brent		−0.11*** (0.003)		−0.12*** (0.003)		−0.09*** (0.005)		−0.10*** (0.004)
Ecommerce	−0.27*** (0.09)	−0.43*** (0.15)	−0.15 (0.09)	−0.23* (0.12)	−1.02** (0.41)	−1.50** (0.62)	−0.99** (0.40)	−1.27** (0.55)
Unemp	−0.07** (0.04)	−0.08* (0.03)			0.16 (0.14)	0.32 (0.22)		
ExpGRP	0.03* (0.02)	0.04** (0.02)	0.10* (0.06)	0.10* (0.06)	0.37*** (0.08)	0.44*** (0.10)	0.57*** (0.08)	0.60*** (0.09)
Wages			0.06 (0.09)	0.35*** (0.10)			0.09 (0.06)	0.37*** (0.08)
Constant	4.08*** (0.23)	5.98*** (0.25)	2.16*** (0.70)	2.26*** (0.72)				
R^2 — within	0.76	0.46	0.65	0.46	0.82	0.55	0.80	0.62
R^2 — within (adj)	0.76	0.46	0.65	0.45	0.78	0.45	0.76	0.54
Number of observations	486	486	488	488	486	486	488	488

Source: Compiled by the authors.

Note: Robust standard errors are indicated in the brackets; *, ** and *** indicate the significance of the model coefficients at 1%, 5% and 10% significance levels respectively; R^2-within (adj) — adjusted coefficient of determination of within-group regression.

overall price growth. Rise in oil value leads to strengthening of national currency, lower prices of imported goods and lower rate of price growth. Rise in unemployment rate leads to lower price growth, in line with the Phillips curve concept. Higher budget expenditures (as a% of GRP) and higher nominal wages lead to higher prices. These trends reflect the growth of economic activity, which stimulates demand growth and upward pressure on prices.

According to the evaluation of the model (2), the spread of Internet commerce in the regions of Russia has a disinflative effect. Depending on the specification of the model (2), an increase in the share of online sales by 1 p.p. leads to a decrease in regional inflation by 23–150 basis points. At the same time, no significant downward inflationary impact of the spread of Internet commerce was found by the authors in the non-temporary 2020 panel data. The result confirms the authors' hypothesis about the increased role of e-commerce as a macroeconomic indicator. The significant deflationary impact of the spread of online trading in the medium term could be a factor requiring analysis and consideration in national monetary policy decisions.

CONCLUSION

Currently in Russia there is an intense development of e-commerce, which actualizes the study of the impact of this process on macroeconomic indicators, in particular prices.

A considerable amount of research theoretically supports the downward pressure of the development of e-commerce on prices. Individual country studies confirm the deflationary effect of the spread of e-commerce, while large-scale studies for groups of countries are hampered by the lack of comparable data on online trade volumes. These terms may justify the use of a variable percentage of Internet users as a proxy variable, since access to the Internet is a prerequisite for the existence of e-commerce. The authors' econometric analysis revealed some evidence in favor of a decreasing inflationary pressure on the growth of the number of Internet users over the separate periods of 2002–2020.

The study is supplemented by an econometric verification of the hypothesis of the downward pressure of e-commerce development on inflation in the regions of Russia. Analysis of panel data for 82 Russian entities revealed the deflationary effect of the spread of e-commerce in the period 2014–2020.

The authors expect that as e-commerce develops in Russian areas, the accounting of Internet trade as a disinflationary component in monetary policy choices will be updated.

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ABOUT THE AUTHORS

Alina M. Grebenkina — Cand. Sci. (Econ.), Researcher, Russian Presidential Academy of National Economy and Public Administration (RANEPA), Moscow, Russia; Assoc. Prof. Lomonosov Moscow State University, Moscow, Russia
https://orcid.org/0000-0002-7264-5399
Corresponding author:
grebenkina-am@ranepa.ru

Maria N. Kuznetsova — Researcher at the Center for Central Banking Studies of the Institute for Applied Economic Research (IPER), Russian Presidential Academy of National Economy and Public Administration (RANEPA), Moscow, Russia
https://orcid.org/0000-0002-3660-6587
kuznetsova-mn@ranepa.ru

Elena V. Sinelnikova-Muryleva — Cand. Sci. (Econ.), senior researcher at the Center for Central Banking Studies, Institute of Applied Economic Research (IPER), Russian Presidential Academy of National Economy and Public Administration (RANEPA), Moscow, Russia
https://orcid.org/0000-0001-7494-2728
e.sinelnikova@ranepa.ru

Authors' declared contribution:
A.M. Grebenkina — theoretical literature review, international experience review, collection and analysis of data by countries, model No. 1 development and validation, description of the results.
M.N. Kuznetsova — collection and analysis of data by Russian regions, model No. 2 development and validation, description of the results.
E.V. Sinelnikova-Muryleva — statement of the problem, development of the conceptual framework of the article, scientific editing of the text, critical analysis of research results.

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Appendix

Evaluation Results for Model (1)

	2002–2020				2002–2009				2010–2020			
Specification 1 (Economy control variable — real GDP)												
	All sample	**DEV**	**EM**	**D**	**All sample**	**DEV**	**EM**	**D**	**All sample**	**DEV**	**EM**	**D**
rGDP (1 lag)	−0.39***	0.07*	0.02	−0.46***	0.1	0.25**	0.12	0.11	−0.53***	0.04	−0.02	−0.62***
	(0.06)	(0.03)	(0.07)	(0.08)	(0.07)	(0.08)	(0.14)	(0.09)	(0.08)	(0.03)	(0.08)	(0.11)
Money (1 lag)	0.3***	0.04**	0.14***	0.32***	0.1***	−0.00	0.08	0.11***	0.46***	−0.00	0.22***	0.48***
	(0.02)	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.05)	(0.02)	(0.03)	(0.02)	(0.04)	(0.04)
NER (1 lag)	−0.00	0.04**	0.14***	−0.00	0.31***	0.08**	0.31***	0.33***	−0.00	0.04***	0.1***	−0.00
	(0.00)	(0.01)	(0.02)	(0.00)	(0.02)	(0.03)	(0.04)	(0.03)	(0.00)	(0.01)	(0.02)	(0.00)
Internet (1 lag)	−0.00	0.01	−0.00	0.01	0.06	0.06	−0.09	0.09	0.02	−0.09**	0.03	0.02
	−0.03	−0.02	−0.02	−0.04	−0.05	−0.05	−0.06	−0.09	−0.06	−0.03	−0.03	−0.08
R^2 — within	0.13	0.16	0.3	0.14	0.31	0.24	0.47	0.32	0.16	0.24	0.37	0.17
R^2 — within (adj)	0.06	0	0.19	0.06	0.15	−0.06	0.26	0.17	0.05	0.06	0.25	0.05
Number of observations	1838	202	272	1364	642	75	81	486	1196	127	191	878
Specification 2 (Economy control variable — industrial production index)												
	2002–2020				**2002–2009**				**2010–2020**			
	All sample	**DEV**	**EM**	**D**	**All sample**	**DEV**	**EM**	**D**	**All sample**	**DEV**	**EM**	**D**
IPI (1 lag)	0.00	0.05***	0.01	0.00	0.05	0.15**	0.08	0.07	−0.01	0.03**	−0.01	−0.01
	(0.01)	(0.01)	(0.04)	(0.02)	(0.03)	(0.04)	(0.06)	(0.05)	(0.01)	(0.01)	(0.06)	(0.02)
Money (1 lag)	0.06***	0.04*	0.23***	0.05*	0.02	−0.02	0.07	0.02	0.07*	0.01	0.3***	0.05
	(0.01)	(0.01)	(0.04)	(0.02)	(0.02)	(0.02)	(0.06)	(0.03)	(0.03)	(0.02)	(0.05)	(0.04)

Appendix (continued)

	2002–2020				2002–2009				2010–2020			
	All sample	**DEV**	**EM**	**D**	**All sample**	**DEV**	**EM**	**D**	**All sample**	**DEV**	**EM**	**D**
NER (1 lag)	0.15***	0.04**	0.1***	0.23***	0.15***	0.02	0.23***	0.21**	0.15***	0.04**	0.07**	0.23***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)	(0.05)	(0.07)	(0.02)	(0.01)	(0.02)	(0.03)
Internet (1 lag)	−0.04*	−0.01	0.03	−0.04	−0.02	0.01	0.04	−0.11	0.00	−0.12***	0.11	0.00
	(0.02)	(0.02)	(0.04)	(0.03)	(0.04)	(0.04)	(0.08)	(0.09)	(0.03)	(0.03)	(0.06)	(0.06)
R^2 – within	0.19	0.2	0.37	0.22	0.17	0.33	0.42	0.15	0.18	0.29	0.43	0.23
R^2 – within (adj)	0.1	0.02	0.21	0.1	0	0.04	0.14	0	0.06	0.08	0.26	0.08
Number of observations	685	172	147	366	237	64	53	120	448	108	94	246
Specification 3 (Economy control variable – unemployment)												
	2002–2020				**2002–2009**				**2010–2020**			
	All sample	**DEV**	**EM**	**D**	**All sample**	**DEV**	**EM**	**D**	**All sample**	**DEV**	**EM**	**D**
Unemp (1 lag)	−0.00	−0.22	−0.19*	−0.00	−0.00	−0.56	−0.3	0.09	−0.00	0.09	−0.11	−0.00
	(0.00)	(0.13)	(0.09)	(0.00)	(0.1)	(0.49)	(0.2)	(0.14)	(0.00)	(0.11)	(0.11)	(0.00)
Money (1 lag)	0.14***	0.03	0.14***	0.15***	0.14***	−0.01	0.09	0.17***	0.14***	−0.01	0.18***	0.14***
	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.05)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
NER (1 lag)	0.16***	0.05***	0.13***	0.21***	0.19***	0.09**	0.21***	0.21***	0.14***	0.04***	0.1***	0.17***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	(0.04)	(0.02)	(0.01)	(0.02)	(0.03)
Internet (1 lag)	−0.02	−0.01	−0.01	−0.01	−0.1	0.01	−0.05	−0.25*	−0.01	−0.09**	0.05	−0.04
	(0.02)	(0.02)	(0.02)	(0.03)	(0.06)	(0.06)	(0.07)	(0.12)	(0.03)	(0.03)	(0.03)	(0.05)
R^2 – within	0.27	0.16	0.31	0.29	0.33	0.16	0.33	0.39	0.22	0.25	0.35	0.22
R^2 – within (adj)	0.18	−0.03	0.2	0.17	0.11	0	0.09	0.12	0.08	0.03	0.22	0.04
Number of observations	1039	167	291	581	358	62	102	194	681	105	189	387

Source: Compiled by the authors.

Note: DEV – developed countries, EM – emerging market economies, D – developing countries; standard errors are indicated in the brackets; *, ** and *** indicate the significance of the model coefficients at 1%, 5% and 10% significance levels respectively; R^2-within (adj) – adjusted coefficient of determination of within-group regression.

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Loans Secured by Republican Brands from a Regional Banking Syndicate*

O.F. Maslenkova
Kuzbass Humanitarian Pedagogical Institute, Kemerovo State University, Novokuznetsk, Russia

ABSTRACT

The subject of the study is loans secured by republican brands from the regional banking syndicate of the Republic of Tatarstan. **The object** of the study is regional banks and key companies of the Republic of Tatarstan. **The relevance** of the study is due to the need to introduce promising types of loans, increase interest income and increase the competitiveness of regional banks; providing opportunities for regional companies to raise funds to finance their activities. **The goal** is to determine the possibility of granting syndicated loans secured by republican brands to the regional banking syndicate of Tatarstan. **Information base** – official data of the Bank of Russia, Rospatent, companies and banks. **Methods** of sampling, grouping, analysis, comparison, analogy, synthesis, generalization are used. **The results** are as follows. The concentration of functioning regional banks in the federal districts was determined as of December 20, 2021. As of October 1, 2021, an analysis of key indicators of banks registered in Tatarstan was carried out. The characteristics of transactions of pledge of exclusive rights to objects of intellectual property (IP on OIP) in Tatarstan for 2014–2021 are presented (pledgers, pledgees, the number and types of OIP pledged, the duration of each of the pledge agreements, the number and date of official state registration, the number of contracts). **It can be concluded** that the banks of Tatarstan have the opportunity to provide local companies with syndicated loans. **Recommendations** were given: 1) it was proposed to merge local banks of Tatarstan into a regional banking syndicate to provide syndicated loans against various types of collateral, including intellectual assets owned by leading companies in Tatarstan; 2) consider the possibility of using popular brands of companies operating in Tatarstan as collateral. A list of companies and their brands has been compiled, and characteristics of corporate brands have been given. The list of brands that can be pledged also includes the republican brands "Heritage of Tatarstan" and "Visit Tatarstan"; 3) the expected positive results of interaction for all participants of the regional banking syndicate are determined. **Directions of research**: assessment of the possibility of attracting banks from other Russian regions for interaction.

Keywords: Republic of Tatarstan; bank; syndicate; syndicated loan; pledge; intellectual property; exclusive right; brand; budget

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INTRODUCTION

The scientific problem of the study is determined, on the one hand, by the difficulties of the development of syndicated lending in Russian banking practice due to the disparities in the level of development of regional and federal banks; on the other hand, the significant decrease of foreign funding for Russian regional banks and regional companies in the severe conditions of economic sanctions by a number of States in relation to Russia, the accompanying difficulty.[1]

By the agreement of a syndicated credit (loan), several creditors undertake to provide in agreement with each other or to provide the borrower with funds in the amount and periods stipulated by the contract for each creditor, and the borrower undertakes to return to the creditors the funds received from them, to pay interest for the use of funds, as well as other payments, if the obligation to pay them is provided by the contract.[2]

The definition of the concept of "syndicated credit" is also given in the Decree of the Government of the Russian Federation No. 158 from 15.02.2018 "On the project "Financing Factory Programme".[3]

In December 2020, the Federal Law No. 486 from 31.12.2017 "On syndicated credit (loan) and amendments to certain legislative acts of the Russian Federation" was amended to promote the development of Russian practice of syndicate credit (actions of creditors in the situation of bankruptcy of the borrower, improvement of the practice of working with collateral, funded sub-transactions).[4]

Factors of increased attention to syndicated loans: participating banks receive (and retain) a large company as a borrower, form interest income; the company quickly and on agreed terms receives the necessary funding in large amounts. Parties can also generate additional preferences.

Questions of competent organization of syndicated lending (taking into account the arguments and problems indicated above) are, of course, important for ensuring the effective operation of the regional banks.

Taking into account the Russian Federation Government and the Bank of Russia's focus on the development of innovative technologies, strengthening of regional banking systems, further progress of the Republic of Tatarstan as one of the key Russian regions, the feasibility of the study is obvious, as the ability to provide funding for large local companies through syndicated lending is determined precisely from the regional bank syndicate.

The problems of banking syndicates and syndicated lending are examined by foreign authors [1–3]. Note that the above-mentioned authors represent foreign experience that does not take into account the reality of our country.

In modern Russian literature qualitatively and from different sides are presented various components of syndicated lending.

A number of dissertation studies by Russian scientists are devoted to various aspects of syndicated lending [4–5].

From Russian publications we will pay attention to papers [6–11]. It should be noted that the issues of the creation and functioning of the regional banking syndicate were not investigated in these papers. The exception is the study of O.F. Maslenkova [12], in which the author, noting the importance and feasibility of the creation of a regional banking syndicate, considers such aspects of its activities as the technology of creation, credit procedures, utility of merging (based on calculations). The prospective direction of the development of syndicated lending considers the entry into the

[1] Trade unions demand intervention of the Central Bank. URL: https://www.rbc.ru/newspaper/2022/03/09/6223ab239a79473 1606ce0c4 (accessed on 15.07.2022).

[2] Federal Law No. 486 from 31.12.2017 "On syndicated credit (loan) and amendments to certain legislative acts of the Russian Federation", Art. 2.

[3] Decree of the Government of the Russian Federation No. 158 from 15.02.2018 "On the Project "Financing Factory Programme".

[4] Federal Law No. 447 from 22.12.2020 "On amendments to the Federal Law "On syndicated credit (lend) and amendment of certain legislative acts of the Russian Federation" and certain legal acts".

market of the leading regional banks and the largest regional borrowers also A. A. Tarasov [13]. The current situation and prospects of the practice of syndicated lending in Russia experts consider positive.[5]

RESULTS OF THE STUDY

A syndicated loan from the banking syndicate is a viable method of funding activities of businesses. In Russian banking practice, pledge — is the key assurance of debt obligations of borrowers. The object of the security may be exclusive rights to the results of intellectual activity and means of individualization (intellectual property).

For the development of the activities of the regional banking syndicate of the Republic of Tatarstan, we will pay attention to the possibility of using as collateral exclusive rights to objects of intellectual property (hereinafter — OIP) (including corporate brands) belonging to companies of Tatarstan (both independent collateral property and complementary to the traditional).

The analysis of the dynamics of the presence of regional banks in eight federal districts (by region: area, republic, land) carried out by the author on the basis of official data of the Bank of Russia as at 20.12.2021 showed that the Republic of Tatarstan is in the third place among the Russian regions in terms of the number of operating regional Banks (13); more banks with local registration are located only in Moscow (166) and St. Petersburg (19).

Key indicators of commercial banks registered in the Republic of Tatarstan for the period 2019–01.10.2021 are presented in *Table 1* (the list of banks is formed taking into account the value of the currency of the balance sheet).

The dynamics of total own capital (the main indicator in this case) is positive (steadily increasing); the amount of total equity unambiguously allows regional banks of Tatarstan when merging into a syndicate to issue syndicated loans (*Table 1*).

There is no doubt in the sustained demand for syndicated loans offered by the future regional banking syndicate of the Republic of Tatarstan, given that successful companies of federal and regional importance, interested in obtaining loans in large sizes, are operating in Tatarstan. First of all, these are companies included in the list of the largest Russian enterprises according to the ranking of RBC "The 500 largest companies of Russia by revenue for 2020"[6]:

1. PJSC "Tatneft" (Almetyevsk, oil and gas production, No. 14).
2. JSC "TAIF-NC" (Nizhnekamsk; oil refinery, gasoline plant, Heavy Residue Conversion Complex, No. 69).
3. PJSC "KAMAZ" (Naberezhnye Chelny, production of heavy vehicles, No. 78).
4. PJSC "Nizhnekamskneftekhim" (Nizhnekamsk, rubber and plastic production, No. 84).
5. PJSC "Kazanorgsintez" (Kazan, polymer production, No. 189).
6. JSC "Tatenergosbyt" (Kazan, production and distribution of thermal and electrical energy in the territory of Tatarstan, No. 199).
7. JSC "Nefis cosmetics" (Kazan, production of household chemicals and cosmetic products, No. 241).
8. JSC "TATENERGO" (Kazan, production of electric and thermal energy, No. 276).
9. Bank "AK Bars" (Kazan, No. 302).
10. JSC "Alkotorg" (Kazan, exclusive distributor of production of JSC "Tatspirtprom" in the Russian Federation, No. 313).
11. "DK Rus" (Naberezhnye Chelny, production and sale of cars, No. 336).
12. JSC "TGK-16" (Kazan, electric power production, No. 373).
13. Holding "Tagras" (Almetyevsk, oil service group, providing a full range of services for companies of oil and gas industry, No. 450).

[5] XII Conference "Syndicated Lending in Russia and the CIS". 07.10.2021. Moscow. URL: http://cbonds-congress.com/events/639/materials/?l=1 (accessed on 15.07.2022).

[6] 500 largest Russian companies 2020. URL: https://pro.rbc.ru/rbc500 (accessed on 15.07.2022).

Table 1

Key Indicators of Commercial Banks Registered in the Republic of Tatarstan for 2019–01.10.2021, Billion Rubles

No.	Bank	Balance currency			Equity capital			Financial result		
		2019	2020	01.10. 2021	2019	2020	01.10. 2021	2019	2020	01.10. 2021
1	PJSC "AK BARS" BANK (Kazan)	561.15	594.03	639.17	73.16	72.73	78.45	5.08	–0.11	5,75
2	LLC Bank "Avers" (Kazan)	107.9	121.36	121.94	24.36	25.12	25.20	2.39	1.96	1,29
3	PJSC "AKIBANK" (Naberezhnye Chelny)	25.29	24.13	23.02	5.12	5.45	5.68	0.28	0.32	0,23
4	JSC "TATSOCBANK" (Kazan)	20.51	34.72	21.96	8.62	9.18	9.81	0.65	0.56	0,62
5	JSC "Energobank" (Kazan)	17.25	18.21	20.30	5.15	5.46	5.74	0.77	0.66	0,31
6	LLC "Bank Kazan" (Kazan)	13.15	12.62	12.64	1.78	1.82	1.85	0.10	0.035	0,05
7	JSC "Avtogradbank (Naberezhnye Chelny)	6.63	6.32	6.09	0.86	0.84	0.88	–0.03	–0.02	0,04
8	LLC "Kamsky Commercial Bank" (Naberezhnye Chelny)	3.95	4.01	3.68	0.81	0.72	0.80	–0.01	–0.03	0,01
9	"Bank Zarechye" (JSC) (Kazan)	2.94	4.52	3.07	1.22	1.22	1.14	0.02	0.004	–0,07
10	JSC "Investment Cooperative Bank" (Kazan)	2.22	2.46	2.23	0.39	0.37	0.24	0.01	–0.017	–0,14
11	LLC "ALTYNBANK" (Kazan)	1.44	1.78	1.74	0.51	0.71	0.73	– 0.10	0.046	0,02
12	LLC "AvtoCreditBank" (Kazan)	1.70	2.82	2.62	0.51	0.55	0.59	0.03	0.04	0,03
13	LLC "Bank 131" (Kazan)	0.58	1.27	1.66	0.45	0.43	0.48	–0.04	–0.017	0,05
Total		764,7	828.25	860.12	122.9	124.6	131.59	9.15	3.43	8.19

Source: Compiled by the author according to Bank of Russia.

Table 2

Characteristics of Transactions of Pledge of Exclusive Rights to Objects of Intellectual Property in the Republic of Tatarstan for 2014–2021

Pledgegiver	Pledgeholder	Number of contracts	Characteristics of the pledge agreement				
			Intellectual Property	Amount of Intellectual Property	Contract period	Data on the state registration of the contract	
						Data	No.
1	2	3	4	5	6	7	8
Inventions. Utility model. Industrial designs							
JSC "Kazan Synthetic Rubber Plant"	Bank "Yoshkar-Ola" (PJSC)	1	Invention	10	For up to 24.08.2018	08.11.2017	RD 0236414
LLC "ZaryaD"	JSC "NPK "Chemical engineering", Moscow	1	Invention	1	For up to 01.07.2021	29.11.2019	RD 0317857
LLC "InTechPlast"	JSC "Avtogradbank"	1	Invention	1	For up to 10.05.2023	07.09.2020	RD 0340117
LLC "Aidos-Medicine"	PJSC "AK BARS" BANK	1	Invention	3	For the period of validity of the patent on the Russian Federation	02.06.2020	RD 0333865
			Utility model	9			
LLC "Airon"	PJSC "Sberbank of Russia"	1	Industrial design	3	For up to 11.11.2023	21.10.2020	RD 0344359
			Utility model	1			
LLC "Aidos-Medicine"	PJSC "AK BARS" BANK	1	Invention	8	For up to 08.09.2026	11.02.2021	RD 0354587
			Utility model	1			
			Industrial design	1			
Total I, UM, ID for 2014–2021		6		38			
Trademarks							
Individual entrepreneur	PJSC "Sberbank of Russia"	1	Trademarks	5	Until 20.09.2024	07.12.2015	RD 0187512
JSC "Kazan fat plant"	PJSC "Sberbank of Russia"	1	Trademarks	1	Until 20.09.2024	07.12.2015	RD 0187510
Individual entrepreneur	PJSC "Sberbank of Russia"	1	Trademarks	5	For up to 20.09.2024 inclusively	26.10.2017	RD 0235353
Individual entrepreneur	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 09.10.2021	06.09.2017	RD 0231152
JSC "Kazan fat plant"	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 20.09.2024 inclusively	26.10.2017	RD 0235352
JSC "Kazan Synthetic Rubber Plant"	Bank "Yoshkar-Ola" (PJSC)	0	Trademarks	1	For up to 24.08.2018	08.11.2017	RD 0236414
JSC "Kazan fat plant"	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 09.10.2021	06.09.2017	RD 0231154
Individual entrepreneur	PJSC "Sberbank of Russia"	1	Trademarks	5	For up to 20.09.2024 inclusively	12.01.2018	RD 0241260

Table 2 (continued)

Pledgegiver	Pledgeholder	Number of contracts	Characteristics of the pledge agreement				
			Intellectual Property	Amount of Intellectual Property	Contract period	Data on the state registration of the contract	
						Data	No.
Individual entrepreneur	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 09.10.2024 inclusively	12.01.2018	RD 0241261 (580)
Individual entrepreneur	PJSC "Sberbank of Russia"	1	Trademarks	5	For up to 28.11.2021 inclusive on the Russian Federation	09.02.2018	RD 0243596
Individual entrepreneur	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 28.11.2021 inclusive on the Russian Federation	09.02.2018	RD 0243597
JSC "Kazan fat plant"	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 09.10.2021	06.03.2018	RD 0245766
JSC "Kazan fat plant"	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 09.10.2021	06.03.2018	RD 0245765
JSC "Kazan fat plant"	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 28.11.2021	06.03.2018	RD 0245775
JSC "Kazan fat plant"	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 28.11.2021	06.03.2018	RD 0245774
Individual entrepreneur	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 09.10.2021 inclusively	13.03.2018	RD 0246073
JSC "Kazan fat plant"	PJSC "Sberbank of Russia"	1	Trademarks	1	For up to 09.10.2021	23.05.2018	RD 0252806
Individual entrepreneur	LLC "RNGO", Moscow	1	Trademarks	303	For up to 31.12.2019	17.07.2019	RD 0301813
LLC "ZaryaD"	JSC "NPK "Chemical engineering", Moscow	0	Trademarks	1	For up to 01.07.2021	29.11.2019	RD 0317857
LLC "Airon"	PJSC "Sberbank of Russia"	1	Trademarks	7	For up to 11.11.2023.	22.10.2020	RD 0344459
Individual	PJSC Bank "Financial Corporation Opening"	1	Trademarks	1	For up to 21.01.2022	03.03.2021	RD 0356652 RU № 607392
LLC "Insurance adviser "Brokers"	Individual, Republic of Tatarstan	1	Trademarks	1	Until the pledgegiver's obligations under the Basic Treaty are properly fulfilled	31.05.2021	RD 0364980
LLC "TathimPlast"	JSC "Russian Bank for Support of Small and Medium Business"	1	Trademarks	1	For up to 24.05.2023	08.08.2021	RD 0371167
Individual entrepreneur	"Gazprombank" (JSC)	1	Trademarks	304	For up to 31.12.2035 inclusively	15.02.2021	RD 0354986
Total transactions for 2014–2021		**22**		**651**			
Total RIA (I, UM, ID) and transactions for 2014–2021		**28**		**689**			

Source: Compiled by the author.

The largest are also other companies of Tatarstan.

Currently, in Russian banking practice[7] there are examples of lending under security of IE to OIPs of economic entities, which are mentioned by the authors [14–18]. In foreign practice such a pledge is known and popular for quite a long time from the theoretical [19, 20] and from the practical point of view.[8] Moreover, Maria Loumioti [21] says that 21% of syndicated loans issued in the US between 1996 and 2005 were secured by intangible assets.

The possibilities of practical application of such pledge can be judged by the example of PJSC "Tatneft". According to Forbes,[9] by 2020, this company should invest 100 bln rubles to increase the annual output of ultra-binding oil to 2 mln tons (7,5% to the current annual production volume, at the moment this share is about 1%). To this end, the company has formed a package of its own technologies from more than 60 international patents. Exclusive rights of PJSC "Tatneft" on results of intellectual activity (hereinafter — RIA) and means of individualization (brands) may be the subject of collateral when obtaining a syndicated loan from a regional banking syndicate.

The presence in Tatarstan of popular corporate brands with excellent market value can be used for the benefit of companies-owners. Corporate brands and other OIPs owned by companies of Tatarstan may be used as security. Information on the largest corporate brands of Tatarstan (Tatneft, TAIF-NK, Kazan-orgsynthesis, AK-BARS, KAMAZ, Bahetle, Maheev, Mr. Ricco, POZIS, Sorti, AOS, etc.) is given in the study [22, p. 356–359].

The author conducted a study of the practice of the pledge of exclusive rights to objects of intellectual property in Tatarstan for 2014–2021 on the subject of the existence of such practice (at least) and obtaining the parameters of such transactions (at a maximum). Characteristics of IE pledge transactions on OIP in the Republic of Tatarstan for 2014–2021 are presented in *Table 2*. Note that all pledgegivers (*Table 2*, Column 1) are registered in the Republic of Tatarstan.

Dynamics of the IE pledge on RIA and trademarks in the Republic of Tatarstan is presented in *Table 3*.

It should be noted that in 2015 by individual entrepreneur from Tatarstan was deposited his owned trademarks in PJSC "Sberbank of Russia" (hereinafter also in 2017 and in 2018); in LLC "RNGO" (Moscow, in 2019) and in 2021 in "Gazprombank" (JSC). For the period 2014–2021, the first RIA pledge in Tatarstan in 2017 was carried out by Kazan synthetic rubber factory jointly with Bank "Yoshkar-Ola" (Republic of Mari El).

Transactions pledge IE on OIP with pledgegivers registered in Tatarstan, in 2014–2021 was led: PJSC "Sberbank of Russia" (12 contracts, 31 OIP on pledge, types of OIP: utility models, industrial designs and trademarks); JSC "Russian Bank for Support of Small and Medium Enterprises" (one contract, one OIP on pledge, type of OIP: trademark); Bank "Gazprombank" (JSC) — one contract, 304 OIPs on pledge, type of OIP: is trademark; JSC Bank "Financial Corporation "Opening" (one contract, one OIP on pledge, type of OIP: is trademark).

As of 01.01.2022, two banks from 13 regional banks of Tatarstan have taken advantage of the experience of IE's pledge on OIP: PJSC "AK BARS" BANK — two contracts (in 2020 and 2021; inventions, utility models and industrial designs on pledge); JSC

[7] Volodin A. Possibilities of business financing on pledge of intangible assets in 2021. URL: https://vmo24.ru/news/vozmozhnosti_finansirovaniya_biznesa_pod_zalog_nematerialnyh_aktivov_v_2021_godu (accessed on 15.07.2022).

[8] The Top 20 Patent Loan Lenders — BoA, JPMorgan Chase & Silicon Valley Bank Are the Most Active Dealmakers. URL: https://www.inquartik.com/blog/the-top-20-patent-loan-lenders/ (accessed on 15.07.2022).

[9] 200 largest companies in Russia-2015. URL: https://www.forbes.ru/forbes/issue/2015–10/300529–200-krupneishikh-kompanii-rossii (accessed on 15.07.2022).

Table 3

Dynamics of the Pledge of Exclusive Rights to the Results of Intellectual Activity and Trademarks by Pledgegiver and Pledgeholder Registered in the Republic of Tatarstan for 2014–2021, Units

Indicators	2014	2015	2016	2017	2018	2019	2020	2021	Total for 2014–2021		Absolute deviation, 2021/2014
									Number	Share, %	
Individual entrepreneur pledge agreement on OIP											
1. RIA, total	0	0	0	1	0	1	3	1	6.0	21.4	1.0
1.1. Inventions	0	0	0	1	0	1	2	1	5.0	17.9	1.0
1.2. Utility models	0	0	0	0	0	0	1	0	1.0	3.6	0.0
1.3. Industrial designs	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2. Trademarks	0	2	0	4	10	1	1	4	22.0	78.6	4.0
Total (p. 1 + p. 2)	**0**	**2**	**0**	**5**	**10**	**2**	**4**	**5**	**28.0**	**100**	5.0
Types of OIPs in pledge											
1. RIA, total, including	0	0	0	10	0	1	17	10	38.0	5.5	10.0
1.1. Inventions	0	0	0	10	0	1	4	8	23.0	3.3	8.0
1.2. Utility models	0	0	0	0	0	0	10	1	11.0	1.6	1.0
1.3. Industrial designs	0	0	0	0	0	0	3	1	4.0	0.6	1.0
2. Trademarks	0	6	0	9	18	304	7	307	651.0	94.5	307.0
Total (p. 1 + p. 2)	**0**	**6**	**0**	**19**	**18**	**305**	**24**	**317**	**689.0**	**100**	**317.0**

Source: Compiled by the author.

Note: 2017 – ten inventions and one trademark included in one pledge agreement; 2019 – one invention and one trademark included in one pledge agreement; 2020 – one pledge agreement includes three inventions, nine utility models; one contract includes one utility model and three industrial designs; 2021 – eight inventions, one utility model, one industrial design are included in one pledge agreement.

Table 4

Characteristics of Pledgegiver and Pledgeholder Registered in the Republic of Tatarstan, when Pledging Exclusive Rights to the Results of Intellectual Activity and Trademarks for 2014–2021, Units

Category		Pledgegiver												Pledgeholder											
		2014	2015	2016	2017	2018	2019	2020	2021	2014–2021		2021/2014 rr.		2014	2015	2016	2017	2018	2019	2020	2021	2014–2021		2021/2014	
										un.	share, %	ab. dev.	growth rate, share un.									un.	share, %	ab. dev.	growth rate, share un.
Regional banks of the Republic of Tatarstan (banks registered in the Republic of Tatarstan)	Participants in the transaction	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	0	2	1	**3**	**21.43**	**1**	-
	Executed pledge agreement	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	0	2	1	**3**	**10.71**	**1**	-
	OIP – objects of pledge	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	0	13	10	**23**	**3.34**	**10**	-
Russian banks registered outside the Republic of Tatarstan	Participants in the transaction	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	1	**0**	2	1	0	1	3	**8**	**57.14**	**3**	-
	Executed pledge agreement	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	2	**0**	5	10	0	2	3	**22**	**78.57**	**3**	-
	OIP – objects of pledge	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	6	**0**	19	18	0	11	306	**360**	**52.25**	**306**	-
Foreign banks and banking syndicates	Participants in the transaction	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-
	Executed pledge agreement	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-
	OIP – objects of pledge	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-
Companies registered in the Republic of Tatarstan	Participants in the transaction	0	1	0	2	1	1	3	3	**11**	**64.71**	**3**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-
	Executed pledge agreement	0	1	0	3	5	1	4	3	**17**	**60.71**	**3**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-
	OIP – objects of pledge	0	1	0	13	5	2	24	12	**57**	**8.27**	**12**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-

Table 4 (continued)

Category		Pledgegiver												Pledgeholder											
		2014	2015	2016	2017	2018	2019	2020	2021	2014–2021		2021/2014 гг.		2014	2015	2016	2017	2018	2019	2020	2021	2014–2021		2021/2014	
										un.	share, %	ab. dev.	growth rate, share un.									un.	share, %	ab. dev.	growth rate, share un.
Companies registered outside the Republic of Tatarstan	Participants in the transaction	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	2	0	0	**2**	**14.29**	**0**	-
	Executed pledge agreement	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	2	0	0	**2**	**7.14**	**0**	-
	OIP – objects of pledge	0	0	0	0	0	0	0	0	**0**	**0.00**	**0**	-	0	0	**0**	0	0	305	0	0	**305**	**44.27**	**0**	-
Individual entrepreneurs registered in the Republic of Tatarstan	Participants in the transaction	0	1	0	1	1	1	0	1	**5**	**29.41**	**1**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-
	Executed pledge agreement	0	1	0	2	5	1	0	1	**10**	**35.71**	**1**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-
	OIP – objects of pledge	0	5	0	6	13	303	0	304	**631**	**91.58**	**304**	-	0	0	**0**	0	0	0	0	0	**0**	**0.00**	**0**	-
Individuals-residents, registered in the Republic of Tatarstan	Participants in the transaction	0	0	0	0	0	0	0	1	**1**	**5.88**	**1**	-	0	0	**0**	0	0	0	0	1	**1**	**7.14**	**1**	-
	Executed pledge agreement	0	0	0	0	0	0	0	1	**1**	**3.57**	**1**	-	0	0	**0**	0	0	0	0	1	**1**	**3.57**	**1**	-
	OIP – objects of pledge	0	0	0	0	0	0	0	1	**1**	**0.15**	**1**	-	0	0	**0**	0	0	0	0	1	**1**	**0.15**	**1**	-
Total	Participants in the transaction	**0**	**2**	**0**	**3**	**2**	**2**	**3**	**5**	**17**	**100.00**	**5**	-	**0**	**1**	**0**	**2**	**1**	**2**	**3**	**5**	**14**	**100.00**	**5**	-
	Executed pledge agreement	**0**	**2**	**0**	**5**	**10**	**2**	**4**	**5**	**28**	**100.00**	**5**	-	**0**	**2**	**0**	**5**	**10**	**2**	**4**	**5**	**28**	**100.00**	**5**	-
	OIP – objects of pledge	**0**	**6**	**0**	**19**	**18**	**305**	**24**	**317**	**689**	**100.00**	**317**	-	**0**	**6**	**0**	**19**	**18**	**305**	**24**	**317**	**689**	**100.00**	**317**	-

Source: Developed by the author.

"Avtogradbank" — one contract (at 2020, one invention on pledge).

This fact can be regarded as an additional positive argument in favor of PJSC "AK BARS" BANK when deciding on the issue of the bank-organizer for the future.

Thus, not only federal, but also banks from other regions use a similar pledge in work with clients from Tatarstan. Pledgegivers of Tatarstan have experience of IE pledge on OIP and other pledgeholders.

Information on pledgegivers and pledgeholders with IE pledge on OIP in Tatarstan for 2014–2021 is presented in *Table 4*.

The development of similar credit transactions in Tatarstan regional banks individually and through the regional banking syndicate (at least as a pilot project; at most — on a continuous basis with the development of this practice, including the use of high-end regional brands) seems reasonable and relevant given that Russian (including regional) companies have experience obtaining loans on OIP pledge directly in foreign banks [17, p. 38].

CONCLUSION

The possibility of attracting a loan from the syndicate of regional banks of Tatarstan under security of IE on OIP will allow:

1. Local banks of the Republic of Tatarstan to expand credit expansion in conditions of limited resources; to diversify and minimize their risks; to improve the quality of credit portfolios; to form additional interest income and, therefore, to strengthen their own financial results; in the end to work effectively in a complex and competitive banking market.

2. To promote the development of republican regional enterprises and, as a result, of the Republic of Tatarstan by obtaining funding of the necessary amount.

3. Expand the range of pledge objects through the use of exclusive rights to intellectual property objects (including corporate brands of leading republican companies) as pledges when obtaining a syndicated loan from the regional banking syndicate of the Republic of Tatarstan.

4. The Government of the Republic of Tatarstan, if necessary, to use its exclusive rights to objects of intellectual property (including the republican brands "Tatarstan Heritage" and Visit Tatarstan) to attract the funds required in the circumstances of the deficit of the republic's budget.

Note that according to the Law of the Republic of Tatarstan No. 86 from 25.11.2021 "On the budget of the Republic of Tatarstan for 2022 and the planned period 2023 and 2024" the budget deficit will be: in 2022–24 013 bln rubles; in 2023–21 617 bln rubles; in 2024–20 883 bln rubles.[10]

The activities of the regional banking syndicate to finance local businesses on their own IE on OIP (including corporate brands) will enable the improvement of the competitiveness of local businesses and banks, as well as the Republic of Tatarstan's whole banking system. In order to increase competitiveness and ensure territorial expansion, the regional banking union of Tatarstan may be offered to join local banks from neighboring regions.

[10] Budget revenues of Tatarstan in 2022, 2023, 2024. URL: https://minfin.tatarstan.ru/2022.htm (accessed on 15.07.2022).

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ABOUT THE AUTHOR

Olga F. Maslenkova — Cand. Sci. (Econ.), Assoc. Prof., Department of Economics and Management, Kuzbass Humanitarian Pedagogical Institute, Kemerovo State University, Novokuznetsk, Russia
https://orcid.org/0000-0003-2234-7884
o_maslenkova@mail.ru

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