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CONTENTS

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Valuation of Digital Intellectual Assets: Principles, Factors, Approaches and Methods

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ABSTRACT

The **object of the study** is digital assets and digital intellectual assets as objects of valuation. The **subject of the research** are the principles, factors, approaches and methods of assessing the value of digital assets, including digital intellectual assets, in order to involve them in civil turnover in modern realities. The **relevance** of the problem is caused, on the one hand, by the formation of new types of assets — digital, including intellectual — in the context of digitalization of the economy and public relations, on the other — by the uncertainties arising during their identification, as well as the need to substantiate the applicability of valuation principles, approaches and methods to determine the value of such assets for further involvement in civil turnover. The **purpose** of the study is to substantiate the principles, factors, approaches and methods applicable to the valuation of digital intellectual assets, their approbation on specific examples (domain names). **Methods** of statistical and comparative analysis, generalization, classification, and valuation were used. The essential characteristics of digital intellectual assets have been defined: intangible nature, creation with the help of digital technology; manifestation of value in the information system; the ability to civil (property) turnover as objects of intellectual rights. The applicability of valuation principles, income and comparative approaches to the valuation of digital intellectual assets is substantiated. The factors influencing the value of digital intellectual assets, as well as specific factors characteristic of one of the types of digital intellectual assets — domain names are identified. An example of using the analogs method to estimate the cost of a second-level domain name in the framework of a comparative approach is shown. It is **concluded** that digital intellectual assets satisfying all essential characteristics can be put on the balance sheet as intangible assets, and their market value is determined on the basis of income or comparative approaches using the principles of evaluation and identified factors.

Keywords: digital assets; digital intellectual assets; value; valuation approaches and methods

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INTRODUCTION

The relevance of the study of digital intellectual assets as objects of valuation is due to a number of recent socio-economic trends and factors.

First, there is the demand of the State and society for the formation of a new digital economy, encompassing all sides of economic processes and social relations. According to the Decree of the President of the Russian Federation No. 474 of 23 July 2020 "On the national development goals of the Russian Federation for the period up to 2030", the digital transformation is in the national interests of Russia. The digital economy is defined as "economic activity, where digital data are the key to production, processing of large volumes and the use of the results of analysis which, in comparison with traditional forms of economic management, allow to significantly increase the efficiency of various types of production, technologies, equipment, storage, sale, delivery of goods and services".[1]

The basis directions of the development of digital technologies in Russia are defined in the program "Digital Economy of the Russian Federation", approved by the Decree of the Government of the Russian Federation No.1632 of 28 July 2017.[2] The implementation of this programme involves State support for a number of federal projects aimed at digital development, including the regulatory framework, human resources, infrastructure, information security, and digital management (*Fig. 1*).

The necessity for early implementation of these projects is determined by Russia's lag from the world's leading economies in terms of digital transformation of socio-economic processes. The International Digital Economy and Society Index (*I –DESI*) 2018 showed that of 27 EU countries and 18 other foreign countries, Denmark, Finland, the Netherlands, the USA, and the UK are in the top five. Russia with an index of 0.43 is inferior to the average value of the EU Index (0.52), however, it is comparable to China (0.46) and exceeds Turkey (0.34), Brazil (0.37), Serbia (0.38), with significant growth potential (39%) of the sub–index components: broadband infrastructure (connectivity), human capital, use of Internet, integration of digital technology and digital public services. The highest is the sub–index of human capital (0.64) and the smallest is the sub–index of business integration of digital technologies (0.28).[3]

According to the Business Digitization Index (compiled by HSE University),[4] which characterizes the speed of adaptation to the digital transformation of business sector organizations in Russia, European countries, the Republic of Korea, Turkey, and Japan, our country is only in the 28th place, that comparable to the Central and Eastern European countries of Bulgaria, Hungary, Poland, and Romania. The leading position is occupied by Finland (50), followed by Belgium (47), Denmark (46), Republic of Korea (45). The Business Digitization Index is determined by indicators of the level of use of broadband Internet, cloud services, RFID–technologies, ERP–systems, the inclusion of organizations in electronic commerce.

The percentage of cloud services distribution in Russian organizations can be compared with the average by EU countries — 21%. But Russia is ahead of France and Austria (17%) and Germany (16%).

In 2021, Russia ranked 42nd in the World Digital Competitiveness Ranking — IMD Business School.[5] The leaders are the USA, Hong Kong, and Sweden. Among the evaluated criteria, Russia has the highest result in the

[1] Decree of the President of the Russian Federation from 09 May 2017 No.203 "On the Strategy of development of the information society in the Russian Federation for 2017–2030".

[2] Program "Digital Economy of the Russian Federation". Decree of the Government of the Russian Federation from 28 July 2017 No.1632. URL: http://static.government.ru/media/files/9gFM4FHj4PsB 79I5v7yLVuPgu4bvR 7M0.pdf. (accessed on 21.05.2022).

[3] International Digital Economy and Society Index (I-DESI). URL: https://digital-strategy.ec.europa.eu/en/library/i-desi-2020-how-digital-europe-compared-other-major-world-economies (accessed on 20.05.2022).

[4] Business Digitization Index. HSE University. URL: https://www.tadviser.ru/index.php. Article: Russia_in_IT-ratings (accessed on 20.05.2022).

[5] URL: https://www.tadviser.ru/images/f/f6/Digital_2021.pdf (accessed on 20.04.2022).

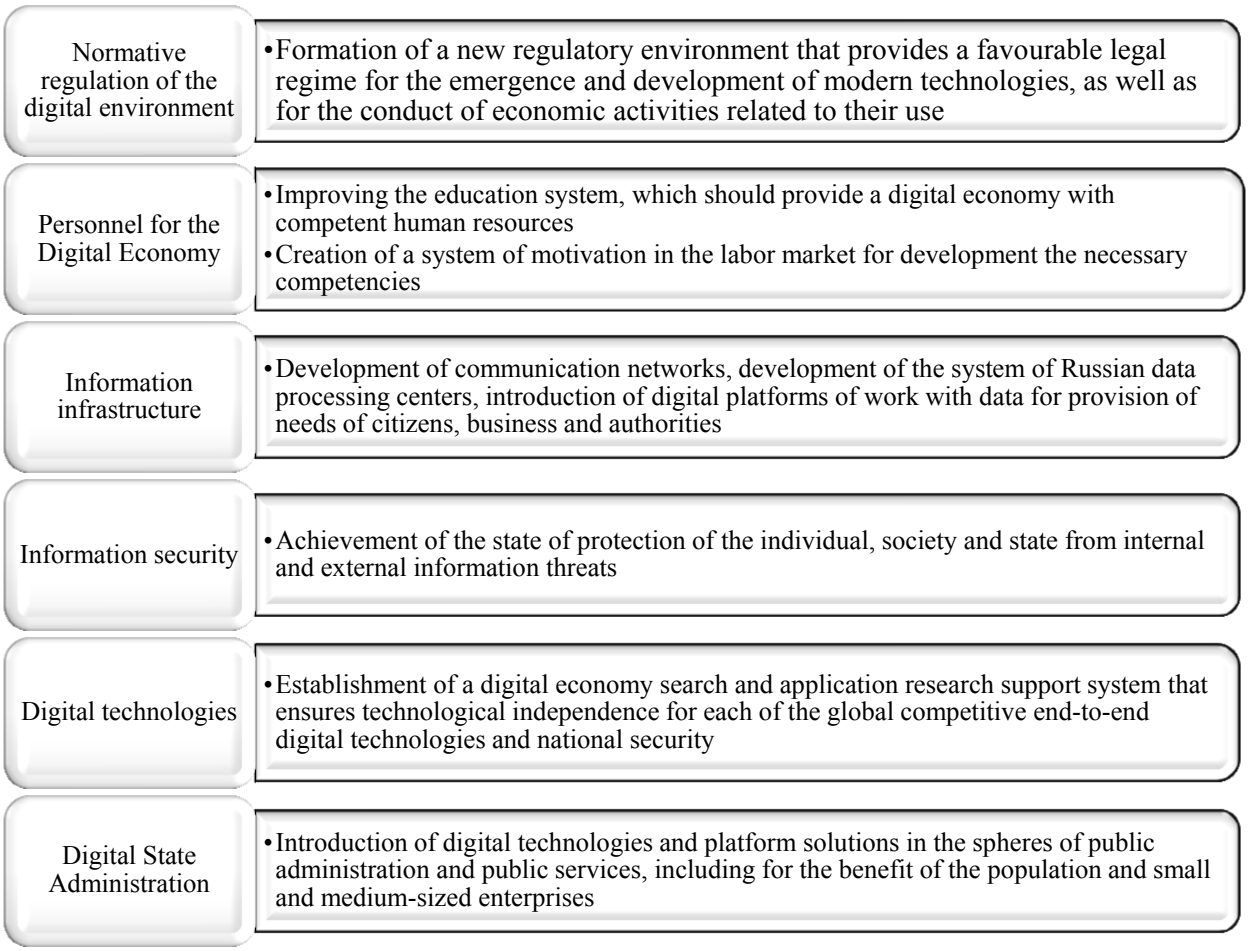

Fig. 1. **Federal projects of the Digital Economy of the Russian Federation Program**

Source: compiled by the authors on the basis of the national project Passport. URL: https://digital.gov.ru/uploaded/files/natsionalnaya-programma-tsifrovaya-ekonomika-rossijskoj-federatsii_NcN 2nOO.pdf (accessed on 21.05.2022).

"knowledge" block (24th place). The Russian Federation ranked 48th according to the "technology" block, which consists of the following components: regulation (39), including intellectual property (56); research legislation (46); capital (58), including venture capital (60); banking services (53); financing technology development (49); technological infrastructure (45).

Another trend that stimulates the digital transformation of the business is related to the difficult epidemiological situation caused by coronavirus infection, which led to explosive growth in online trading, the volume of which at the end of 2021 amounted to about 4.1 trillion rubles (3.4% of GDP).[6]

According to the same source (*DataInsight*), the Russian e-commerce market in 2020 with a growth rate of 58% became the fastest growing market compared to other countries and demonstrated the ability to accelerate digital transformation.

According to *Fig. 2*, the share of online sales in retail trade in 2017–2021 years has grown steadily against the backdrop of pandemic restrictions and inability to make purchases in the traditional way and reached 12% in 2021. The share of organizations that received orders for goods (works, services) on the Internet also grew (*Fig. 3*).

At the same time, according to the data of the Federal State Statistics Service, which monitors the development of the information society in Russia since 2010, it can be concluded that the pandemic as a whole has

[6] Inline trading in Russia 2021. Data Insight. URL: https://datainsight.ru/sites/default/files/DI_eCommerce2021.pdf (accessed on 20.04.2022).

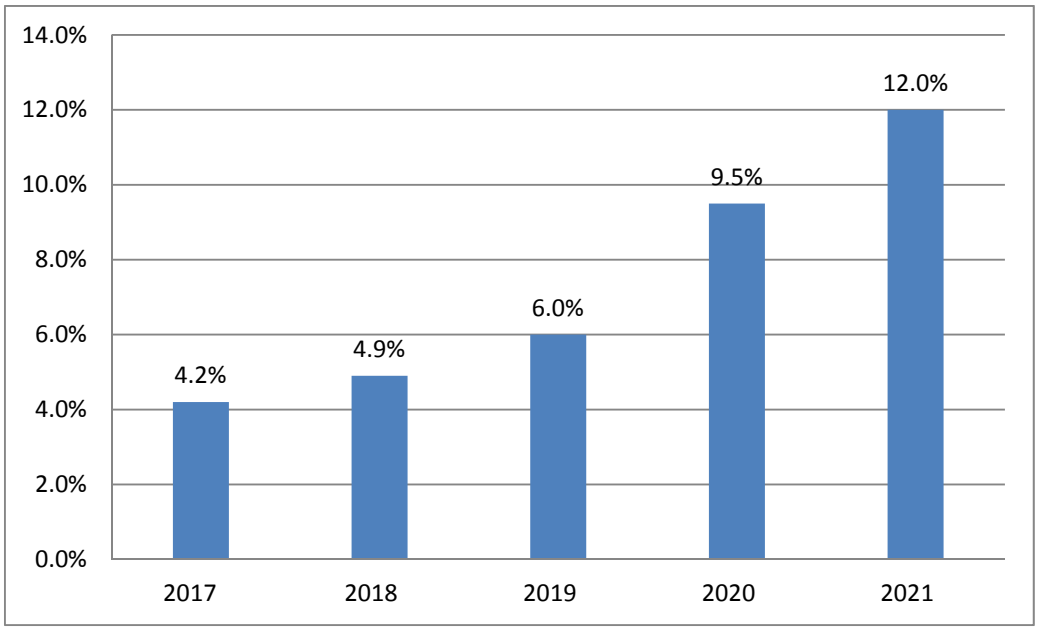

Fig. 2. **The share of e-commerce in the Russian retail market in 2017–2021, %**

Source: compiled by the authors based on data from Data Insight.

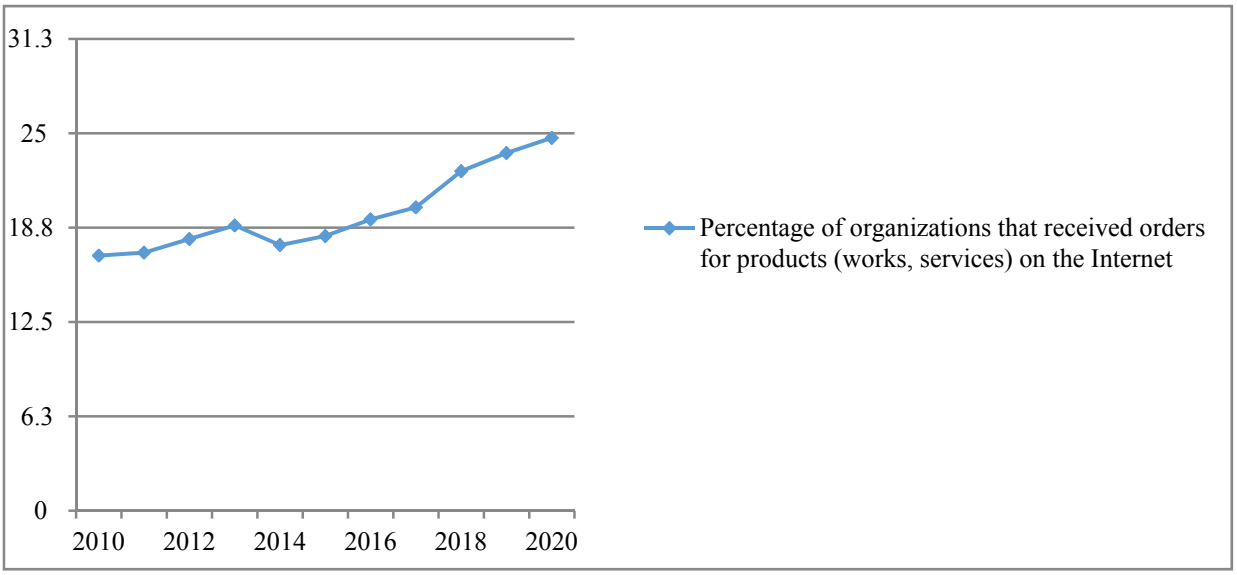

Fig. 3. **The share of organizations that received orders for manufactured goods (works, services) via the Internet, %**

Source: compiled by the authors on the basis of Rosstat data.

had a negative impact on the development of the innovative capacity of the country, on a number of indicators of the use of information and communication technologies (ICT), above all in e-business, the share of fundamentally new technologies (*Fig. 6*). It should be noted the growth of interest in education in the direction of training "Computer Science and Engineering" (*Fig. 4*). Thus, half of the indicators (50%) that was presented to the *Fig. 5 and 6* has a negative trend in 2019–2021 compared to the pre-production period.

Of course, there is still work to be done in terms of investment and stimulation of

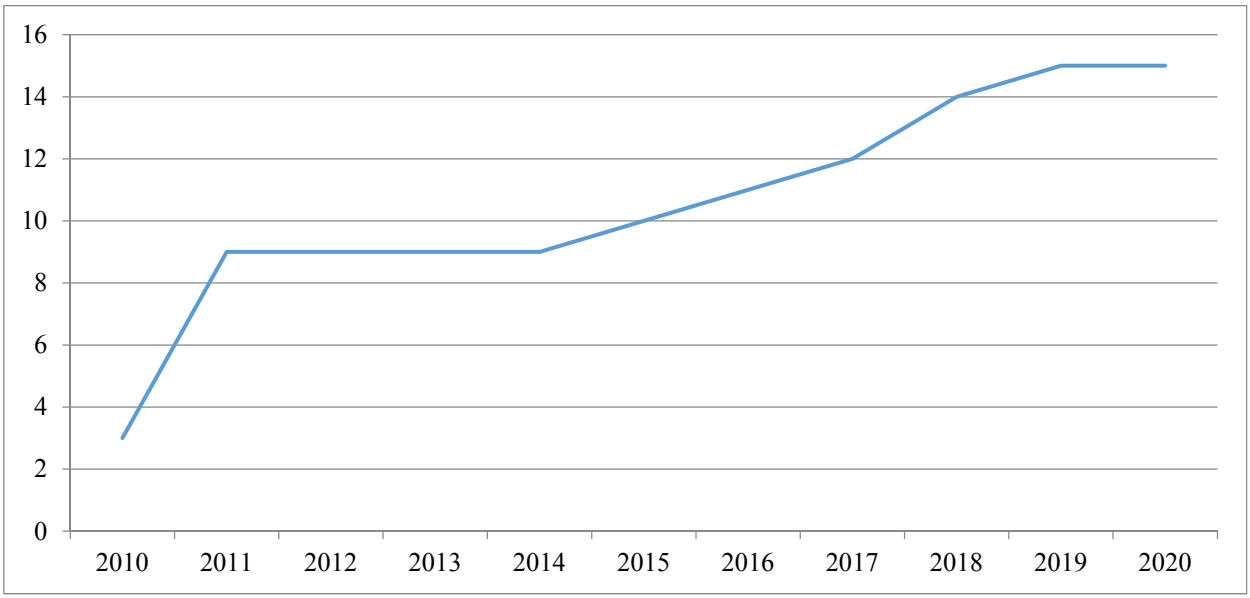

Fig. 4. **The number of students admitted to state educational organizations of higher education in the field of Computer Science and computer Engineering per 10 000 population, 2010–2020, %**

Source: compiled by the authors on the basis of Rosstat data.

the digital economy, but the digitalization process cannot be stopped, it is one of the priorities of the national economy, which is based primarily on intellectual capital, which includes human capital, organizational capital, including intellectual property, and market capital (relationship capital).

At the same time, the needs of economic entities in the digital economy are somehow connected with new (digital) objects of ownership, which necessitates the formation of the appropriate legislative framework, which should lead to the introduction of new objects of property in civil law, the development of approaches and methods of valuation of digital assets, including intellectual.

Thus, the purpose of the study is to determine the identification characteristics of digital intellectual assets, principles, factors, approaches, and methods of their valuation for further use by economic entities in the process of digital business transformation.

To achieve the purpose the following objectives were established:

- disclose the identity of digital assets and digital intellectual assets, and suggest their classification and valuation principles;
- define cost factors, approaches and methods of valuation of digital intellectual assets;
- calculate the value of digital intellectual assets using a specific approach (method) using domain names.

MATERIALS AND METHODS

The research was based on the work of domestic and foreign scientists involved in the research of scientific and practical aspects of identification and valuation of digital assets (financial and non-financial) as objects of civil rights, legal and regulatory acts, including Russian and international standards in the field of evaluation activity, data of Rosstat.

The COVID-19 pandemic, with all its negative effects on the population and the global economy, has been a powerful catalyst for the digitalization of society, and also caused the active development of the cryptocurrency market, setting the objectives of providing a legal basis for the market turnover of digital assets and the development of a financial mechanism for their monitoring and evaluation.

The study was based on the analysis of the problems of the development of digital

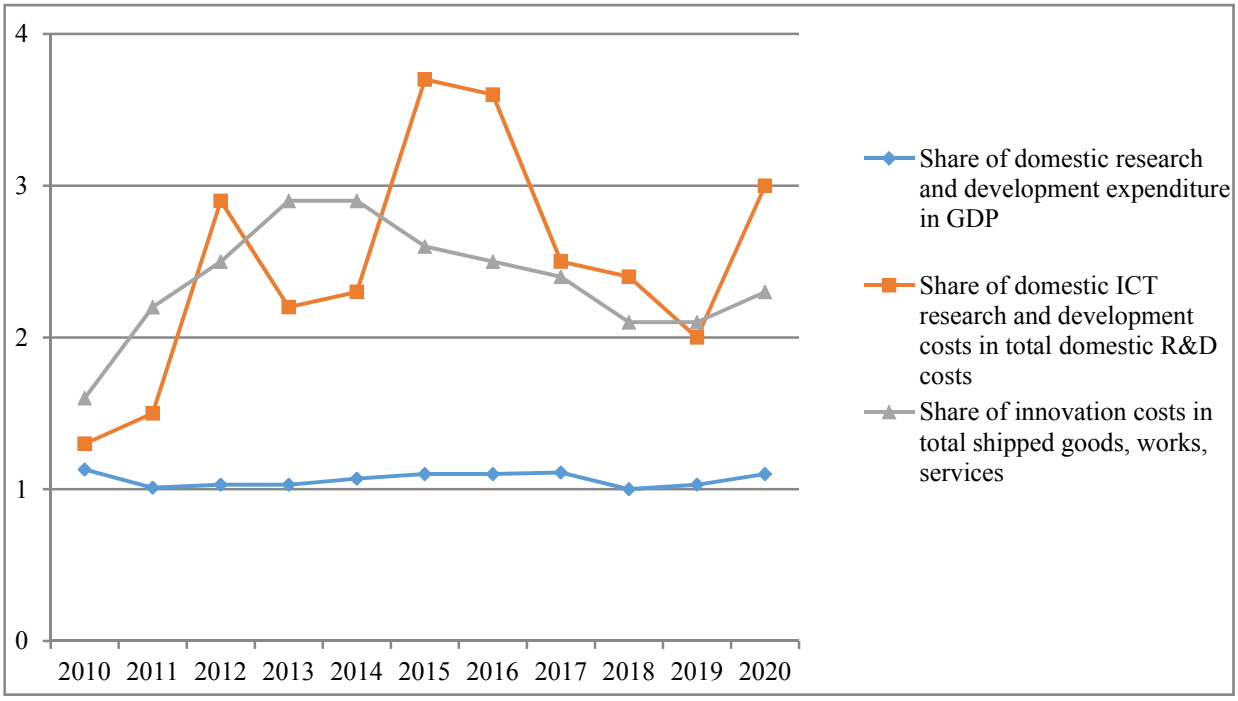

Fig. 5. **Dynamics of indicators of innovation potential in Russia in 2010–2020, %**

Source: compiled by the authors on the basis of Rosstat data.

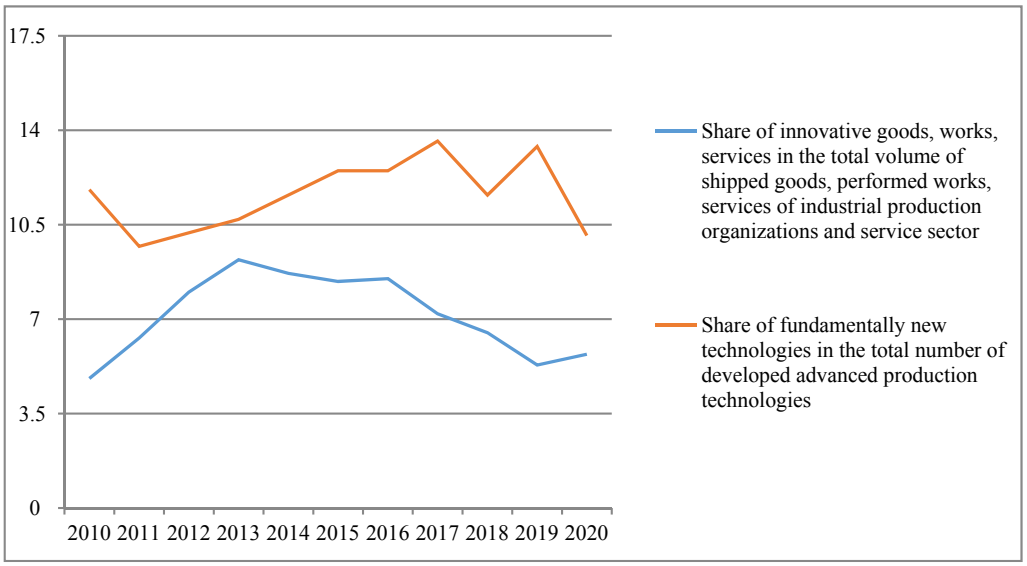

Fig. 6. **Dynamics of indicators of the institutional and infrastructural environment of the information society in Russia in 2010–2020, %**

Source: compiled by the authors on the basis of Rosstat data.

property in modern economic conditions. As part of the solution to the problem of valuation of digital intellectual assets, it is necessary at the first stage to define the essence of digital assets as objects of civil rights capable of circulation, because it is precisely this characteristic that allows them to be classified as objects of assessment, based on the existing legislation in the field of assessment activities. This problem is covered in Russian [1–5] and foreign studies [6], including discussions of the inappropriate identification of digital and digitized assets.

In the next stage of the research, it is necessary to determine the essence and characteristics of digital intellectual assets, and separate them from other types of digital assets. Such research related to the classification of digital assets is quite often discussed in the choice between financial and intangible (intellectual) digital assets [5, 7–14]. The work [11, 12, 14] identifies various specific characteristics of digital financial assets, and work [10] focuses on disclosure of the nature and characteristics of digital intellectual assets. The authors of [5, 7–9] lead their judgment on the classification of digital assets for valuation and accounting purposes. However, analysis has shown that the sources lack an integrated vision of all characteristics and their integration into a single identity — a digital intellectual asset.

The central issues in the development of the methodology of estimation of the value of digital intellectual assets are the identification of factors of pricing, principles, approaches, and methods of formation of their value. In addition, the relationship between the value of digital intellectual assets and the value of the business is an essential issue for understanding the importance of developing such a methodology and the valuation methodology itself. Analysis of existing research proves that intangible assets in modern conditions have a significant impact on the welfare of all stakeholders of operating business [15, 16] and, in turn, the cost of business significantly affects the cost of individual digital intellectual assets.

The composition of the pricing factors of digital assets and digital intellectual assets and their analysis are given in the works [17–20, 21]. The conducted analysis of sources showed significant importance of studying the market of sales of the analyzed assets and features of income generation from each type of digital intellectual assets.

The study of factors of pricing of digital assets and digital intellectual assets allowed us to determine the applicability of methods and approaches to the formation of their value. An analysis of the literature on the valuation methodology applied to the valuation of digital assets [18, 20, 21] led to a study of the applicability of traditional valuation approaches and methods. For example, the valuation of a domain name is presented in [18], and the analysis of the applicability of approaches and valuation methods to digital assets is given in the works [20, 21]. Based on such analysis, as well as its own interpretations and theoretical provisions, the article discloses the stages of formation of the value of digital intellectual assets on the basis of the use of profitable and comparative approaches to evaluation and their application in practice, taking into account the allocated specificity of a specific digital intellectual asset — domain name.

RESULTS OF THE STUDY

Classification, valuation principles and valuation factors of digital intellectual assets as objects of civil rights

Digital assets can be attributed to objects of civil rights on the basis of the action of art. 128 of the Civil Code of the Russian Federation, where the list of such objects indicates digital rights. Article 141.1 of the Civil Code of the Russian Federation defines the essence of digital rights as follows: "obligatory and other rights, the content and conditions of which are determined in accordance with the rules of the information system, meeting the criteria established by law".

By digital asset we will understand the kind of property (economic asset, a revolving object of civil rights) having an intangible nature and digital form, created with the help of digital technologies, showing its value (cost) in the information system and capable of civil (property) turnover. The digital asset combines economic (value), judicial (legal) and technological essence.

The work [7] presents a detailed classification of digital assets for management and valuation purposes on the basis of *Table 1*.

It should be noted that certain types of digital assets have a multifunctional nature and may overlap, which creates some difficulties in classifying them. The list of

Table 1

Classification of digital assets

No.	Classification feature (base)	Classification and examples
1	In the form of functioning	– Financial (payment tokens); – Non-financial (NFT-tokens)
2	In relation to objects of civil rights	– Assets with explicitly of legal regulation (domain names); – Assets with implicitly of legal regulation (3D-models); – Assets with uncertain of legal regulation (virtual property)
3	In relation to the objects of assessment	– Property, including digital and intellectual rights to digital assets; – Digital assets relating to other property
4	In the turnover rate	Noncurrent and current
5	In terms of liquidity	Highly liquid, medium liquid and low liquid

Source: compiled by the authors.

grounds is not complete and will need to be further developed in the development of the legislative framework and expansion of the practice of using digital assets in economic turnover.

Under a digital intellectual asset (further — DIA) in this paper is understood the economic asset in the form of intellectual property combined with intellectual rights to it, having a digital form, created with the help of digital technology, demonstrating its value (cost) in the information system and capable of civil (property) turnover. The digital intellectual asset, like any digital asset, integrates the economic (value), judicial (legal), and technological essence.

Since the digital intellectual asset is of an intangible nature and is created through digital technology, it is immediately implied that all digital assets are the result of intellectual activity (intellectual property). This view is most often expressed in the legal literature [2]. However, if they are assessed against the organization's intangible asset accounting criteria, not all digital assets meet these criteria. In particular, not all digital assets are intended for long-term use (more than 12 months), and for them, the organization may expect to sell the facility within 12 months or the normal operating cycle, so most researchers on this issue classify digital assets as financial investments [8]. That is, those digital assets that cannot be attributed to intangible assets will be accounted for as financial investments.

We consider the classification of digital assets by the form of operation (*Fig. 7*).

Obviously, most non-financial digital assets are digital intellectual assets. In this case, it is controversial to attribute to digital intellectual assets the content of social networks or any sites, certain questions arise and in relation to the bases of the Big Data. The content of networks or sites is a digitized version of texts or drawings that may or may not exist digitally. This is where the object of copyright arises, i.e. intellectual property takes place, but such an asset is not digitally created. According to some authors, here the *digital* and *electronic* form of an asset is mistakenly identified [2]. In the case of BigData as a database, i.e. an intellectual property object, the question arises as to whether there are exclusive rights to such objects, given that the compilers of such databases compile data that are freely available on the Internet.

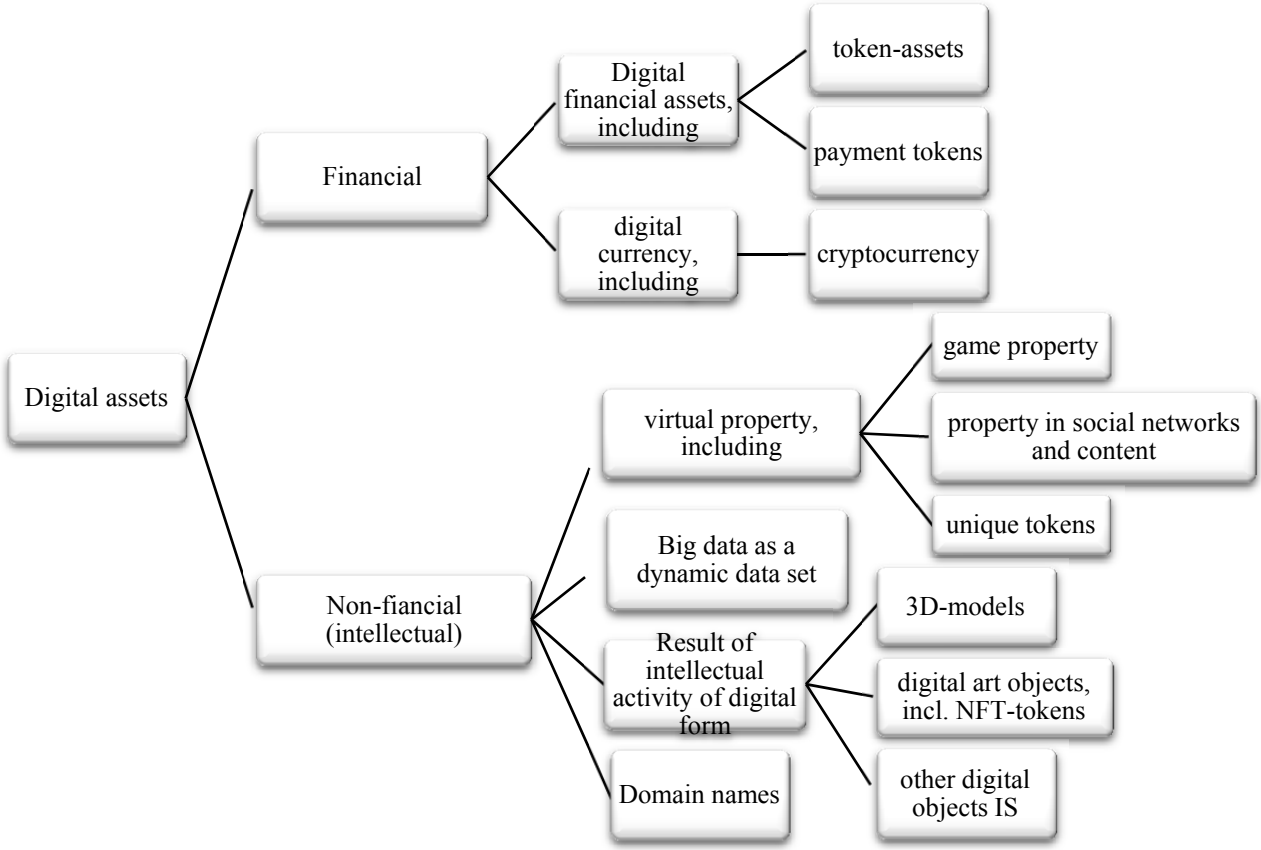

Fig. 7. **Classification of digital assets by form of functioning**

Source: compiled by the authors.

The classification of domain names as Internet business or individual identifiers as digital assets is supported by the following considerations. In accordance with art. 1484 of the Civil Code of the Russian Federation domain name is a way of addressing the Internet and is intended to provide access to the information posted on the site. Domain name can be the object of transactions, have economic value as marketing intangible asset of the company. However, domain names do not belong to the list of intellectual property objects specified in art. 1225 of the Civil Code of the Russian Federation. As a subject of civil law, a domain name is a proprietary right that can be realized by the domain name administrator and, as a result, the domain name is a participant of civil circulation and has a value. The fact that domain name exclusivity is within the purview of the World Intellectual Property Organization (WIPO) indicates that it can be valued using valuation techniques for intellectual property objects.

Thus, domain names have the economic and legal essence of the digital asset. As for technological nature, it is defined in art. 2 of the Federal Act from 27 July 2006 No. 149 (ed. from 06 July 2016) "On information, information technology and information security", "domain name — identify by symbols", i.e. not digital in itself, but can be converted to a digital IP–address via network protocols. In this regard, domain names can be referred to as digital assets in our understanding.

There are still many unresolved issues related to the identification of DIA, and further clarification of the attribution of assets to digital assets and individual digital assets to intellectual property is required.

The next question to consider in more detail is the definition of the principles of valuation of DIA. The set of principles of assessment is a systematic tool of analysis of the

value of the object of assessment, a methodological basis for the application of approaches and methods to estimate the value of objects of assessment. Evaluation principles allow us to conduct a comprehensive analysis of the value of the object of assessment and determine the factors that influence the value of the object.

Consider the features of the application of valuation principles to the formation of DIA. There are several groups of evaluation principles[7]:

- based on user perceptions (principles of utility, substitution, and expectation);
- related to the exploitation of property (principles of residual productivity, contribution, balance, increasing and decreasing incomes (or marginal productivity), economic size, economic division);
- the external (market) environment (principles of competition, supply and demand, conformity, dependencies, changes in value);
- principle of the most efficient use (MEU).

It should be noted that the list of groups of principles and their composition vary from source to source. The MEU principle is often included in the third group of principles, and the composition of the second and third group principles is also changing.

For digital intellectual assets, the first set of principles is fully operational without any significant change. The second group of principles proposes the use of the principle of optimality, analogous to the principle of balance, which can be interpreted as follows: maximization of DIA value is due to optimum characteristics of each element of the system of such an asset.

The third group of principles can also be applied to DIA in full.

The authors would like to dwell separately on the principle of MEU. This principle is realized as a result of the analysis of various options for using DIA and choosing from them the best option in the assumption that with this use of the asset the maximum value of the market value will be formed. This analyses:

- the ability of the digital market to accept this use, assessed by DIA;
- the legal basis for the formation and functioning of DIA and the presence of restrictions imposed by the regulator;
- technical characteristics of the evaluated DIA, for example, for an NFT–token it is primarily the cryptographic characteristics, legal security, which determine a particular use and the corresponding value of the digital asset;
- financial soundness of use of a variant of DIA (value of cash flows, efficiency of use). Particular attention should be paid to sources of income from the use of a digital asset, its size and timing, and the material and intangible costs of creating and operating assets. All this is directly related to the commercialization of DIA.

Thus, the obvious factors that affect the value of DIA are the amount and period of income that an asset generates; the cost of creating and operating a digital asset; the technical characteristics of the asset; the market prices of the equivalent asset.

In addition, factors of the environment will certainly play a significant role in the formation of the cost of DIA, as well as for any other objects of assessment: macroeconomic condition, political stability, legislative framework, price dynamics in the market of the subject of the assessment.

However, when determining the value of DIA, it is necessary to take into account the specific factors of their formation of value, which affect the value of only such assets: level of development of information technologies, qualification and professional level of manufacturers, sellers, and buyers of DIA and a number of other factors that relate to specific types of digital intellectual assets (*Table 2*).

Thus, summarizing the list of factors that affect the cost of DIA, it is possible to group them in terms of two characteristics: external and internal relative to the asset; and

[7] See more: Eskindarov M.A., Fedotova M.A., ed. Business valuation. Textbook. Moscow: KnoRus; 2015. 320 p.; Katzman V.E., Kosorukova I.V., Rodin A. Yu., Kharitonov S.V. Fundamentals of assessment activities. Textbook. 3rd ed. Moscow: Synergy University; 2012. 267 p.; Kosorukova I.V., ed. Assessment activities. Textbook. Moscow: KnoRus; 2021. 334 p.

Table 2

Special factors in the formation of the value of certain types of digital intellectual assets

The name of the type of digital intellectual asset or the right to it	Cost formation factors
Neurotechnology and artificial intelligence	Opportunity for learning Learning limit
Distributed registry systems	Quotes (prices) in the market of certain transactions Investment potential of the asset
Innovative technologies for the production of goods and services, including those based on quantum physics	1. Savings on measuring industries 2. Optimization of communication and information logistics 3. Information processing optimization, cost benefit 4. Competitive advantages in the market 5. Costs of the digitalization process 6. Increasing the investment attractiveness of the consumer due to the prospects of innovative development
Robotics and sensor equipment	1. Level of innovation of the object 2. Share of elements in total object 3. Positive and negative externalities as a result of the use of the object 4. Direct and indirect costs of the facility 5. Additional profit of the user taking the object
Wireless communication	1. Positive and negative price externalities 2. Speed of information transfer and investment decisions 3. Level of wireless infrastructure development
Virtual and augmented reality	1. Optimization of business process modeling 2. Completeness and accuracy of the restructuring of the facility revealed by these technologies 3. Creating competitive advantages due to the intrinsic nature of the model to the environment
Neurotechnology and artificial intelligence	Opportunity for learning Learning limit

Source: compiled by the authors.

traditional (analyzed against any objects of assessment) and special (analyzed against DIA only) factors. Of course, this classification of factors is not new, as there are special factors for any object of valuation that influence the valuation of the asset in question. However, this is the first time we have systematized special factors of digital intellectual assets.

Problems, approaches and methods of valuation of digital intellectual assets

In valuing digital intellectual assets, the value first needs to understand what value should be determined. There may be a problem related to the essential interpretation of the value in connection with the Order of the Ministry of Economic Development of Russia from 14 April 2022 No. 200 "On approval of federal evaluation standards and on amendments to some orders of the Ministry of Economic Development of Russia on federal evaluation standards" (further — Order No. 200), correspond from 07 November 2022. FSA (Federal Standard Assessment) II determines the value as a measure of the value of the facility to market participants or individuals,

expressed as a monetary amount determined at a specific date according to a specific type of value established by federal valuation standards. However, the Order of the Ministry of Economic Development of Russia does not define the essence of the measure of the value of the object.

The current Federal Standard Assessment, cost is interpreted in the same way as in International Standard Assessment: the most likely estimated value determined at the valuation date according to the selected value according to the requirements of the Federal Standard Assessment "Purpose of valuation and types of value (FSA No. 2)".[8] In our opinion, the definition of value in the current national valuation standards is more correct than the newly introduced standards, since the term "value" is mentioned in International Standard Assessment (further — ISA) 2007 only in the context of investment value (value in use), value for a particular user: "The investment value or value of a property asset may be higher or lower than the market value of that asset. The terms "investment value" or "value" should not be confused with the notion of market value of investment property. The term "investment value" is used in North America, the term "value" as its synonym — in the countries of the British Commonwealth".[9]

New national standards indicate three possible values: market, investment, and equilibrium. This list is still in conflict with the current version of the Federal Law from 29 July 1998 No. 135 (ed. from 02 July 2021) "Evaluation activities in the Russian Federation" (further — FL No. 135).

Consider the nature and types of values in existing and coming into force normative documents (*Table 3*).

The analysis presented in *Table 3* indicates that the original intention of preparing new FSA to bring national standards closer to international ones on the use of types of value has not materialized, the goal is not achieved, because the proposed list of value types in the FSA II is much longer listed in the ISA.

At the same time in the new FSA II, there is a para. 22, the essence of which is difficult to unequivocally interpret: "If the legislation, normative legal acts or other documents according to which the evaluator operates, there is a value assessment, the type of which is not defined or absent in para. 12 of this federal valuation standard... in this case, the assessment assignment and the evaluation report must contain the background, the basis for their determination and the selected type of value. In doing so, account must be taken of the provisions of article 7 of the Federal Law on the presumption of the market value of the object of valuation". It is not clear what the developers had in mind, but it seems that if no type of value from the list can be applied to para. 12, the market value will be applied. Or the appraiser can determine what kind of value he finds.

It is possible to note that the list of types of value removed the types of value presented in the ISA. That is, fair value, which is defined for the purpose of reporting on IFRS and for the presentation of the revaluation results of Federal Standards of Accounting 6/2020,[10] as also provided for in the project Federal Standards of Accounting 14/2021 "Intangible assets",[11] and Russian appraiser can now form as part of the assessment report only using the provisions of the above ambiguous para. 22 of FSA II.

That is, with respect to digital intellectual assets that will be placed on the balance sheet as intangible assets, the ability to determine the revalued value as fair value is questionable. However, according to current legislation, this problem does not arise

[8] URL: https://docs.cntd.ru/document/420276012 (accessed on 26.05.2022).

[9] International Standard Assessment. 2007. 8th edition. Translation from English. Moscow: Russian society of appraisers; 2008. 422 p.

[10] Order of the Russian Ministry of Finance from 17 September 2020 No. 204 "On adoption of Federal Accounting Standards FAS 6/2020 "Fixed assets" and FSA 26/2020 "Capital investments", para. 15. Consultant plus.

[11] Project of Order of the Russian Ministry of Finance "On adoption of Federal Accounting Standards FAS 14/2021 "Intangible assets" (as at 28 September 2021) (prepared by the Russian Ministry of Finance, ID project 04/15/09–21/00120843). Consultant plus.

Table 3

Comparative analysis of types of value in national and international valuation standards and Federal Law No. 135

Type of cost	Current FVS and Federal Law No. 135	Accepted FVS (Order No. 200)	MCO / IVS
Market	Most probable price at which the subject of the valuation may be excluded from the open market under competitive conditions, when the parties do reasonably well, reasonably with all the necessary information, and the transaction price is not affected by any extraordinary circumstances	Coincides with the existing FSA and FL No. 135	Estimated amount of money for which an asset or liability would be exchanged at the valuation date between the interested buyer and the interested seller as a result of a commercial transaction after proper marketing, in which each party would act informed, prudently and without coercion
Investment	Value of the object of valuation for a specific person or group of persons when the person(s) have established the investment purposes of the object of valuation	Coincides with the existing FSA and FL No. 135	The value of an asset to a particular owner or potential owner, taking into account their individual investment or operational objectives
Liquidation	Estimated value of the most probable price, according to which this object of assessment may be alienated for the period of exposure of the object of assessment, less than the typical period of exposure of the object of assessment for market conditions, under conditions, when the seller is forced to make a disposition transaction	None. Consideration of the application of market value in the pre-liquidation of the object of valuation in a voluntary sale. And when determining the value in the assumption of a forced sale, the liquidation value is determined in the interpretation in art. 3 FL No. 135	The amount of money that could have been recovered when the asset or group of assets sold in instalments. The liquidation value should take into account the cost of pre-sale preparation of the assets as well as the cost of their disposal activities. The liquidation value can be determined on the basis of two different assumptions: 1. Orderly deal with normal marketing period. 2. Forced transaction with a short marketing period
Cadastral	Value established as a result of the State cadastral assessment or as a result of a dispute over the results of the determination of the cadastral value or as determined in cases provided by art. 24.19 FL No. 135	None. However, other types of value may apply, as provided by FL No. 135. And the cadastral value is provided by FL No. 135	There is no

Table 3 (continued)

Type of cost	Current FVS and Federal Law No. 135	Accepted FVS (Order No. 200)	MCO / IVS
Equilibrium	None	Represents the amount of money for which the facility would presumably be exchanged between specific, knowledgeable and ready to deal parties at the valuation date, reflecting the interests of those parties	Equitable Value — estimated sale price of an asset or obligation between specifically identified, knowledgeable and interested parties, which reflects the respective interests of the parties
Other types of value	This list of types of value is not exhaustive. The appraiser is entitled to use other types of value in accordance with the current legislation of the Russian Federation, and international assessment standards	Other types of cost may apply provided by FL No. 135	Market rent, synergistic, fair value, fair market value, fair market value

Source: compiled by the authors.

Turning to the use of existing valuation approaches and techniques for digital, including intellectual assets. In evaluation activities, three approaches are used to assess the value of an object of assessment: comparative, profitable, and cost-effective. The essence of these approaches is presented in the federal and international standards assessment.

The applicability of approaches and methods to the valuation of digital assets depends on the nature of the asset and its utility[12] to the owner/user (*Table 4*).

Data in *Table 5* indicate that the main approach to valuing digital assets is the income approach, since the utility, and therefore the value, of such assets is determined by the income that the asset generates.

Each of the assessment approaches uses a combination of methods to implement the concept, principles, conditions, assumptions, limitations, and prerequisites of the assessment approach. The development of estimation methods may be conditioned by a change in the nature of the approach itself and the assumptions, assumptions, and relationships between the basic metrics. Recommended methodological tools for the valuation of digital assets are presented in *Table 5*.

Consider the application of approaches and estimation methods on the example of a specific type of DIA — domain name.

Valuation of digital intellectual assets based on domain names

It has already been shown above that a domain name can be attributed to digital intellectual assets because it is a means of individualization (intellectual property object) with a market value, is subject to civil rights (digital property), which can be traded, has a digital form of representation in the form of a network IP-address.

In 2020, the Coordination Center of National Domains.RU and.RF based on the analysis of the prices of sales transactions of 20 thousand second-level domain names has developed and published the Methodology of estimation of market value of domain names of the

[12] The utility of a thing is the ability of a thing to satisfy a user's needs in a certain place and at a certain time.

Table 4

Applicability of approaches to valuation of various digital assets

No.	The name of a digital asset	The essence and characteristics of the utility of a digital asset	Cost approaches		
			Income	Comparative	Costly
1	Rights digital and realized in the information sphere	1. System of rights of claim of things, intellectual rights, performance of works and rendering of services functioning in the information system. 2. Utility consists in the notion of financial and legal types of benefits. 3. Amount of services received. 4. Performance (real and potential) transmitted by RID	Applied in DCF part in EVA part in ROV	In case of mass nature of the object of assessment	Not advisable to apply
2	Digital property complex and its elements	1. Similar to tangible property and non-digital IA. 2. Virtual needs satisfaction. 3. Profits	Apply	With enough analogs available	Not appropriate
3	Digital intellectual rights	1. Allows you to register ownership. 2. Opportunity to make a profit while observing established rules and regulations. 3. Opportunity to combine profitable transactions	Applied to specific methods	Not advisable	Does not apply
4	Big Data	1. Collection, systematization and storage of large databases. 2. Expands the amplitude of information retrieval. 3. Optimizes model construction and prediction	The object of the evaluation is the right of access, it is possible to apply the adjusted DCF	Not advisable	Not in use
5	Artificial intelligence, machinery, training, etc. innovative technologies	1. Each technology performs unique functions that optimize management and production costs. 2. Saving time. 3. Increasing the enterprise speed of management investment, cost decisions	The valuation methodology is similar to that of technology assessments	In rare cases	Does not apply

Source: compiled by the authors.

second level in the top-level domains.RU and. Russian Federation in the secondary market of domain names[13] (further — Methodology), which has had a positive impact on business efficiency with digital assets. The main cost factors in determining the economic value of the domain name according to this Methodology are:

1) the semantic content of the domain name content, understandable to a wide audience (for example, "apteka", "Russia");

[13] URL: https://app.cctld.ru/KC_buklet_2020.pdf (accessed on 12.05.2022).

Table 5

Approaches and methodological tools for assessing the market value of digital assets

The name of a digital asset	Income approach (discounted cash flow method)	Comparative approach (method of analogues)
Digital rights (utilitarian digital rights)	+	+
Digital property	+	+
Digital assets as part of digital property	+	+
Digital rights as objects of civil rights	+	+
Big data	+	–
Neurotechnology and artificial intelligence	+	–
Distributed register systems	+	+
Quantum technologies	+	–
New production technologies	+	–
Industrial Intelligence	+	–
Components of robotics	+	–
Wireless technology	+	+
Virtual and augmented reality technologies	+	–

Source: compiled by the authors.

2) domain name creation method;

3) domain name match to trademark or brand;

4) number and level of income of the population of the territory indicated in the domain name (geographical meaning);

5) technical characteristics: domain extension, domain name exposure period, number of characters, number of search queries corresponding to the second-level domain name in English and Russian.

Most of the models in the Methodology allow the estimation of the domain name price on the basis of the proposed formulas that take into account mainly the above parameters, rather than market characteristics.

We are interested in applying the approaches and methods discussed above to the valuation of the market value of the right to a domain name as a digital intellectual asset. Domain names with semantic content (existing and modified words, word combinations, well-known abbreviations) or associated with trademarks, geography, or temporary objects are therefore the most appropriate for valuation purposes. In this case, the domain name can be widely recognizable and have a clear link to a specific product, trademark, or brand, for example, sberbank.ru, youtube.com, sportmaster.ru. In this case, domain names are essentially unique DIA, their value will be comparable to the value of trademarks and depend on the amount of cash flows gener-

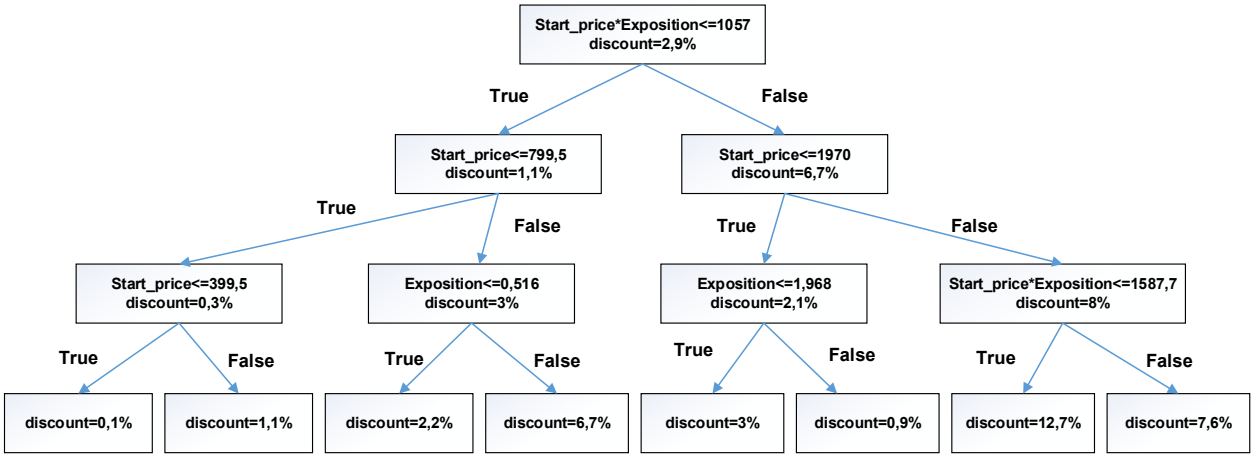

Fig. 8. **Algorithm for determining the value of the discount on the auction**

Source: compiled on the basis of the Methodology.

Note: Start_price — initial sale price (before discount); Exposition — term of the domain name exposure on the open market. Determined according to the date of advertisement of the evaluated domain name on the online platforms.

ated through the use of domain name companies. Only a profitable approach and the DCF method, which is widely known and used by professional appraisers when assessing IA, is acceptable, so there is no need to dwell on it.

Consider domain names that have semantic content suitable for a potential owner due to the specificity of his professional activities, which will allow consumers to associate the domain name with his company or his product. Examples of such domains are apteka.ru, dostavka.ru, taxi.rf and etc. According to the MEU principle, the owner will choose to use the domain name in the most efficient way, based on the content, and the most suitable subject matter. In this case, domains with the same meaning are actually substitutes (analogues) for each other. But, since each domain can be registered in a single copy, the analogues will differ in "technical" characteristics (constructs that do not make sense but allow to distinguish domain names), for example, apteka12.ru, dostavka+.ru. Or there will be "complexity" of the domain name due to the addition of new semantic constructions or word modifications, in particular dostavka-vip.ru, do$tavka.ru. The more popular domain content, the problem of the lack of necessary domains is more acute and the higher, respectively, their cost. Thus, the market price of the domain name will be formed by estimating the market value of the main semantic component and adjustments related to technical characteristics. In this case, the preferred approach to the estimation of the market value of semantic domain names, not associated with a well-known trademark (brand), is a comparative approach and method of analogues. Consider their use on the example of domain name evaluation "dostavka5".

The domain name "dostavka5" has a semantic component, understandable to a wide audience, as well as additional elements ("5") that do not complicate the perception of the main meaning. In addition, "dostavka5" is not associated with any known trademark (brand). The assessment of the market value of a given domain name is the following sequence of actions.

1. The selection of domain-like names with similar semantic content to the evaluated domain name, for which transaction prices are known, or (if data on market transactions are unknown) open offers of sale. In the latter case, use the adjustment for bidding, which we will define according to the rules given in the Methodology, taking into account, in addition to the price of the offer, the period of exposure of domain names-analogues (*Fig. 8*).

2. The cost of analogues is adjusted for the way the domain name is formed from the original semantic component according to the rules of the Methodology (*Fig. 6, 7*).

Table 6

List of ways to form domain names formed from an existing word

Method of forming	Example	Description
Clear	example.ru, examples.ru	Full compliance with the original semantic component or its multiple form
Error	eczample.ru, exam-ple.ru	Semantic component with a spelling error or including the inappropriate hyphen. The meaning of the original word is saved
Good Addition	theexample.ru, example24.ru	Semantic component with more symbols that fit well with the main word. The meaning of the original word is saved. For more information see below
Addition	examplea.ru, 6-example.ru	Semantic component with any extra symbol at the beginning or end, including a hyphen. The meaning of the original word is saved
2Addition	examplefk.ru, dfexample.ru	Semantic component with two extra characters at the beginning or at the end. The meaning of the original word is saved
3Addition	examplefkn.ru, 67l-example.ru	Semantic component with three extra characters at the beginning or at the end, including a hyphen. The meaning of the original word is saved
2Num	34example.ru	Semantic component with two extra numeric characters at the beginning or at the end. The meaning of the original word is saved
2Dash	3r-example.ru, 67-example.ru	Semantic component with any two extra characters at the beginning or at the end via a hyphen. The meaning of the original word is saved

Source: compiled on the basis of the Methodology.

Table 7

Adjusting the market value of domain names for the method of formation

Numerator / Denominator	Clear	Error	Good Addition	Addition	2Addition	3Addition	2Num	2Dash
Clear	1	2.53	1.87	2.35	2.62	2.66	5.78	4.23
Error	0.40	1	0.74	0.93	1.04	1.05	2.28	1.67
Good Addition	0.53	1.35	1	1.26	1.40	1.42	3.08	2.26
Addition	0.42	1.08	0.80	1	1.11	1.13	2.46	1.80
2Addition	0.38	0.96	0.71	0.90	1	1.02	2.20	1.61
3Addition	0.38	0.95	0.70	0.88	0.99	1	2.17	1.59
2Num	0.17	0.44	0.32	0.41	0.45	0.46	1	0.73
2Dash	0.24	0.60	0.44	0.56	0.62	0.63	1.36	1

Source: compiled on the basis of the Methodology.

Table 8

Adjusting the market value of domain names for the method of formation

Indicator name	Object of evaluation	Analog object No. 1	Analog object No. 2	Analog object No. 3
Domain name	dostavka5.ru	dostavka12.ru	dostavka+.ru	Rosdostavka.rf
Sale price, rub.		18 000	21 000	10 300
Kind of value	Market value	Offer price	Offer price	Offer price
Exposure period, years		1.28	3.12	0.81
Sale price, rub.		18 000	21 000	10 300
Exposure period × sale price		23 040	65 520	8343
Trade adjustment		–7.60%	–7.60%	–7.60%
Adjusted price, rub		21 289	60 540	8335
Domain name category	One semantic components	One semantic components	One semantic components	One semantic components
Method of formation of the initial semantic component (Table 7)	Addition	2Num	GoodAddition	GoodAddition
Adjustment for the method of formation from the original semantic component (Table 8)		2.46	0.8	0.8
Adjusted price, rub.		52 371	48 432	6668
First-level domain name	ru	ru	ru	rf
Adjustment to a first level domain name		0%	0%	56%
Adjusted price, rub.		52 371	48 432	10 402
Market value calculation*, rub.	52371 × 0.4 + 48 432 × 0.4 +10 402 × 0.2 = 42 401.6 rub.			

Source: compiled by the authors.

Note: weighting factors were determined based on the proximity of the analogue to the object being evaluated, the number and magnitude of adjustments made.

3. Adjusts the cost of analogues to the domain area (.ru or.rf) assuming that the domain extension.rf reduces the cost of the domain name by 56% (as calculated by the Consultant).[14]

4. The average value of adjusted prices of selected analogue objects is determined.

Calculations are presented in *Table 8*.

Thus, the market value of domain name "dostavka5" will be 42 400 rubles with rounding.

CONCLUSION

The following conclusions can be drawn from the research:

1. An analysis of trends in the development of the information society in Russia for 2010–2021 showed that the sanctions of 2014 and the coronavirus pandemic in 2019–2021 were significant negative factors for the digitalization of the economy. Russia still lags behind the EU, USA, Korea, and China in terms of digitalization of society and business, as evidenced by the international ratings given in the article, but has significant growth potential on components of human capital and digital infrastructure.

2. The key characteristics of digital assets and digital intellectual assets that define them are: intangible nature and digital form; creation by digital technology; display of value (cost) in the information system; capacity for civil (property) turnover. For digital intellectual assets, there is an additional characteristic — the asset is represented as intellectual property in conjunction with intellectual rights on it.

3. Digital assets can be classified on different bases: in the form of functioning, in relation to objects of civil rights, in relation to objects of valuation, in terms of turnover rate, and degree of liquidity. This classification allows to determine the characteristics of digital assets that form the price–forming and cost-creating factors. The most common accounting treatment of digital intellectual assets is intangible assets.

4. Specific factors affecting the value of digital assets include the level of information technology development, qualification and professional level of manufacturers, sellers and buyers of digital assets, quotes (prices) in the market of certain transactions, the investment potential of the asset, change in costs due to use of the asset in operational activities, etc. For each type of digital intellectual asset, specific characteristics that affect value may be considered, in particular for domain names, these characteristics are the following: semantic content; method of formation; conformity to trademark (brand); number and level of income of the population of the territory (if the domain name has a geographical meaning); technical characteristics (domain zone, number of search queries, etc.).

5. Analysis of the applicability of traditional valuation approaches and techniques to the valuation of digital assets showed that it is possible to apply income and comparative approaches to their valuation. In the income approach it is recommended to use the method of discounted cash flows, and in comparative — the method of analogues. The application of the comparative approach and analogue method is shown by the example of domain names for which it is substantiated that they are one of the types of DIA.

6. To the directions of development of instruments of valuation can be attributed to the: development of IT-oriented tools; development of control and protection of information and ownership rights; development and improvement of the legal and regulatory framework for valuation, development of FSA for digital assets valuation; enable the integration of tools and techniques in which they are applied into existing or newly established ecosystems.

Further directions of research in relation to digital intellectual assets should include the development of methodological tools that take into account the specifics of specific types of assets.

[14] URL: https://app.cctld.ru/KC_buklet_2020.pdf (accessed on 12.05.2022).

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O.V. Loseva — the essence and classification of digital assets, the determination of the value of domain names and the formation of research conclusions.
I.V. Kosorukova — literature analysis, problems, approaches and methods of valuation of digital assets.
M.A. Fedotova — statement of the problem, development of the concept of the article.
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Multi-Capital Approach for Sustainable Growth: Experience from the Oil & Gas Companies

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ABSTRACT

Nowadays, companies traditionally use economic capital and follow the interests of profit-making by shareholders or financial structures. However, recently there has been a tendency to analyze non-financial factors affecting equity. Multi-capitalism is a doctrine that studies the impact of social, environmental, and economic indicators on equity. **The subject** of the study is the Chinese oil and gas companies' sustainable growth. **The paper's purpose** is to consider the interdependence of non-financial indicators with the Higgins Sustainable Growth Rate (SGR) and the Ivashkovskaya Sustainable Growth Index (SGI). The primary task is to solve the problems faced by China oil and gas companies regarding the introduction of non-financial reporting. **The methodological basis** of the study is a regression analysis of the influence of non-financial factors on sustainable growth indices. The authors analyze the impact of non-financial factors EROI, PRP, ES, ROE_{env}, ROL, ROE_{sr} on the China oil and gas companies' SGR and SGI. It is shown that non-financial indicators show a stronger correlation with SGR than SGI. The study's main conclusion is that there is a significant positive correlation between individual non-financial indicators and sustainable growth indices. The practical application of the obtained research results is seen in the development of non-financial reporting of oil and gas companies in China by including indicators EROI, PRP, ES, ROE_{env}, ROL, ROE_{sr} to assess the work of sustainable growth of the enterprise.

***Keywords*:** multi-capital approach; sustainable growth; China oil and gas companies; Higgins sustainable growth rate; Ivashkovskaya sustainable growth index

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INTRODUCTION

Economic issues have become global concerns regarding ecological imbalances, resource exhaustion, and pollution because they have a strong connection with social progress and the survival of humans [1]. An economy with low energy consumption, low pollution, and low emission levels, has become the necessary choice and direction for economic development. During the 1980s, researchers began a fundamental reappraisal of thinking on economic growth. However, nowadays contradictions of the sustainable financial growth traditional organization model as "alone" functional focused on the finance aspects only [2, 3]. Nowadays, economic development and sustainable growth are inseparable from green finance support. Green finance sees social responsibility and environmental protection as the core of action based on traditional finances and has become a new point of development, a new driving force for developing the economy [4].

China companies are quite an interesting example of how non-financial indicators are implemented in the companies' reporting. Thus, in August 2016, China's seven ministers and committees announced Guidelines for the Green Financial System, specifically recommending supporting a multi-capital approach to support green finance change. China chose a more progressive way for the country's sustainable development and Ecological civilization formation. For the first time, the 17th National Congress raised the construction of ecological civilization as a strategic task. At this meeting, comrade Hu Jintao described the main objective of ecological civilization, namely, "the formation of a larger circular economy, a significant increase in the proportion of renewable energy" [5]. Hu Jintao pointed out that one of China's current

environmental work priorities is "to improve the legal and policy system to promote ecological construction, to develop national ecological protection plan, vigorously carry out ecological civilization education in the whole society." At the end of the year issued the "State Council on the implementation of the scientific concept of development to strengthen environmental protection decision" also clearly requires environmental protection work should be in the scientific concept of development under the leadership of "relying on scientific and technological progress, the development of circular economy, promote ecological civilization, strengthen the environmental rule of Law, improve. So, environmental "vision" will be in all points of view [6]. Analyzing energy, environmental and social indicators for the reporting on China's companies has attracted much attention, especially after 2000 [7, 8].

This paper addresses the theory of sustainable growth. Unlike traditional financial treatments, in this research, sustainable growth is treated as a result of the interaction and interconnection among energy, environmental, economic, and social indicators. The primary purpose of the study is to evaluate non-financial indicators influencing Higgins sustainable growth rate (SGR) [2] and sustainable growth index SGI [3]. The authors give recommendations on which indices need to involve in non-financial reporting. The paper analyzes various factors in the non-financial reporting, analyzing the correlation between energy and environmental indicators with China's oil and gas companies' sustainable growth.

1. LITERATURE REVIEW

1.1. Multi-Capital Approach in Non-Financial Reporting Initiatives

Multi-capitalism is a doctrine that measures and manages the impacts organizations are having on multiple capitals and therefore their own triple bottom lines: their social, environmental, and economic performance. There are few researchers investigated Systems Thinking Using a Multi-Capital Model [9].

The financial system has been extraordinarily successful at moving the capital to where it can create more financial value. But it has not been successful at moving capital to create social or environmental value. The result is large swaths of society and the environment that continue to need capital even as our global economy grows year over year. The resulting tension between those that have and those that need capital is leading to new frameworks for how capital can be conceived, measured, and balanced [10]. These multi-capital approaches bear the potential to create more responsible and sustainable companies. However, too frequently, multi-capital approaches are presumed to lead to inclusive or equitable distribution [11].

David Alexander and Veronique Blum emphasized attention that German sociologist Niklas Luhmann (1927–1998) said that multi-capital approach development is the only way for sustainable reporting development. Niklas Luhmann with the highly topical issue of sustainability reporting. Luhmann sought a detailed description of the world asset of complex systems which applied to ecology. Consistent with Luhmann's approach was found a coherent way of understanding and analyzing the complex set of systems and sub-systems involved in the multi-capital, multi-measurement-unit, multi-stakeholder, and multi-motivated current content of the sustainability issue [12].

Brestovanska Eva and M. Medved derive a system of differential equations on time scales of the Solow type corresponding to a production function depending on several capitals. A sufficient condition for the exponential stability of the steady-state solution with positive coordinates is proved. The obtained results are applied to the case of the Cobb-Douglas type production function [13]. In the Mariia Evdokimova and Sergei A. Kuzubov working paper, it was revealed that companies publishing non-financial reports have a lower COC. COD, COE, and WACC reduce after NFR. Six industries, where the cost of equity and debt capital is lower for companies publishing NFR, were determined: consumer discretionary, energy, industrials, information technology, healthcare, and materials. According to the analysis, companies that issued non-financial reports have a lower COE capital growth rate. [14]. In response to pressure from civil society and investors, the corporate sector has developed multi-capital accounting to report on a company's impact on natural, social, and human capital [15, 16].

1.2. How Non-financial Factors Influence Sustainable Growth

Concerning social responsibility questions, Chami et al. [17] and Scholtens and Dam [18] showed that green finance and Equator Principles might obtain social recognition and reputation by providing

financial institutions successfully and improving financial results. However, the research on green finance evaluation lacks precise quantitative norms and statistical data. The scientific literature includes numerous articles in which the interrelation between Energy, Economy, and Environment is identified with the nomenclature "3E" [19, 20].

Nowadays society traditionally educates the generation of economic capital, mainly for the benefit of shareholders or other providers of financial capital. In the same way, oil and gas companies are concerned about financial capital globally [21]. However, we also recognize the enormity of the environmental footprint our economic growth has left over the last 250 years and the ever-growing disparity between that footprint's annual demands and the biosphere's capacity to support them. Many researchers therefore believe the world needs to attend to the quality and sufficiency of all its vital capitals, not just its economic capitals.

China's oil and gas companies' have implemented energy factors in the annual reporting, like Energy Return on Investment (EROI) [22, 23]. In the same way, some companies used energy efficiency indicators [8, 24]. While the current growth rate could not easily be met by renewable energy technologies (capacity expansion is slower on an absolute scale than conventional technologies), it is also apparent that renewable energy holds solutions to two of the three E's: environment and energy [25], [26–28]. It is reasonable to use the 3E methodology for building energy efficiency too [29].

Steblyanskaya with co-authors fulfilled research concerning influencing nonfinancial factors on the China oil and gas companies' sustainable growth. The result showed that EROI, ROEenv, and RER influence sustainable growth in a serious way [30–32].

2. METHODOLOGY

2.1. Data

This paper took into consideration the biggest Chinese oil and gas companies' financial data. The study focused on CNPC, Sinopec, and CNOOC data between the years 1996 and 2020. Internal companies' indicators were divided into energy, environment, and social data. A list of indicators used in the study is included in Appendix A. Full dataset is available under reasonable request. The python package SciPy and scikit-learn were used in the implementation of linear and polynomial regression models respectively. SciPy's statistics module was employed to perform linear regression models to obtain the Pearson correlation coefficient (coefficient of determination).

2.2. Sustainable Growth Indicators

In this study we used calculations of the Higgins sustainable growth rate (SGR) [2] and Ivashkovskaya sustainable growth index (SGI) [3, 33] for the evaluation of how non-financial indicators influence companies' sustainable growth.

Higgins R. proposed a model of sustainable growth — a tool for effective interaction between the operating policies, financing policies, and strategies for growth [2]. According to Higgins, "the enterprise's financial sustainable growth rate (SGR) refers to the biggest increasing sales by enterprises under conditions of financial resources are not exhausted". Factors such as industry structure, trends, and position relative to competitors can be analyzed to detect and use special features. A sustainable growth rate is usually expressed as follows:

$$SGR = f\left(P, R, A, T\right), \quad (1)$$

where SGR — is the index of sustainable growth, expressed in percent;

P — Profit after taxes;

R — The Rate of reinvestment;

A —Turnover of assets;

T — The Ratio of assets to Equity or Financial leverage.

Irina Ivashkovskaya and Elene Zhivotova presented the rationale for a new tool for financial analysis of the company's growth — the growth sustainability index. The proposed tool develops the concept of substantiating the company's market strategies based on the economic profit created in it. The method and results of empirical testing of the analysis of growth sustainability on a sample of 26 large Russian companies are shown.

Thus, to analyze and assess the sustainability of the company's growth, a comprehensive indicator is needed, in which key factors of economic profit are integrated. Ivashkovskaya and co-authors suggested using the following index [34]:

$$SGI = \left(1 + g_s\right) \times \frac{1}{k} \times \sum_{i=1}^{k} max\left[0, \left(ROCE_i - WACC_i\right)\right], \quad (2)$$

were $1 + g_s$ — average sales growth rate;

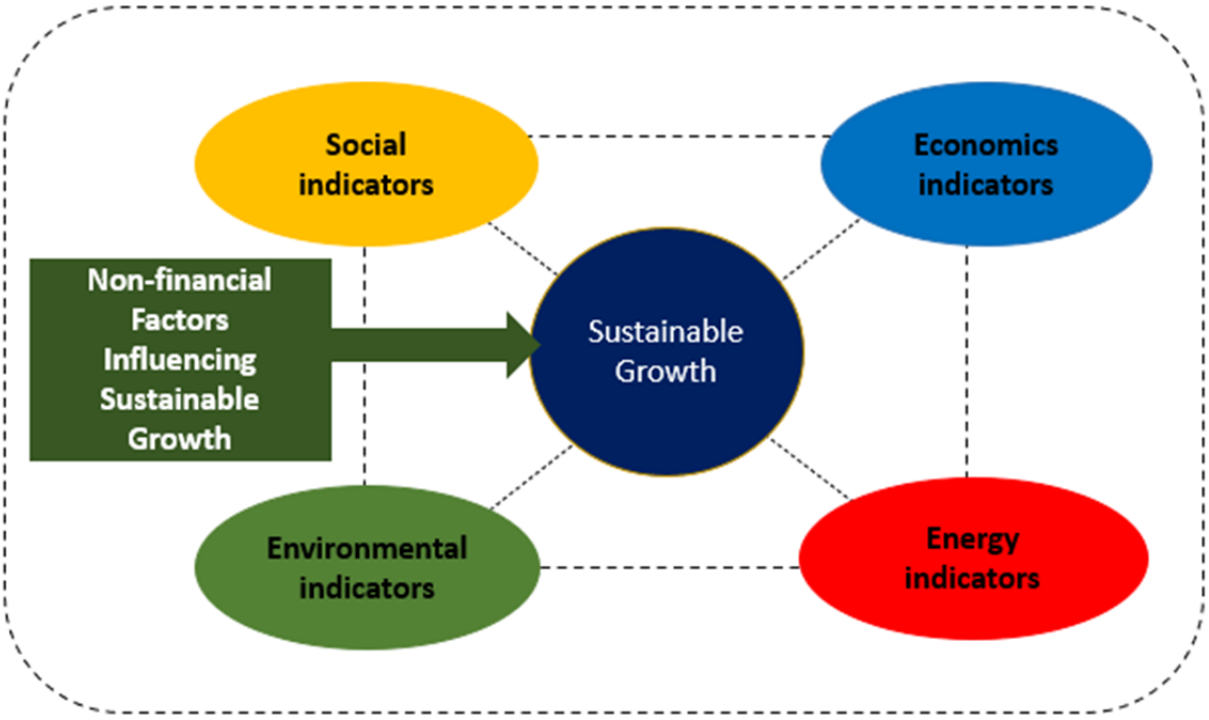

Fig. 1. **Non-financial indicators influence sustainable growth**
Source: authors' vision.

k — number of years of observations;

l — number of years during which the return-on-investment capital spread is positive;

$ROCE_i$ — return on capital employed per year;

$WACC_i$ — weighted average cost of capital per year.

The direct introduction of spread values into the sustainable growth index focuses on two different directions of creating a positive spread: increasing the return on capital and reducing the cost of capital.

2.3. Methodological Base

A multi-capital approach looks at all capitals (financial and natural, social, human, built, etc.) not with an eye toward maximizing them, but rather dynamically balancing them amongst each other, and importantly, maintaining the health of their cycles (through regeneration of flows from originating stocks) within the carrying capacities of these resources.

Figure 1 shows the research scheme, where the authors analyze the interrelations between sustainable growth indicators and energy, economy, and environmental indicators. For evaluating the correlation between indicators, we use regression analysis. There are many regression methods available such as linear, polynomial, and multivariate regression. These regression methods are employed to investigate relationships between a phenomenon of interest and its features or variables. In this work, we investigate the relationship between sustainable growth rates data (as provided by Higgins and Ivashkovskaya) and non-financial features such as environmental capital, human and social. To answer whether some features influence the growth rates and to what extent.

We seek to find a function that maps these features or variables to the sustainable growth rates sufficiently well to get an estimator for future sustainable growth rates. Our dependent variable, in this case, is sustainable growth rates denoted by SGR and SGI for Higgins and Ivashkovskaya respectively.

The independent variables are environmental capital features denoted by EROI, PRP, ES, ROEnv. Human capital features are denoted by ROL, RER. Human capital features are denoted by ROEsr. Both dependent and independent variables are continuous and normally distributed.

We investigate these relationships by first performing linear regression and 2nd to 8th order polynomial regression analysis on each instance of the independent and dependent variables. In implementing linear regression of the dependent variable $y = (SGI \; or \; SGR)$ on the set of independent variables

$x=(EROI, PRP, ES, ROEnv, RoL, RER, ROEsr)$, we assume the linear relationship between y and $x: y=\beta^0+\beta^1 x^1+\cdots+\beta_r x_r+\varepsilon$. Where $\beta_0, \beta_1, \ldots, \beta_r$ are the regression coefficients, and ε is the random error.

Linear regression calculates the predicted weights, denoted with $b_0, b_1, \ldots, b_r$, which defines the estimated regression function $f(x)=b_0+b_1x_1+\cdots+b_rx_r$. For polynomial, the regression function takes the form $f(x)=b_0+b_1x+b_2x^2+\ldots+b_rx_r^r$. It is expected that this function captures the dependencies between the independent and dependent variables significantly well. Thus, the method of least squares is employed to minimize the sum of squared residuals (SSR) for all events

$$i=EROI, PRP, ES, ROEnv, RoL, RER, ROEsr: SSR=$$
$$=\Sigma_i\left(y_{SGR}-f(x_i)\right)^2.$$

The Pearson correlation coefficient of determination, denoted by R^2, measures the linear relationship between two datasets. It indicates the amount of variation in y that can be explained by the dependence on **x** using the regression model. A Larger R^2 indicates a better fit and means that the model can better explain the variation of the independent with different and dependent variables. Hence, $-1<RI<1$, with 0 implying no correlation. Correlations of –1 or +1 imply an exact linear relationship. Positive correlations imply that as x increases, so does y. Negative correlations imply that as x increases, y decreases and vice-versa.

3. RESULTS AND DISCUSSION

In the paper, we analyzed the SGI and SGR with the purpose of understanding which non-financial indicator will influence the sustainable growth rate more.

Figure 2 shows the coefficient of determination of SGI with the features expressed from the linear to 8th order regression explored. It is seen that, except for RER which has a negative correlation, all the features namely EROI, PRP, ES, ROEnv, ROL, and ROEsr have a positive correlation coefficient of determination and thus suggest some level of influence on the SGI. The magnitude of such influence is determined by the value of R^2. Therefore, the exact values of R^2 is seen in table 1 below. Therefore, there is enough evidence to support the claim that the non-financial features EROI, PRP, ES, ROEnv, ROL, and ROEsr have a significant positive relationship with SGI.

Again, it can be observed that the order of polynomial regression has a significant determination on the magnitude of such a relationship. Increasing the order of polynomial regression increases the fit between the features and SGI. The effect of the polynomial increase is however maxed out on the 4th order polynomial regression for EROI, PRP, ES, and ROEsr. Whilst ROEnv and RoL have the highest correlation on the 8th order polynomial regression.

It can also be deduced that the 4th order polynomial regression:

SGI verse EROI:

$$y=0.1633594+1.0576463x-24.0784120x^2+$$
$$+137.0858166x^3-248.0717506x^4,\ R^2=0.0676965$$

SGI verse PRP:

$$y=0.1918784-6.1934256x+139.0819089x^2-$$
$$-1068.048928x^3+2638.9344516x^4,\ R^2=0.1136183$$

SGI verse ES:

$$y=0.9178820-0.0011764x+0.0000006x^2-$$
$$-1.29\text{E}-10x^3+9.64\text{E}-15\,x^4,\ R^2=0.1461317$$

SGI verse ROEsr:

$$y=1.0839354-67.8717151x+1673.8930564x^2-$$
$$-17139.45041x^3+62006.47505x^4,\ R^2=0.1011466$$

SGI verse ROEnv:

$$y=1.9050217-344.7190396x+24277.7789104x^2-$$
$$-824660.5207x^3+15246982.85x^4-160407538.8x^5+$$
$$+948660837.4x^6-2902121369x^7+3547344946x^8,$$
$$R^2=0.3432300$$

SGI verse RoL:

$$y=-13.9212974+726.7650830x-15059.8085693x^2+$$
$$+161692.2653x^3-977313.7548x^4+3405013.097x^5-$$
$$-6752103.714x^6+7067345.133x^7-3029118.311x^8,$$
$$R^2=0.6775944$$

Figure 3 shows detailed correlation SGI with EROI, ES, PRP and ROE_{sr}.

Figure 4 shows a detailed correlation of SGI with ROE_{env}. and Ro L.

Please, see the detailed calculations in *Tables 1–3*.

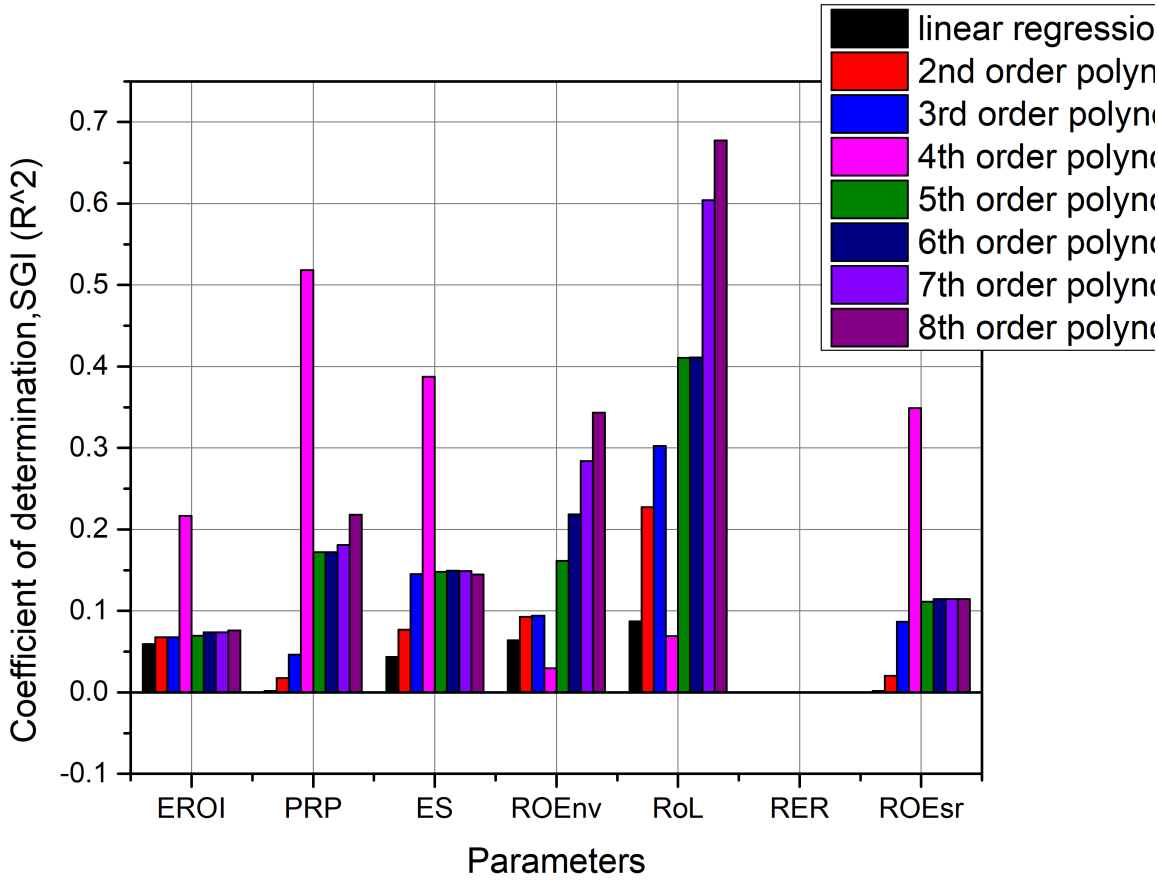

Fig. 2. **Coefficient of determination of features with SGI for linear to 8th order polynomial regression**
Source: authors' calculations.

Single EROI, PRP, ES, and ROEsr show a significant positive correlation to SGI at the 4th polynomial regression, they are all combined to form a linear multivariate polynomial regression to obtain a final function that maps the relationship significantly.

In the case of SGR, as shown in *Figure 5,* there is also a positive correlation of SGR with all features except for PRP which has a slightly negative to zero correlation. With PRP showing the strongest correlation, followed by ES, ROEsr, EROI, ROL, and then ROEnv in order of decreasing correlation. The correlations in SGR show a continuous increase with increasing order of polynomial regression as opposed to SGI which showed no widespread increase in correlation after the 4th order polynomial, except in the case of ROEnv and Ro L.

The feature RER has zero correction because the data points are constant. Consequently, there are no variations in the data points. Hence do not influence both SGI and SGR.

SGR verse EROI:

$$y = -377.6863593 + 22662.48585x - 588267.0465x^2 + \\ + 8626723.633x^3 - 78152213.19x^4 + 447762514.8x^5 - \\ - 1583956781x^6 + 3162220431x^7 + -2727168475x^8, \\ R^2 = 0.2608748452$$

SGR verse ES:

$$y = 0.0252724484 - 5.25E - 30x + 6.14E - 21x^2 - \\ - 1.95E - 23x^3 - 2.28E - 20x^4 - 1.58E - 17x^5 + \\ + 1.63E - 20x^6 - 5.47E - 241x^7 + 5.98E - 28x^8, \\ R^2 = 0.3468527717$$

SGR verse PRP:

$$y = 0.06385453633 - 9.952344456x + 675.6822926x^2 - \\ - 22262.70369x^3 + 405507.9399x^4 - 4276838.995x^5 + \\ + 25896465.68x^6 - 83207537.77x^7 + 109583896.1x^8, \\ R^2 = 0.5950886545$$

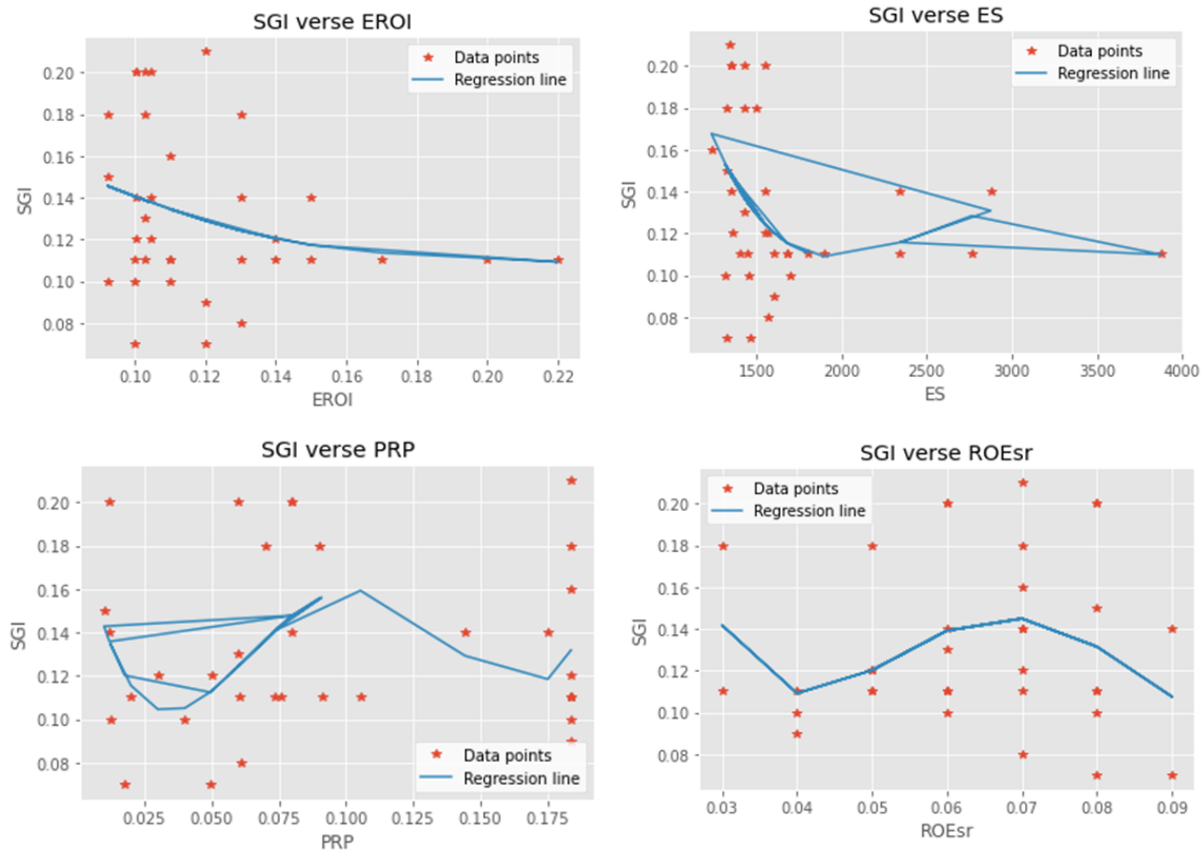

Fig. 3. **Plot of 4th order polynomial regression of SGR_iv with individual features: EROI, ES, PRP, roesr**

Source: authors' calculations.

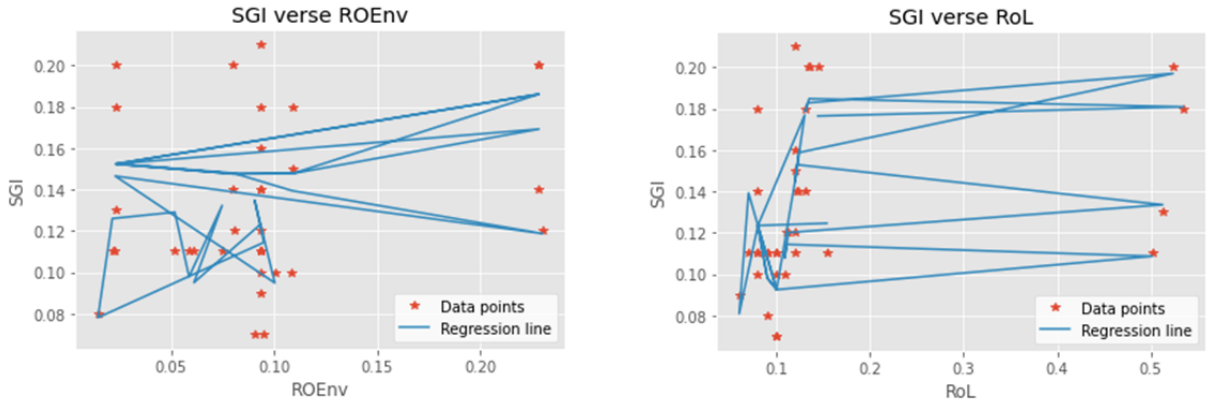

Fig. 4. **Plot of 8th order polynomial regression of SGI with social and environmental coefficients**

Source: authors' calculations.

SGR verse ROEsr:

$$y = 1.41616219 - 161.0682442x + 7446.784405x^2 - \\ - 179117.6437x^3 + 2366291.403x^4 - 16126684.43x^5 + \\ + 42141609.86x^6 + 18913043.85x^7 + 4700468.791x^8, \\ R^2 = 0.3607652186$$

SGR verse ROEnv:

$$y = 0.1789796526 - 28.65621749x + 1856.517925x^2 - \\ - 59036.57124x^3 + 1036874.695x^4 - 10485694.29x^5 + \\ + 60180501.33x^6 - 180066081.5x^7 + 216563186x^8, \\ R^2 = 0.03641632218$$

Table 1

4th order polynomial regression coefficients and R^2

	4th order	intercept	Coefficients			
	R^2	b_0	b_1	b_2	b_3	b_4
EROI	0.0676965	0.1633594	1.0576463	−24.0784120	137.0858166	−248.0717506
PRP	0.1136183	0.1918784	−6.1934256	139.0819089	−1068.048928	2638.934451
ES	0.1461317	0.9178820	−0.0011764	0.0000006	−1.29E-10	9.64E-15
ROEnv	0.1581626	0.0129479	9.1785511	−201.3707226	1597.916548	−3846.148708
RoL	0.3722127	0.2444385	−4.4463105	43.6525574	−130.6186373	120.1394892
ROEsr	0.1011466	1.0839354	−67.8717151	1673.8930564	−17139.45041	62006.47505

Source: authors' calculations.

Table 2

8th order polynomial regression coefficients and R^2

	8th order	intercept	Coefficients							
	R^2	b_0	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8
ROEnv	0.343229991	1.905021	−344.719039	24277.7789	−824660.52	15246982.8	−160407538.	948660837.	−290212136	3547344946
RoL	0.67759444	−13.921297	726.765083	−15059.8085	161692.26	−977313.754	3405013.09	−6752103.71	7067345.13	−3029118.311

Source: authors' calculations.

Table 3

Table of the correlation coefficients of SGI with all parameters from the linear regression to the 8th order regression

Parameters	R^2 (SGI)							
	linear	2nd order	3rd order	4th order	5th order	6th order	7th order	8th order
EROI	0.0594	0.0675	0.0676	0.0677	0.0695	0.0737	0.0737	0.0758
PRP	0.0019	0.0177	0.0462	0.1136	0.1719	0.1719	0.1807	0.2181
ES	0.0435	0.0769	0.1453	0.1461	0.1480	0.1493	0.1487	0.1447
ROEnv	0.0639	0.0929	0.0940	0.1582	0.1616	0.2186	0.2837	0.3432
RoL	0.0869	0.2271	0.3023	0.3722	0.4106	0.4111	0.6044	0.6776
RER	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ROEsr	0.0017	0.0201	0.0866	0.1011	0.1114	0.1145	0.1145	0.1145

Source: authors' calculations.

SGR verse RoL:

$$y = -1.658893372 + 84.42928597x - 1703.836978x^2 + \\ + 17705.35134x^3 - 102294.378x^4 + 334990.4207x^5 + \\ + -616652.984x^6 + 594718.7362x^7 - 233943.3675x^8,$$

$$R^2 = 0.2258364275$$

Figure 6 shows a detailed correlation SGR with ROE_{env}., PRP, EROI, ES, ROE_{sr}., Ro L.

Please, see the detailed calculations in *Table 4*.

Figure 7 shows SGI is more correlated with environmental, energy, and social coefficients used in our study.

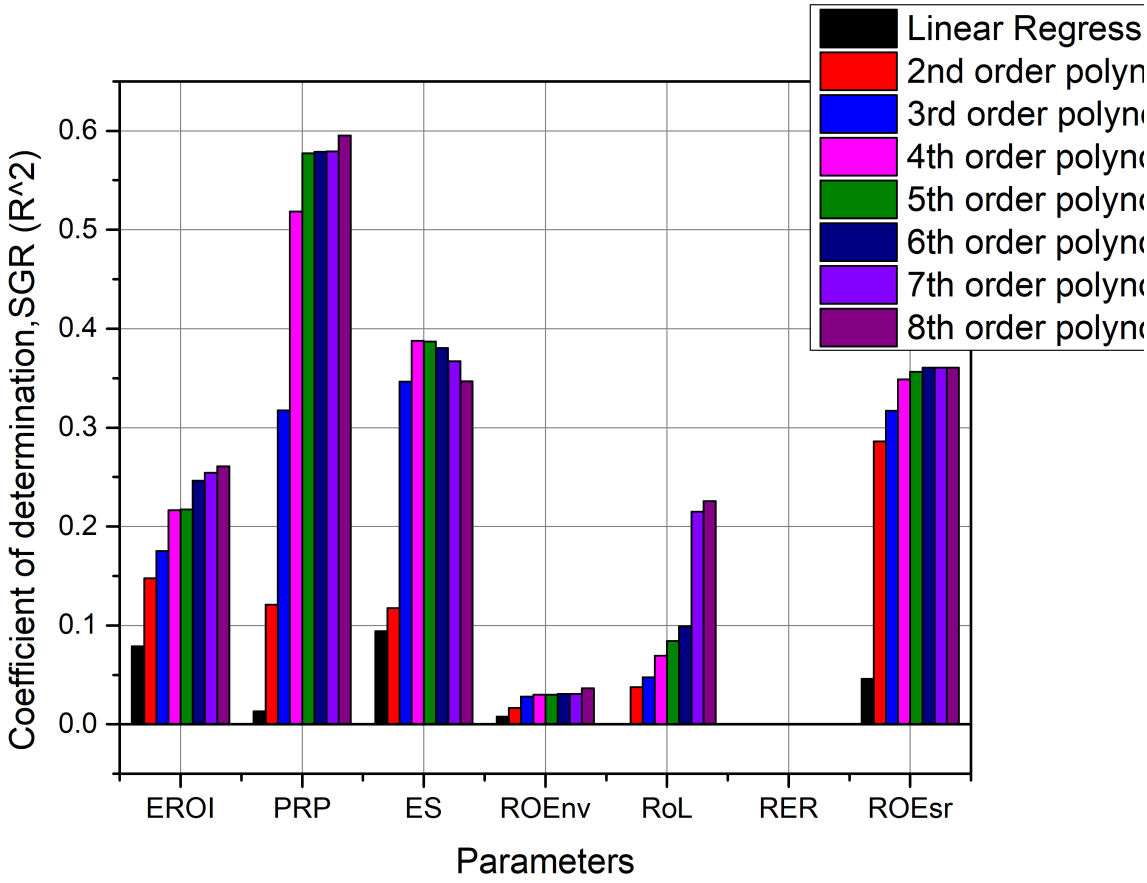

Fig. 5. **Coefficient of determination of features with SGR from linear to 8th order polynomial regression**
Source: authors' calculations.

Multivariate linear regression with all the positively correlated features gives the function:

$$SGI\left(EROI, PRP, ES, ROE_{env}, ROL, ROE_{sr}\right) =$$
$$= 0.06595061016801151 + 0.12670756390143945 *$$
$$*EROI + 0.12628401541077403 * PRP +$$
$$+ -4.416662630818413e-06 * ES + 0.3143022053244236 *$$
$$*ROEnv + 0.15729076179055257 * RoL +$$
$$+ 4.416663587664127e-06 * ROEsr$$

$$SGR\left(EROI, PRP, ES, ROE_{env}, ROL, ROE_{sr}\right) =$$
$$= -0.006416830576369234 + 0.07445738465165233 *$$
$$*EROI + 0.01425364038750357 * PRP +$$
$$+1.244561168310676e-06 * ES + 0.04280166790648274 *$$
$$*ROEnv + 0.01673734154952822 * RoL +$$
$$+1.2445606376587648e-06 * ROEsr$$

Thus, we could observe that both sustainable growth rates correlated with non-financial indicators. However, SGI is more correlated with the energy and environmental issues.

CONCLUSION

Companies' economic growth leads to energy resource utilization and environmental degradation when pursuing rapid development [35]. Nowadays, the primary task for companies is to find such indicators for operating that could support environmentally-oriented sustainable growth. Thus, the inevitable way to protect Nature is to implement nonfinancial reporting at all company levels.

The research results are fruitful and lightful. There exists a significant relationship between the non-financial features and sustainable growth rates. Specifically, there is a significant positive correlation between individual non-financial features and sustainable growth rates. The non-financial elements show a stronger correlation with SGI than that of SGR. The authors especially

Table 4

Table of the correlation coefficients of SGR with all parameters from the linear regression to the 8th order regression

Parameters	R^2 (SGR)							
	linear	2nd order	3rd order	4th order	5th order	6th order	7th order	8th order
EROI	0.0790	0.14761	0.17509	0.21667	0.21733	0.24626	0.25432	0.26087
PRP	0.0131	0.12089	0.31743	0.51851	0.57732	0.57877	0.57912	0.59509
ES	0.0940	0.11734	0.34637	0.38753	0.38691	0.38040	0.36708	0.34685
ROEnv	0.0078	0.01658	0.02801	0.02979	0.02986	0.03085	0.03087	0.03642
RoL	0.0004	0.03773	0.04746	0.06916	0.08413	0.09905	0.21492	0.22584
RER	0.0000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ROEsr	0.0461	0.28623	0.31682	0.34880	0.35637	0.36077	0.36077	0.36077

Source: authors' calculations.

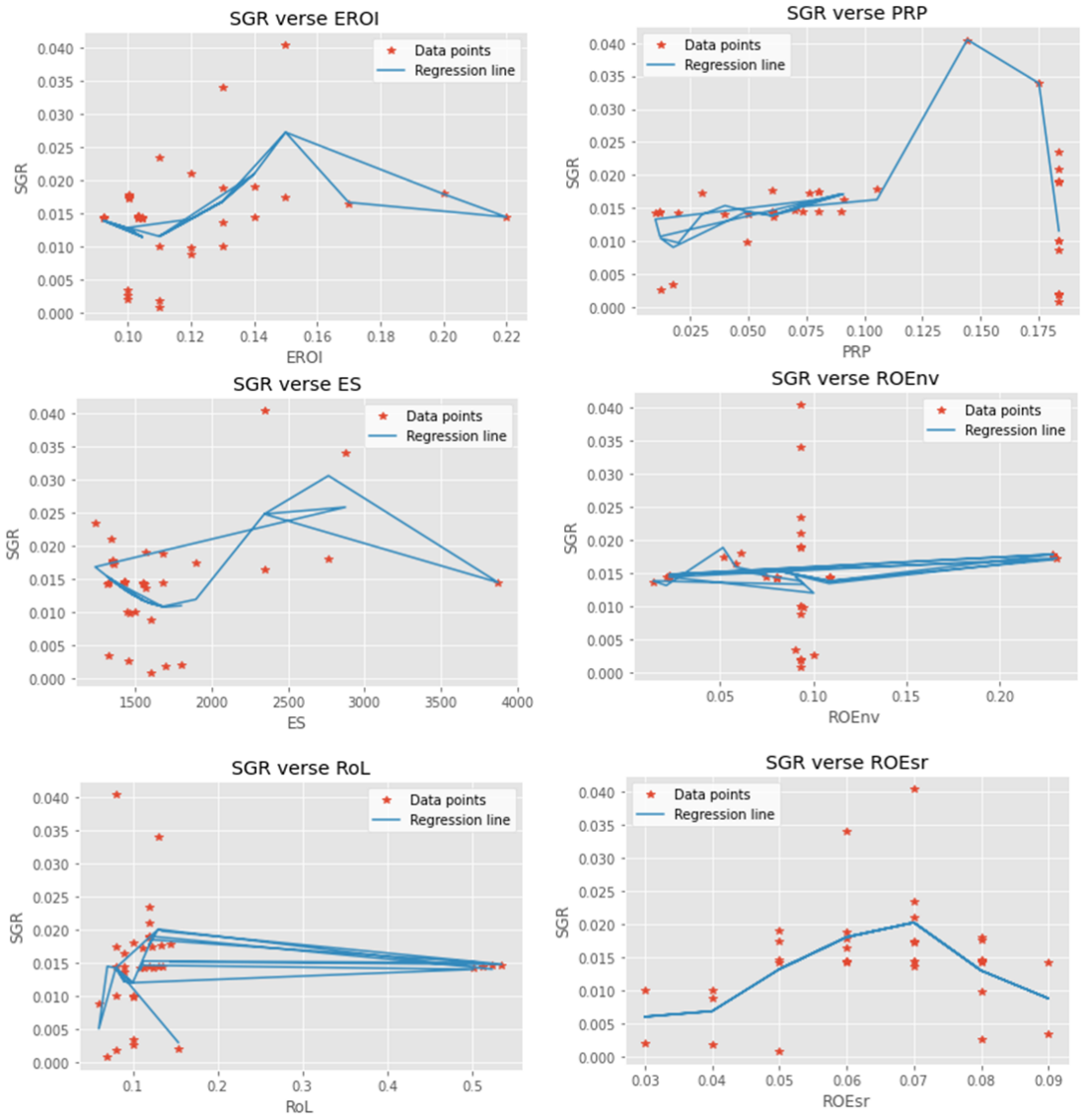

Fig. 6. **Plot of 8th order polynomial regression of SGR with features EROI, ES, PRP, ROEsr, ROEnv, and RoL**

Source: authors' calculations.

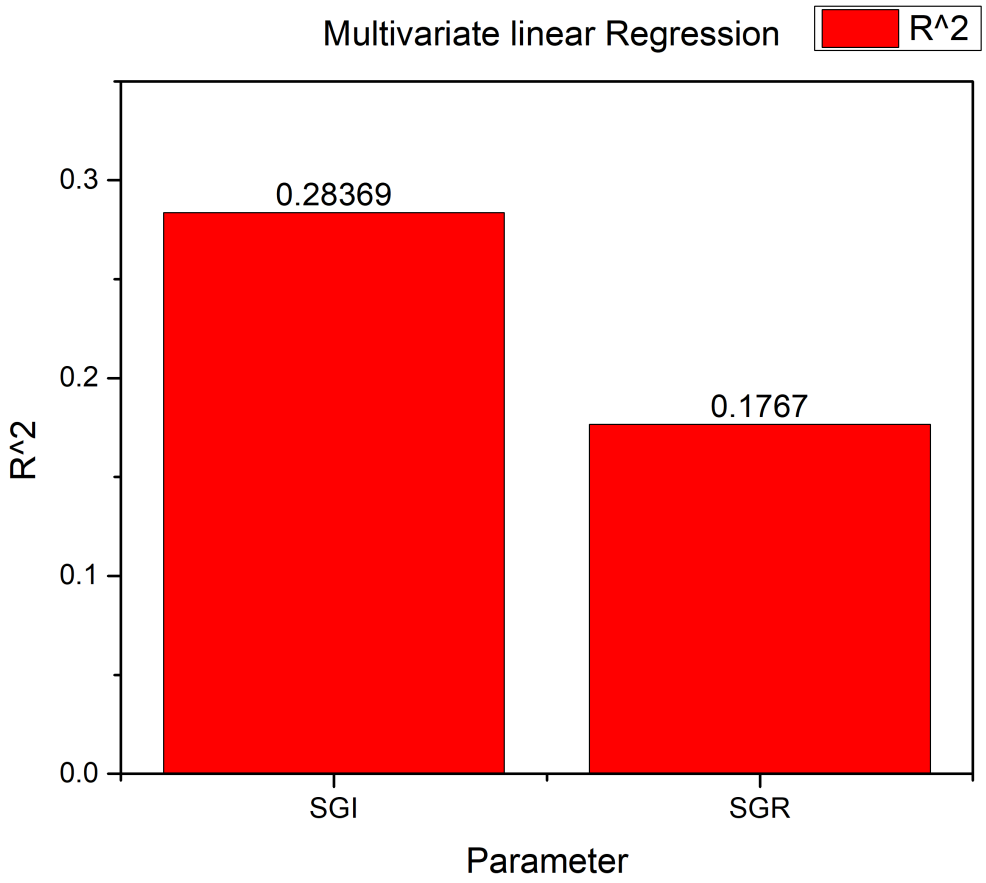

Fig. 7. **Correlation coefficient of multivariate linear regression of both indices' types and features, with exception of RER**

Source: authors' calculations.

emphasize that SGI has strong correlations with energy indicators, like EROI and ES, social indicators, like RoL, and environmental indicators, like ROEnv. Thus, the research proved the China University of Petroleum (Beijing) Feng Lian Yong research group's results, where were found that EROI is the base for healthy and green economic growth (see, for example, [9]).

The research uniqueness is that the authors emphasized attention on the multi-capital approach with an accent on energy indicators. Thus, here is an exciting example of how non-financial indicators could move economics forward sustainability. It is recommended to companies' management to consider EROI, ES, ROEnv, ROEsr, and RoL for non-financial reporting.

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APPENDIX

Table

Full list of indicators used in this study

Factors	Indices	Proxy	Source (accessed on: 14.10.2021)
	Sustainable Growth Rate	SGR, SGI	CNPC https://www.cnpc.com.cn/en/ar2019/AnnualReport_list.shtml, Sinopec www.sinopec.com/.../reports/annual_report, CNOOC https://www.annualreports.com/Company/cnooc-limited
Energy indicators	Energy Return on Investments	EROI	CNPC https://www.cnpc.com.cn/en/ar2019/AnnualReport_list.shtml, Sinopec www.sinopec.com/.../reports/annual_report, CNOOC https://www.annualreports.com/Company/cnooc-limited
	Energy Savings	ES	
Environmental indicators	Return on environmental costs (costs concerning environmental protection)	ROEnv	CNPC https://www.cnpc.com.cn/en/ar2019/AnnualReport_list.shtml, Sinopec www.sinopec.com/.../reports/annual_report, CNOOC https://www.annualreports.com/Company/cnooc-limited
	Production/Reserves ratio	PRP	
Social indicators	Revenue per employee ratio (total revenue/total number of Employees)	RER	CNPC https://www.cnpc.com.cn/en/ar2019/AnnualReport_list.shtml, Sinopec www.sinopec.com/.../reports/annual_report, CNOOC https://www.annualreports.com/Company/cnooc-limited
	Return on social expenses (costs concerning employee benefits/net profit)	ROEsr	
	Return on Laboure (number of employees/Net profit)	ROL	

Source: authors' calculations.

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ORIGINAL PAPER

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Main Drivers of Economic Growth in Armenia: Analysis and Evaluation

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ABSTRACT

Macroeconomic policy in Armenia over the past 30 years has led to a slowdown in economic growth. This, in turn, entails the need to revise approaches to macroeconomic regulation, as well as to search for key drivers of economic growth, which the state should emphasize in the future macroeconomic policy. **The aim** of this research is to analyze and assess the main drivers of economic growth in Armenia. We have employed **the methods** of statistical and comparative analysis, deductive analysis, as well as the analysis of historical data and the current state of the problem. The paper examines the key drivers of economic growth in Armenia, as well as periods of both a stable macroeconomic environment and economic crises, from the point of view of the efficiency and optimality of macroeconomic regulation. The current study identifies the most important sectors of the economy, analyses macroeconomic policy regulation in Armenia, and assesses the impact of such policies on economic growth in the country. **The results** show that today's macroeconomic regulation can be considered ineffective, which certainly has a negative effect on the rate of economic growth. **The key conclusion** of the research is the thesis that it is urgent to develop new socio-economic policy approaches to ensure sustainable economic growth in the future and to emerge quickly from future economic growth crises without restricting or halting economic activity.

Keywords: economic growth; drivers of economic growth; developing economy; economic crises

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1. INTRODUCTION

Over the past two to three centuries, world history has seen many economic crises that affected both individual countries and were reflected in the global economic development dynamics. The fundamental basis for describing the nature and essence of economic crisis can be considered the work of J. Schumpeter [1], which puts forward the idea of economic fluctuations in the short, medium, and long term.

Currently, it is evident that the world economy as a whole, and therefore each economy individually, is facing the challenges of changes in the world order. The latter makes it urgent to review the approaches to macroeconomic regulation both in a crisis and stable macroeconomic environment. One of the most relevant papers devoted to this issue is the work of Alan Greenspan [2]. The author highlights that the origins of the "Great Depression" lie in the deep systemic problems of the world economy, the change in the world order caused by the rejection of the system of fixed rates, linked to the "gold standard", as well as the First World War. Greenspan points out the world's leading economies' inability to adapt to changes in the global economic system and adapt their own economies and mechanisms of its regulation to the emerging new world economic order. In this sense, we can draw parallels between the global financial crisis, and the current crisis caused by the COVID-19 pandemic. Many researches are devoted to finding new approaches during and after the pandemic[1] [3, 4]. Leading economies are currently experiencing severe structural and economic crises [5], particularly the US[2] [6] and EU [7–10]. The latter affects the economic development of other countries.

The most significant number of scientific works devoted to effective economic growth can be found

[1] United Nations. Shared responsibility, global solidarity: Responding to the socio-economic impacts of COVID-19. United Nations. March 2020. URL: https://unsdg.un.org/sites/default/files/2020–03/SG-Report-Socio-Economic-Impact-of-Covid19.pdf. (accessed on 26.09.2021).

[2] Feldstein M. The U.S. Underestimates Growth, The Wall Street Journal, 18 May, 2015. URL: https://www.wsj.com/articles/the-u-s-underestimates-growth-1431989720 (accessed on 01.10.2021).

in the years after the Second World War. The main challenge for analysts was finding answers to questions about why some countries are rich, and others are poor, why some countries are growing faster than others, and the key drivers of economic growth [11]. Economists have found many answers to these questions, including institutional development, state policy, and regulation, and the efficiency of macroeconomic regulation. However, today, the world economy is clearly in need of new solutions.

Developing economies, including Armenia, need a profound revision of approaches to macroeconomic regulation. Analysis of the macroeconomic situation over the past 30 years shows that state policy has not used the drivers of economic growth effectively and primarily contributed to or aggravated the economic crises throughout the period under consideration [12]. At the same time, in the crisis periods in Armenia, the authorities mostly applied an inconsistent approach to anti-crisis policy. A striking example of this is the macroeconomic policy of Armenia in the context of the COVID 19 pandemic [13].

Modern anti-crisis measures are mainly aimed at expanding the money supply in the country by increasing the share of government spending in the economy. For example, the additional expenses of the budgets worldwide for emergency stimulation of the economy reached approximately 12% of world GDP in 2020.[3] Following the example of many countries, Armenia has also increased spending during the crisis, especially over the past year and a half, leading to an increase in public debt. However, if developed economies, having a sufficient reserve of capital and convertible currencies, can neutralize the negative consequences of an increase in public debt, then in the case of Armenia, as a developing economy, the growth of public borrowing can lead to default.

On the other hand, Armenia has been mostly pursuing a policy of maintaining macroeconomic stability, combined with a pro-cyclical economic policy [14], in particular, fiscal policy. At the same time, many studies [15] find the negative impact of pro-cyclical fiscal policy in terms of the higher vulnerability of the state budget during a crisis. In addition, it can be argued that pro-cyclical fiscal policy is accompanied by significant risks to economic growth in the long term. According to Blanchard and Summers [16], one of the factors contributing to the positive impact of fiscal policy on macroeconomic stability is low-interest rates. Thus, coordination of fiscal and monetary policies is required. However, our research proves that there is currently no such coordination in macroeconomic regulation in Armenia [17, 18].

It is known that often, in conditions of economic growth, the state increases budget expenditures in favour of the poor population, which in theory is defined as "populism". Many studies point to the growth of populist movements in countries with large immigration populations, which, as a rule, are characterized by low incomes. In Armenia, elements of populist politics can be observed quite often, which undoubtedly had a negative impact on ensuring sustainable economic growth rates during the last two decades. In this regard, within the framework of this study, we present a detailed analysis and assessment of macroeconomic regulation over the past 30 years to identify the key drivers of economic growth in Armenia.

2. THE MAIN SECTORS AND FACTORS OF ECONOMIC GROWTH AND CRISES IN ARMENIA

We can distinguish the following periods in the history of the Armenian economy: 1990–1993 are the crisis years, 1994–1997 is the first stage of economic growth recovery, 1998–2003 is the second stage of recovery growth, 2004–2009 is the period of high economic growth after the recovery, including the crisis of 2009, 2010–2014 is the recovery period after the crisis of 2009, 2015–2017 and 2018–2019 are the periods of economic growth after the recovery, which differ from each other by the main factors of economic dynamics. 2020 was the global crisis conditioned by Covid-19. However, despite these differences, common factors were relevant throughout the whole period, which constitute the main economic features of the country.

For clarification, (1) the economic growth will be considered as the period during which there is a growth in real value-added, (2) the duration of the economic crisis will be considered as the period (measured in months or years) during which there is a reduction in the volume of output, (3) the post-crisis

[3] World Economic Outlook "A Long and Difficult Ascent", IMF, October 2020, P. 1. URL: https://www.imf.org/en/Publications/WEO/Issues/2020/09/30/world-economic-outlook-october-2020 (accessed on 01.10.2021).

Table 1

Volumes of external financing in Armenia, 1990–2020, at current prices, million USD

	1990–1993	1994–1997	1998–2003	2004–2008	2009	2010–2014	2015–2017	2018–2019	2020	1990–2020
External financing	–1092	–1838	–3219	–7497	–2366	–11206	–3430	–3531	–1180	–35359
GDP	6799	6020	12953	35730	8648	52753	32627	26070	12645	194245
% to GDP	–16.1	–30.5	–24.8	–21.0	–27.4	–21.2	–10.5	–15.9	–9.3	–18.2

Source: Balance of payment of Armenia, World Development Indicators, World Bank. URL: https://databank.worldbank.org/source/world-development-indicators (accessed on 15.09.2021).

recovery period will be considered the period during which the pre-crisis volume of output will be restored.

2.1. The main features of the Armenian economy

The first feature is the external financing of the economy, which has been the main factor determining the resumption and continuation of economic growth. The Armenian economy remains highly dependent on external financing, although it has decreased during recent years, with the lowest level recorded in 2020 (*Table 1*).

Another feature of Armenia is the presence of a large Diaspora and permanent emigration, which determines the enormous role of private remittances as one of the main factors in ensuring external financing and economic growth (*Fig. 1*). Moreover, the leading donor countries regarding the inflow of remittances are Russia (45–60% of the total inflow) and the US (about 15% of the total inflow).[4] There are two crucial factors in the case of Russia: the growing number of Diaspora and the seasonal labour migration. Finally, the second Artsakh war conditioned the unprecedented growth of remittances in 2020.

The next feature is the system of financial intermediation. Despite the existence of necessary institutional infrastructure (stock exchange, regulatory legislation, and the regulator — Central Bank), during the last 30 years, the system of the market capitalization of companies — capital market, was not correctly formed. However, after the banking system, the stock market is the second-largest source of financing for the economy in the modern world. The primary indicator of the stock market is the market capitalization of companies. In 2018, the latter amounted to 34.8% of GDP in Russia, 147.7% in the United States, 45.5% in China, 44.1% in Germany, 47% in upper-middle income countries, and 118% in high-income countries.[5] While in Armenia, the market capitalization to GDP ratio is close to 0.

In the case of expansionary monetary policy, which has prevailed in developed countries since 2009, the stock market, absorbing excess monetary resources, contributes to the formation of anti-inflationary trends, which curb the inflation, at the same time becoming increasingly speculative, increasing the probability and intensity of economic crises.

There is no "shadow" system of financial intermediation in Armenia — investment banks, hedge funds, mutual funds, etc. Thus, the financial intermediation system in Armenia currently consists of four subsystems: banking institutions, credit organizations, insurance companies, and institutional investors, where banks have a dominant role: as of 2019, banks have provided 95.3% of domestic credit.

Fig. 2 shows the development of the financial intermediation system and consequently its role in the economy and economic growth in 1994–2020. We can divide this period into two parts: 1994–2003, the period of development, when the system development rates were significantly lower from both the economic growth and development of the international financial system; 2004–2020, when the system was developing faster than the economy and the global economic system, hence gradually becoming the primary source of financing in the economy.

[4] Central Bank of Armenia. URL: www.cba.am (accessed on 05.10.2021).

[5] World Bank Database. URL: https://data.worldbank.org/ (accessed on 05.10.2021).

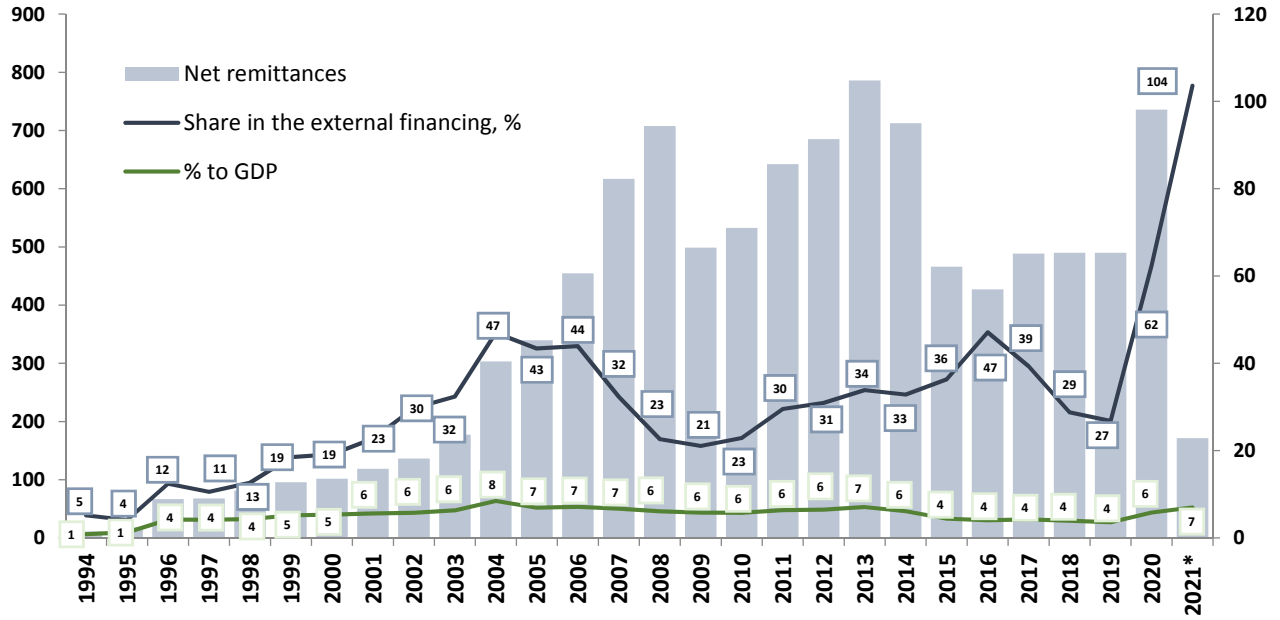

Fig. 1. **Remittances in Armenia in 1994–2021, million USD, at current prices**

Source: Balance of payment of Armenia, World Development Indicators, World Bank. URL: https://databank.worldbank.org/source/world-development-indicators (accessed on 15.09.2021).

Note: * 2021 first quarter.

Thus, in 2003, the share of the financial intermediation system in GDP was 1.4%, lending to the private sector — 5.6% of GDP. In 2019, the percentage of the financial intermediation system in GDP was 6%, private sector lending — 57.1% of GDP.

In 2004, the volume of sectoral lending to the economy began to grow (*Fig. 3*). Until 2004, the system dealt exclusively with supply financing. Since 2004 the financial system started using consumer loans to finance the demand, and since 2005 it has also been using mortgage loans. The nominal volume of consumer loans increased by 23.6 times in 2004–2020 accounting for 20.1% of final household consumption, mortgage loans — by 43.3 times, and 111.5% of value-added in the construction sector.

The level of dollarization of the financial intermediation system and consequently the dollarization in the economy depends on the depth of internal value chains and the stability of the exchange rate. Thus, the degree of dollarization of the financial system is lower when the economic development mainly happens at the expense of non-tradable goods and services.[6] It is higher when the economic development of the economy takes place primarily at the expense of tradable goods and services.

The next feature of the financial intermediation system is "expensive" loans. The interest rates of loans in Armenia are higher than in Georgia since 2009, significantly higher than in Russia, the United States, and China (*Fig. 4*). Although lending rates in Armenia have decreased by about 20 percentage points during the last 20 years, the opportunities for economic development through the financial system are more limited, and the debt obligations are higher than in the benchmarking and many other countries.

Relatively "expensive" loans are mainly explained by the anti-inflationary monetary policy pursued by the Central Bank of Armenia, which was based on maintaining macroeconomic stability and didn't change except for the crisis years of 2009 and 2020. The fiscal policy in 2009 and 2020 was countercyclical, with increased spending amid tax cuts. The differences in these policies since 2009 have led to an increasing expansion of crediting in Armenia through the state encouragement of accelerated financial intermediation, mainly through subsidized interest rates on mortgages and agricultural loans, which can significantly increase lending without lower interest rates.

[6] Non-tradables — construction and services consumed within the country, tradables — products of industry, agriculture, and services that can be exported.

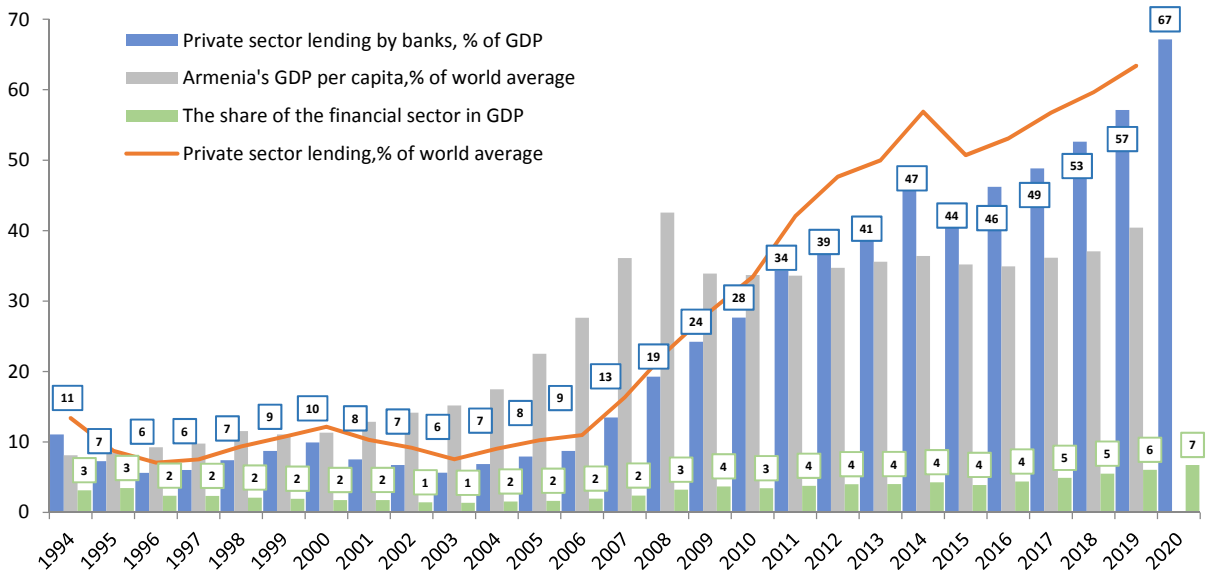

Fig. 2. **Armenia's financial system 1994–2020, main indicators**

Source: National accounts of Armenia, World Development Indicators, World Bank. URL: https://databank.worldbank.org/source/world-development-indicators (accessed on 28.09.2021)

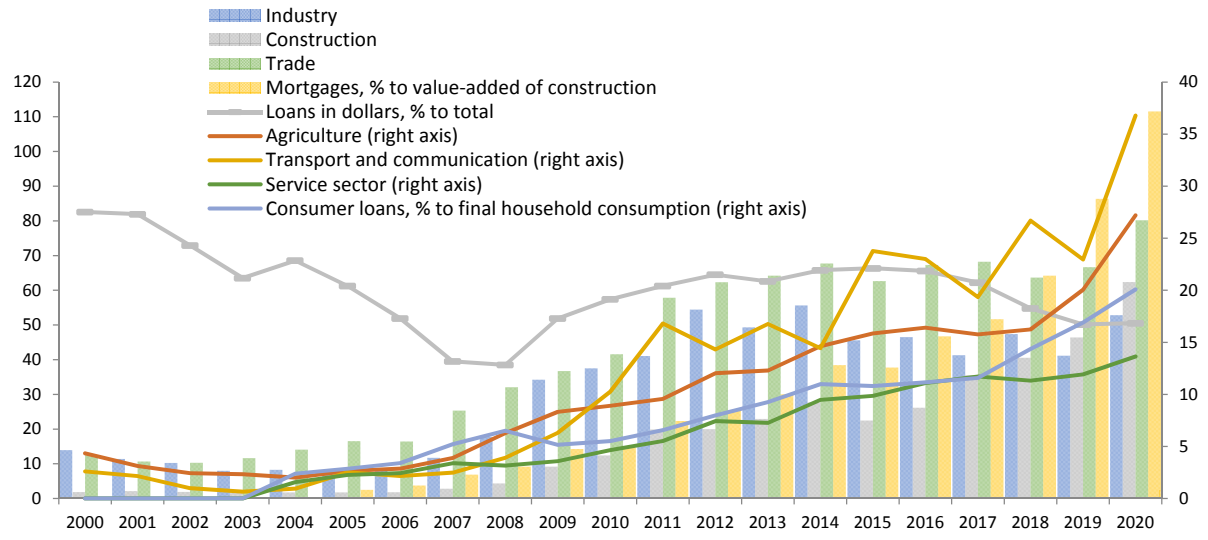

Fig. 3. **Loan structure of the Armenian economy, 2000–2020, current prices**

Source: National Accounts of RA, Database of the Central Bank of Armenia. URL: www.cba.am (accessed on 01.10.2021).

Such developments in the financial intermediation system, mainly the intensive subsidizing of the real estate market in the last few years, pose the risk of a "bubble" in that market and a further crisis. In 2018–2020, the average market prices of real estate in Yerevan increased by 32.2%, and in 2020 by 7.5%. According to some research [19, 20], the rise in the prices of assets acquired at the expense of credit indicates the formation of "bubbles" and a possible further crisis in the sector.

The situation in the field of consumer loans is also distressing. The debt burden of households to the financial system was 929 billion AMD (without interests) or 462.7 thousand AMD per citizen of working age in 2020, and in case of interests included — 555.3 thousand AMD or 2.92 monthly average salary. Including mortgage loans, in 2020, the debt burden amounts to 1410.2 billion drams or 30.5 percent of final household consumption, 22.8 percent of GDP, and in case of interests included — 35.5 percent, or 26.6 percent of GDP. What is worrying here is not the debt volumes but the growth rates and the high service cost.

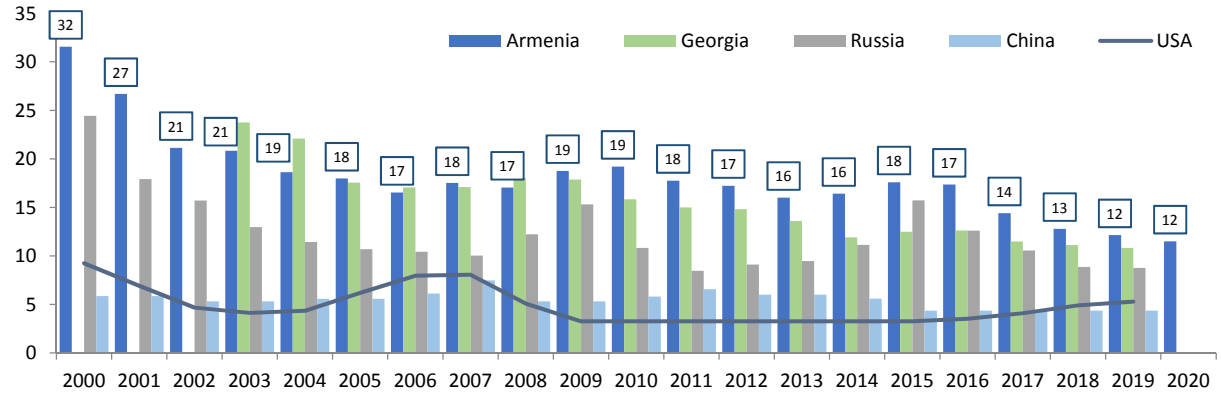

Fig. 4. **Nominal interest rates on loans, 2000–2020**

Source: World Development Indicators, World Bank Database. URL: https://databank.worldbank.org/source/world-development-indicators (accessed on 28.09.2021).

2.2. The economic crisis of 1991–1993

The leading cause of the 1991–1993 economic crisis was the collapse of the USSR, which tore economic ties between the former Soviet republics, all of which experienced a deep economic crisis of various degrees (except China and Vietnam).

In all these countries, the crisis had a systemic nature due to the change in the economic model that presumed a transition to a market economy. In addition to the latter, the war for the liberation of Artsakh started in Armenia, accompanied by the transport blockade and energy crisis. At the same time, the global economic growth continued at an average annual rate of about 2.5%. Thus, this crisis had a systemic-regional nature. In general, the crisis in the Europe and Central Asia countries began in 1992 and lasted two years, from 1992 to 1993. It took another two years to recover the GDP level of 1991.

The crisis in Armenia was shorter, but the economic consequences were heavier than in Russia. It lasted three years with a total economic decline of 53.1% in 1993 compared to 1990. The economic growth resumed in 1994 and continued for 14 years until the crisis of 2009.[7] The pre-crisis GDP level of 1990 was restored only in 2004. The economic crisis affected all economic sectors, completely changing the economic structure. The economic structure was not restored, leaving the country's economic development behind for about 15 years, turning it from industrial to agricultural. The industry was one of the most affected sectors. During the three years, the decline accounted for 57.3%. In general, the pre-crisis volumes of manufacturing output were restored only in 2012, and the volumes of the mining industry in 2001. The pre-crisis level of the industry share in GDP has not yet recovered.

The agricultural sector ensured the economy's survival during the deep crisis, rescuing it from imminent famine by deindustrializing the country and drastically reducing labour productivity. This stabilizing role of agriculture became possible due to the agrarian reform implemented in 1990–1991. As a result, the share of agriculture in GDP increased sharply from 15.8% in 1990 to 48.6% in 1993. Moreover, agriculture was the only sector of the Armenian economy where the economic decline was minimal — 10.9% in 1993, and the 1990 volumes were restored in 1998.

One of the main characteristics of this economic crisis is the sharp decrease in the volume of state financial resources and the need for no less sharp increase in expenditures. In 1990–1994, under the conditions of limited external financing sources, an expansionary fiscal policy was applied in the form of inflationary deficit financed by the Central Bank. As a result, the budget of 1992 had a deficit of 0.25%, the 1993 budget — 50.5%, and the 1994 budget — 38.4%. Since the expansion of preferential foreign financing by international organizations, the policy of macroeconomic stability based on the Washington Consensus has been implemented, as a result of which the 1992–1993 hyperinflation was eliminated, and the budget deficit began to decrease.

In 1990–1993, the country, being in the zone of the Russian ruble, was using the general inflationary monetary policy. Since the introduction of the national

[7] The average annual economic growth accounted to about 9% in 1994–2008, including 5.35% in 1994–1997, 10.6% in 1998–2003, 11.6% in 2004–2008.

currency Dram in November 1993, Armenia started pursuing an independent monetary policy. In 1995, the Central Bank started conducting a restraining monetary policy.

Another key feature of the economic crisis is the disruption of the country's foreign economic relations: exports in 1994 amounted to 65.5% of the 1990 level, while the role of imports increased due to the need to ensure minimum domestic consumption. The volume of imports in 1994 amounted to 91.9% of the 1990 level, so the trade account and balance of payments also deteriorated.

The main external conditions for the Armenian economy to start economic recovery and growth were as follows: ensuring a long-term ceasefire in the first Artsakh War (1994), easing the transport blockade (since 1994), and ending the energy crisis (reopening the NPP 1996). It allowed to significantly reduce the negative economic pressure. The beginning of large-scale financing on external concessional terms (since 1995) allowed to reduce the budget deficit and stop inflationary financing of the economy (which has been legally prohibited since 1997).

2.3. Economic Growth of 1994–2008 and 2010–2019 and the Global Financial Crisis

In 1994–2008, Armenia had continuous economic growth of about 9% on average. The latter was significantly higher than the average global economic growth of about 3.3%. Such economic growth enabled the recovery of the GDP level of 1990 in 2004. However, in 2009 the global economic crisis had a significant negative impact on the Armenian economy: the GDP decreased by 14.1%, about 55% of which was due to the reduction of construction by 41.6%. Other reduced sectors due to the crisis were industry — about 6%, trade — 3.6%, and services — 21.8%.

Almost the entire reduction in services was mainly due to the decrease in the transport and real estate sectors. The former was due to a reduction of foreign trade and the general decline in economic activity. Secondly, it is specific to any economic crisis when people begin to save as financial resources dwindle. Hence, household spending priorities change in favour of food and essential services and to the detriment of long-term consumer and investment goods, including real estate.

It is noteworthy that even though in the US and some other countries the crisis began in the real estate financing market and then spread to the financial intermediation system and later to the real sector of the economy, there was no financial crisis in Armenia for the simple reason that there was no mass mortgage lending. Mortgage lending in 2008 covered 9.2% of the value-added of construction, in 2019–86.4%, in 2020–111.5%.

During the 2009 crisis, there was no financial crisis in Armenia, and hence there was no risk of bankruptcy of system-building businesses. So, the government did not use quantitative easing or bail out policies. Instead, it used actions to increase the budget deficit due to the inevitable decrease in government revenues and the need for increased expenditures and targeted measures to support individual affected economic sectors.

Economic growth in Armenia, as in the rest of the world, was restored in 2010, and it took 4 years to reach the pre-crisis level of 2008. In 2009, the fastest growing sectors suffered from the economic crisis. Overcoming the crisis lead to a new economic structure with new drivers of economic development.

The recovery growth in 1994–1997 (*Table 2*) was mainly due to the return to normal living conditions. However, it was not primarily related to the increase in investment. It was based on restarting existing capacities, and investments were mainly directed to renewing the production infrastructure (e.g., reopening the ANPP in 1996). On the other hand, the high share of net taxes in economic growth was due to the imposition of VAT on imports in 1997.

In the second phase of the recovery growth (1998–2003), we can already notice the significant growing investment component, as construction begins to become the main driving force of the economic growth, surpassing industry, agriculture, and trade, yielding only to the service sector (*Table 3* shows the contribution of each sector to cumulative economic growth).

In 2004–2008, the structure of the economy and the primary sources of economic growth changed dramatically: construction and services together provided 63.2% of total economic growth, compared to 47.7% in the previous period, and the total contribution of industry and agriculture was only 13.1% compared to 27.1% in the previous period.

This model of economic development, where the non-tradeable sectors dominated over the sectors with the potential for import substitution or export,

Table 2

Sectoral sources of economic growth in Armenia in 1994–2019, at comparable prices of 2019, million USD

	1994–1997	1998–2003	2004–2008	2009	2010–2013	2014–2017	2018–2019	1994–2019
Cumulative economic growth	**674.6**	**2360.1**	**4342.5**	**–1449.1**	**1632.6**	**1586.3**	**1589.7**	**10736.6**
including								
Industry	109.4	382.8	135.3	–87.0	462.1	447.5	363.7	1813.7
Extractive	3.6	56.6	22.1	6.75	81.25	186.0	15.5	371.9
Manufacturing	56.6	300.1	60.0	–39.6	314.9	260.5	324.2	1276.8
Energy	49.2	26.0	53.2	–54.2	65.9	0.95	24.1	165.2
Agriculture	29.8	257.7	436.0	82.2	189.3	137.9	–219.3	913.6
Construction	49.4	500.7	1200.8	–798	–134.2	–180.3	40.6	679.0
Trade	203.6	306.0	386.6	–52.3	144.8	216.7	255.0	1460.5
Services	114.9	626.2	1541.9	–327.9	636.5	930.7	948.1	4470.3
Value added, total	507.1	2073.4	3700.5	–1182.9	1298.4	1552.5	1388.3	9337.3
Net taxes, total	167.5	286.7	642.0	–266.2	334.2	33.8	201.4	1399.3

Source: National Accounts of Armenia, Statistical Committee of RA. URL: www.armstat.am (accessed on 10.10.2021).

Note: the table doesn't include data on "Financial Intermediate Services Indirectly Measured".

Table 3

Sectoral sources of economic growth in Armenia in 1994–2019, in %

	1994–1997	1998–2003	2004–2008	2009	2010–2013	2014–2017	2018–2019	1994–2019
Cumulative economic growth	**100.0**	**100.0**	**100.0**	**–100.0**	**100.0**	**100.0**	**100.0**	**100.0**
including								
Industry	16.2	16.2	3.1	–6.0	28.3	28.2	22.9	16.9
Extractive	0.5	2.4	0.5	0.5	5.0	11.7	1.0	3.5
Manufacturing	8.4	12.7	1.4	–2.7	19.3	16.4	20.4	11.9
Energy	7.3	1.1	1.2	–3.7	4.0	0.2	1.5	1.5
Agriculture	4.4	10.9	10.0	5.7	11.6	8.7	–13.8	8.5
Construction	7.3	21.2	27.7	–55.1	–8.2	–11.4	2.6	6.3
Trade	30.2	13.0	8.9	–3.6	8.9	13.7	16.0	13.6
Services	17.0	26.5	35.5	–22.6	39.0	58.7	59.6	41.6
Value added	75.2	87.9	85.2	–81.6	79.5	97.9	87.3	87.0
Net taxes	24.8	12.1	14.8	–18.4	20.5	2.1	12.7	13.0

Source: National Accounts of Armenia, Statistical Committee of RA. URL: www.armstat.am (accessed on 10.10.2021).

Note: the table doesn't include data on "Financial Intermediate Services Indirectly Measured".

Table 4

Sources of economic growth in Armenia in 1990–2019, at comparable prices of 2019 — million USD

	1991–1993	1994–1997	1998–2003	2004–2008	2009	2010–2013	2014–2017	2018–2019	1994–2019
Change in GDP	**–3288**	**674,5**	**2360**	**4342,5**	**–1449**	**1633**	**1586**	**1590**	**10737**
Total domestic consumption	–1797	1186	2470	5484	–1482	1169	347	2755	12035
Final Consumption, Households	–1817	791	1622	2765,1	–359	1295	313	2202	8630
Final Consumption, Government	62	6,5	183	479,9	–14,2	195	12,6	112	1118
Gross capital formation	–42	388	665,5	2240	–1109	–322	21	441	2288
Export of goods and services	–1129	–324	1400	–242	–195	1187	1655	610	4092
External financing	–362	–187,5	–1510	–900	228	–723	–416	–1775	–5391

Source: National Accounts of Armenia, Statistical Committee of RA. URL: www.armstat.am (accessed on 10.10.2021).
Note: Table includes only the essential sources of economic growth.

based on positive expectations of rising real estate prices, fell victim to the 2008–2009 financial crisis, during which, as is usually the case during the global crises, investment in emerging markets, including Armenia, declines sharply due to increased risk (capital flight).

Such a development led to an increase in the volume of investments due to the positive expectations and contributed to the development of the primary developing sector (in this case, construction) and the sectors serving it, such as construction materials, woodworking, metal production, and the growth of related imports. However, when the expectations change, it starts working in the opposite direction, which was the reason for the sectoral reductions in 2009, mainly due to the unprecedented decline in construction. And the stronger the connection of those areas with the leading developing sector, the higher the reduction.

2010–2013 was the period of economic recovery from the crisis, during which growth rates slowed down due to capital flight, and a new economic structure was formed, where services remained the main development driver, and along with it the industry and agriculture started becoming the other driving forces, increasing the export potential of the economy. Thus, the economy got some export direction, and construction continued to decline.

In 2014–2017, the role of services as the primary source of economic growth increased, and its contribution became more significant than the cumulative contribution of other sectors. The role of services as the main driving force of economic growth deepened in 2018–2019, while the decline of agriculture continued since 2016 and was due to the constant reduction of the relative profitability of agriculture and the lack of an effective system to support it.

Table 4 and *Table 5* present the sources of economic growth/recession and the financial connections of the economy with the world during the growth/recession. Since 1994, Armenia has been deeply dependent on foreign financing. On average, half of the economic growth was financed by the capital inflow. Dependence on external financing was the highest in 2018–2019 when external financing growth exceeded GDP growth by 11.7%. In 2004–2008, it was the lowest, as external financing provided about 20% of economic growth. In 2014–2017, 26.6% of economic growth was ensured due to external financing.

Exports were a significant source of economic growth in 1998–2003. In 2014–2017, almost all the economic growth was ensured at the expense of exports. During 2004–2008 the gross capital formation had the highest contribution to economic growth, providing double-digit growth rates.

Table 5

Sources of economic growth in Armenia in 1990–2019, in %

	1991–1993	1994–1997	1998–2003	2004–2008	2009	2010–2013	2014–2017	2018–2019	1994–2019
Change in GDP	**– 100.0**	**100.0**	**100.0**	**100.0**	**–100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total domestic consumption	–54.7	175.8	104.7	126.3	–102.3	71.6	21.9	173.3	112.1
Final Consumption, Households	– 55.3	117.3	68.7	63.7	–24.8	79.3	19.8	138.5	80.4
Final Consumption, Government	1.9	1.0	7.7	11.1	–1.0	12.0	0.8	7.1	10.4
Gross capital formation	– 1.3	57.6	28.2	51.6	–76.6	–19.7	1.3	27.7	21.3
Export of goods and services	–34.3	–48.0	59.3	–5.6	–13.4	72.7	104.3	38.4	38.1
External financing	– 11.0	–27.8	–64.0	–20.7	15.7	–44.3	–26.2	–111.7	–50.2

Source: National Accounts of Armenia, Statistical Committee of RA. URL: www.armstat.am (accessed on 10.10.2021).
Note: Table includes only the essential sources of economic growth.

2.4. The economic crisis of 2020

The global economic crisis of 2020 was of an artificial origin. It was mainly due to lockdowns, particularly in the service sectors involving trade operations and human contacts, such as transportation, hospitality, and restaurants. In the second half of 2020, when these restrictions were eased, the depth of the crisis diminished. In 2021, after their elimination, the economy around the world and Armenia began to recover.

The depth of the 2020 crisis was significantly lower than in 2009 (*Table 6*), as, in 2020, there was no primary driver of the economic growth as construction. On the other hand, the changes in the future structural and economic growth drivers of the economy due to the 2020 crisis will also be less pronounced than they were in 2010–2019.

There were 4 economic sectors with the fastest growth before the crisis of 2020: mining industry (average annual growth in 2010–2019–14.5%, share in GDP in 2010–1.69%, in 2019–3.25%), financial intermediation (average annual growth in 2010–2019–13.9%, share in GDP in 2010–2.75%, in 2019–6%), Accommodation and food service activities (average annual growth in 2010–2019–15.4%, share in GDP in 2010–0.8%, in 2019–1.89%), and Arts, entertainment and recreation (average annual growth 2010–2019–27%, share in GDP in 2010–0.92%, in 2019–5.55%). The total contribution of these sectors to the 2010–2019 economic growth was 37.6%.

Two of these sectors suffered the most: Accommodation and food service activities, Arts, entertainment and recreation. The decline in these two sectors accounted for a 26.2% of GDP decrease in 2020. According to the results of the first half of 2021, the first one has the potential for recovery depending on the growth of gross household consumption (food services) and on the increase in outbound and inbound tourism (accommodation services). Also, the results of the first half of 2021 show that the second sector will most likely cease being a driving force of the economy.

Based on the results of the first half of 2020 and 2021, the information and communication, healthcare, and manufacturing sectors can be added to the above-mentioned growing sectors. As for agriculture, its further development requires further enlargement of farms and a sharp increase in their productivity, which should mainly occur through a significant modernization and expansion of the current system of state subsidies.

Our further research, which will focus on relatively high productivity and, consequently, sectors that create a higher value-added, will provide a more accurate identification of potential areas for future growth and the development of an economic policy toolkit to encourage the development of those sectors.

A comparison of GDP consumption trends during the 2009 and 2020 crises shows that gross consumption in 2020 decreased by about 2.5 times more than in 2009, despite the reduction in GDP being almost twice less. Moreover, the drop was due to the decrease in household consumption by — 13.8%, or –789.8 billion AMD at current prices, while the total

Table 6

Economic recession and characteristics of 2009 and 2020 crises: sectoral structure

	2009	2020	2021*		2009	2020	2021*
GDP	–14.1	–7.4	5.0**	Accommodation and food service activities	23.5	–43.3	62.5***
Agriculture	5.9	–4.1	6.8***	Arts, entertainment and recreation	3.4	–21.3	–36.1***
Industry	–6.4	–1.7	2.1***	Education	2.2	1.3	6.9(1)
Extractive	6.3	8.4	7.2***	Healthcare	–5.4	6.9	42.6(1)
Manufacturing	–5	–3.6	–1.1***	Real estate activities	–20.7	–14.5	18.9(1)
Energy	–12	–1.2		Information and Communication	10.9	8.4	12.7***
Construction	–41.6	–6.7	10.8***	Transport	–28.3	–34.4	7.3***
Trade	–5.3	–13.2	8.0****	Financial and insurance activities	–1.6	5.4	3.1***

Source: National Accounts of Armenia, Statistical Committee of RA. URL: www.armstat.am (accessed on 10.10.2021).
Note: * 2021 January – June, ** Economic activity indicator, *** Gross output, **** Turnover (1) Paid services.

GDP decline amounted to only 361.6 billion drams. It indicates that the policy of stimulating household demand was ineffective in 2020 compared to 2009 when household consumption fell by only 4.3% compared to a 14.1% drop in GDP.

The state policy for stimulating demand in 2020 had three components: (1) a 5.3 per cent increase in state-funded wages to meet the additional household demand of about 200,000 workers at 21.6 billion drams, and (2) an 8.9 per cent increase in pensions, which was to meet the additional household demand of about 464,000 pensioners at 19.4 billion drams and (3) the partial compensation of those who lost their job due to the lockdown.

Given the disproportionate decline in household consumption in 2020 and the increase in the income of state-paid employees and retirees, it becomes clear that private sector incentive programs were insufficient in terms of both coverage and volume.

As for the growth of consumption of state institutions, it was mainly conditioned by two particular circumstances in 2020: the Covid-19 pandemic, the cost of which can be estimated at least 57.3 billion drams, and the second Artsakh war, the value of which we estimate at least 111.8 billion drams without destroyed military equipment and the value of the accumulated ammunition until 2020.

The reduction in gross capital formation was higher than the reduction in GDP (in %) in 2020 but about three times less than in 2009 due to an unprecedented decline in construction, which did not occur in 2020. It reflects the reduction in capital formation during the crisis due to future uncertainty and negative expectations.

Exports of goods and services in 2020 fell by almost three times more than in 2009, mainly due to an unprecedented 62.1% (1 321 million USD) decline in exports of services, 94% of which was due to the reduction in the volume of travel. The volume of exports of goods decreased by only 3.9%. Imports of goods fell by 17.7% in 2020, and imports of services by 61.5% (1 490 million USD), 79% of which was due to reduced travel. The recovery of their pre-crisis levels of export and import largely depends on outbound and inbound tourism dynamics.

2.5. Socio-economic policy of Armenia in 2020

In Armenia, as in many other countries with limited convertibility of national currency, the primary tool of the anti-crisis and countercyclical

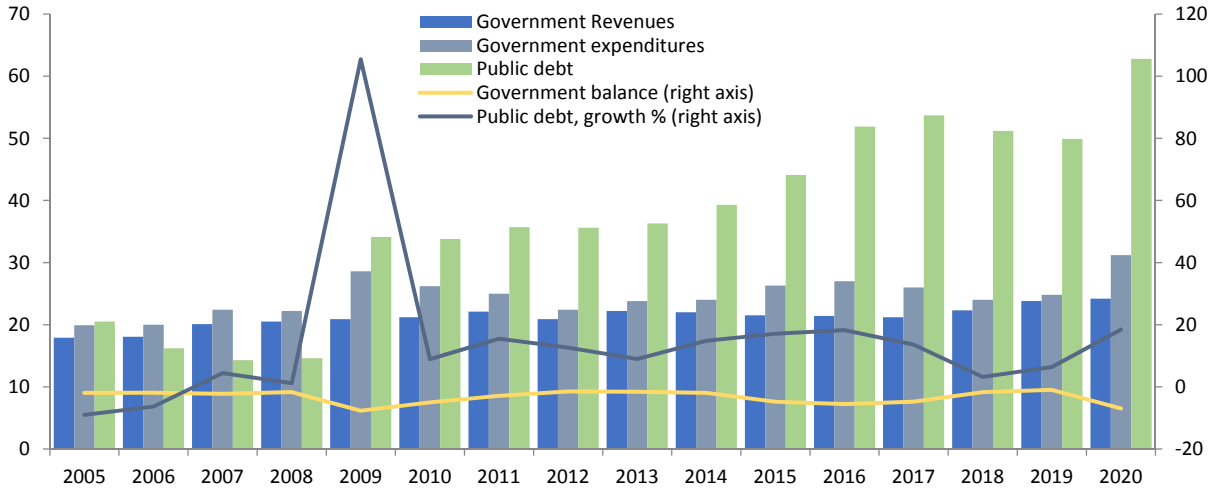

Fig. 5. **The budgeting system of Armenia and the main indicators of the public debt in 2000–2020,% to GDP**

Source: IMF World Economic Outlook, April 2021. URL: https://www.imf.org/en/Publications/WEO/Issues/2021/03/23/world-economic-outlook-april-2021 (accessed on 14.10.2021).

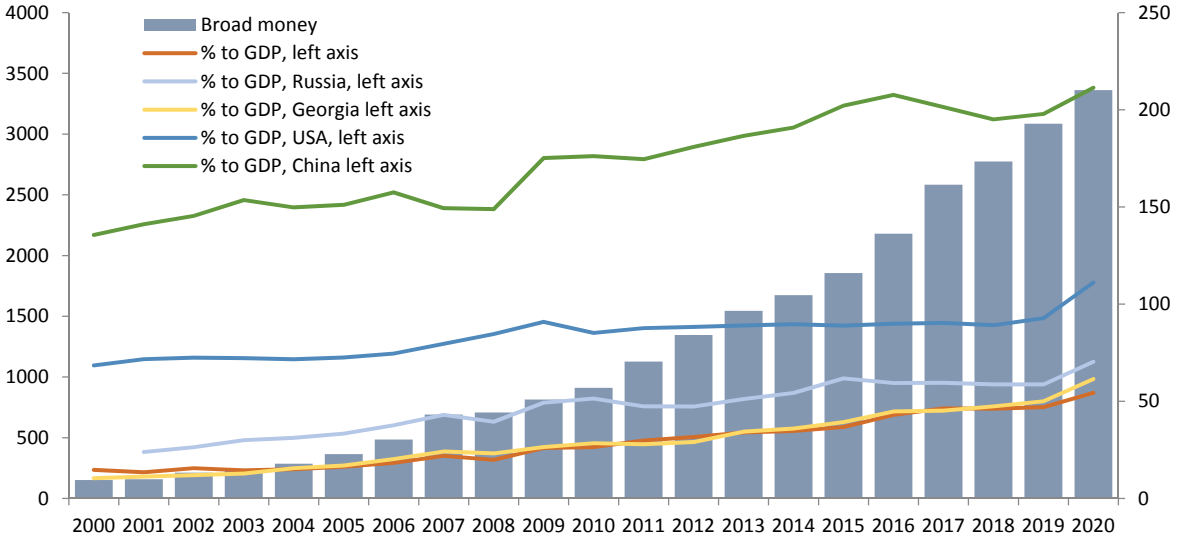

Fig. 6. **Broad money dynamics in absolute terms (billion AMD) and% to GDP, 2000–2020**

Source: Databases of the Central Bank of Armenia, Central Banks of Russia, Georgia, USA and China. URL: www.cba.am, www.cbr.ru, www.nbg.gov.ge, www.federalreserve.gov, http://www.pbc.gov.cn/ (accessed on 18.10.2021).

policy is the expansionary fiscal policy, used during the 2009 and 2020 crises (*Fig. 5*). It assumes a sharp increase in budget expenditures amid declining revenues, significantly increasing the budget deficit, which in turn is financed by increasing the external and domestic public debt. Additional revenues are typically used in three ways: (1) to offset the loss of revenue due to the crisis, which allows not to cut already announced state expenditures and incur additional expenses to stimulate the economic activity by (2) increasing the demand and (3) supply.

During the crisis of 2009, state revenues decreased by 75.1 billion AMD or 2.39% of GDP, and expenditures increased by 103.6 billion AMD or 3.3% of GDP. Considering the decrease in revenues, the absolute growth of expenses amounted to 178.8 billion AMD or 5.7% of GDP. During the 2020 crisis, state revenues decreased by 68.8 billion AMD or 1.1% of GDP, and expenditures increased by 187.4 billion AMD or 3% of GDP. Considering the decrease in revenues, the absolute growth of expenses amounted to 256.2 billion AMD or 4.14% of GDP.

The peculiarity of the countercyclical fiscal policy is that regardless of the post-crisis dynamics of revenues,

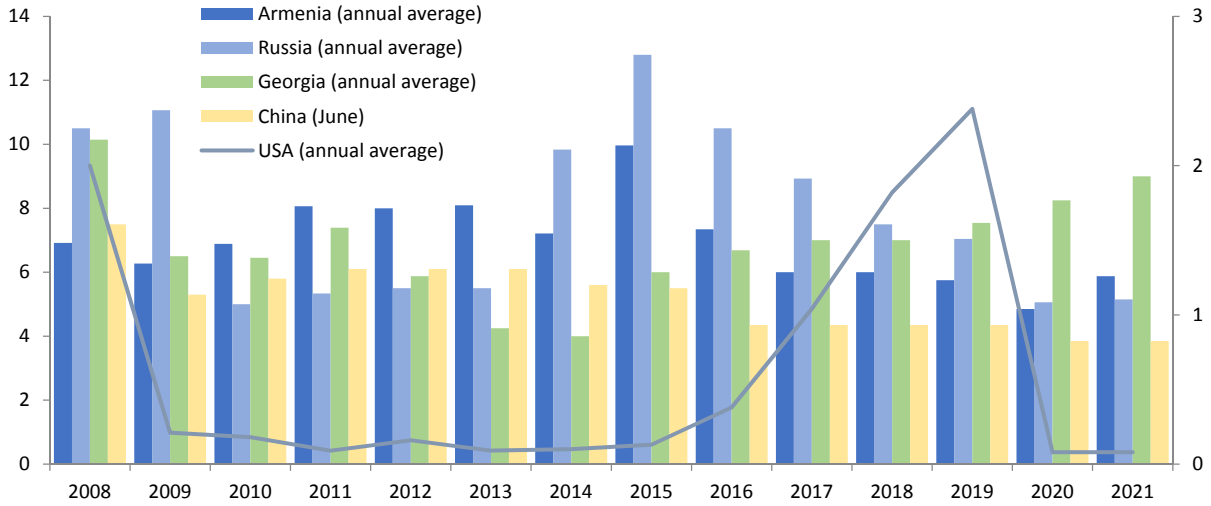

Fig. 7. **Central Bank interest rates, 2008–2020**

Source: Databases of the Central Bank of Armenia, Central Banks of Russia, Georgia, USA and China. URL: www.cba.am, www.cbr.ru, www.nbg.gov.ge, www.federalreserve.gov, http://www.pbc.gov.cn/ (accessed on 18.10.2021).

for various, mainly political reasons, it is impossible to reduce the absolute amount of public spending. The latter leads to a steady increase in public debt in countries with chronic budget deficits. Since 2009, the nominal public debt of Armenia increased by an average of 11.8% per year, compared to the average economic growth of 7.7% in 2010–2019.

The monetary policy, the primary purpose of which is to ensure price stability in Armenia by applying the inflation targeting tools, is usually neutral to economic growth. However, during economic crises, it also acquires the features of an expansionary countercyclical policy and has the edges of agreement with the fiscal policy.

During the 2009 and 2020 crises, the money supply grew at an accelerated rate (*Fig. 6*), including China, where during both the 2009 and 2020 global crises, the country recorded economic growth of 9.4% and 2.3%, respectively. The growth of the money supply in Armenia was 15.1% in 2009 and 8.9% in 2020. Thus, the money supply behaviour in the reviewed countries was countercyclical and expansionary during the crises.

As for the pre-crisis period, according to the experts of the US Federal Reserve System, "The Federal Reserve System… have long monitored the growth of the money supply because of the effects that money supply growth is believed to have on real economic activity and the price level. Over time, the Fed has tried to achieve its macroeconomic goals of price stability, sustainable economic growth, and high employment in part by influencing the size of the money supply. In the past few decades, however, the relationship between growth in the money supply and the performance of the US economy has become much weaker, and emphasis on the money supply as a guide to monetary policy has waned".[8] *Fig. 6* proves this thesis quite clearly.

The central banks' interest rate policy, which, along with mandatory reserves and capital adequacy ratios, is the primary tool for regulating the credit market, has also been countercyclical. During crises, the central banks reduce interest rates and consequently increase lending and reduce their service cost in 2009 (except Russia) and 2020 (except Georgia) (*Fig. 7*).

Notably, no inflationary pressures were registered because of the countercyclical fiscal and monetary policy of 2009 and 2020. We should highlight that the US Fed's expansionary monetary policy with interest rates close to zero in 2009–2015 continued for five years after the end of the crisis, and the situation is the same in 2021. Moreover, as of March 2020, the reserve requirement became zero. The Central Bank of China did not increase the interest rate after 2020.

Thus, developments in countries that have recently maintained near-zero or negative interest rates, show

[8] The Money Supply, Federal Reserve Bank of New York. URL: https://www.newyorkfed.org/aboutthefed/fedpoint/fed49.html (accessed on 17.10.2021).

that the inflationary financing of their economies does not generate inflation either in their countries or countries with highly positive central bank interest rates. In addition, the capabilities of traditional monetary policy tools, including money supply and central bank interest rates, have been exhausted, and new tools are emerging, such as quantitative easing, acquisition of troubled assets by central banks. It is unclear how these changes will affect other countries' monetary policy tools. However, there are specific signals, including in the case of Armenia, that the expansionary monetary policy does not lead to an increase in inflationary pressure.

Armenia implemented additional targeted budget-assisted assistance programs in 2020, the total amount of which, as of September 10, 2020, amounted to 163.4 billion AMD (340 million USD, or 2.5% of GDP). The number of approved programs was 25.[9] It was impossible to determine the actual funding volumes for these programs by the end of 2020. According to a statement made by the Prime Minister of Armenia at the August 12 sitting of the Armenian government, the state has spent 64 billion AMD within the framework of those programs, of which 26.6 billion AMD was spent on social programs, 17.5 billion on economic programs and 19.9 billion on subsidy programs of bank interests.

Many former USSR countries have adopted similar programs to stimulate supply and demand. According to IMF,[10] the package of these programs in Azerbaijan amounted to 4.8% of GDP in 2020, in Georgia — 3.8%, in Russia — 3.5%, in Kazakhstan — about 9%, in Kyrgyzstan — about 7%, in Uzbekistan — about 2%. Thus, the volumes of these programs in Armenia were lower than in most of the mentioned countries. As for the developed countries, due to their wider opportunities to pursue an expansionary fiscal policy, the volumes of these packages were larger and more diverse in coverage. We should also note that the directions for spending these packages were almost the same in all countries, including Armenia, differing in the number of sectors involved and the volume of assistance.

[9] COVID-19 crisis response in Eastern Partner countries. OECD, October 2020. URL: https://www.oecd.org/coronavirus/policy-responses/covid-19-crisis-response-in-eu-eastern-partner-countries-7759afa3/ (accessed on 20.10.2021).

[10] IMF, Policy responses to Covid-19 as of July 21, 2020. URL: https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19 (accessed on 20.10.2021).

3. CONCLUSION

The consequences of the 1991–1993 crisis were heavy in Armenia, affecting all economic sectors and completely changing the economic structure from industrial to agricultural. On the other hand, in our opinion, the 1991–1993 crisis, being unprecedented in its depth and accompanying external factors, is unlikely to repeat in the future.

The economic growth factors changed during different periods in Armenia. After the first economic crisis, construction became the main driver of economic development until the global financial crisis, forming new economic drivers. In the current economic structure, services remained the main development driver, along with industry and agriculture becoming the other driving forces, increasing the export potential of the economy. In our opinion, after the crisis of 2020, the economic structure will not change significantly but will get a more balanced nature, with some development pillars, none of which will play a dominant role, as was the case in 2004–2008 for the construction.

We can say that Armenia's fiscal and monetary policy in general in 2009 and 2020 corresponded to the approaches of the anti-crisis policy pursued in the world. Both monetary and fiscal policies were countercyclical and sufficiently effective.

Considering the resumption of economic growth in 2021 and the probability of recurrence of further lockdowns, it is urgent to develop new socio-economic policy approaches to ensure sustainable economic growth in the future and to emerge quickly from future economic growth crises without restricting or halting economic activity.

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M.A. Voskanyan — critical analysis of literature, interpretation of research results.
A.G. Galstyan — collection of statistical data, results presentation in the form of tables and graphs, work on the English version of the article.

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Implementation of Gender Budgeting in Belarus: Current State and Prospects

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ABSTRACT

The **relevance** of the article is due to the need to develop gender budgeting in Belarus, as a recognized and increasingly demanded tool around the world to achieve gender equality, the United Nations Sustainable Development Goals and the implementation of the Beijing Platform for Action. The **purpose** of the study is to analyse the work done and the existing problems in the implementation of gender budgeting in Belarus, and to identify measures of State policy that contribute to a more comprehensive implementation of gender budgeting in the country. The **methodology** of the study consists in the analysis of the normative legal acts and state programs of the Republic of Belarus, scientific publications, Internet sources, official statistics, survey data, and recommendations of international organizations on compliance of the Belarusian policy with international best practice in gender budgeting. The **results** of the work are an reviewed progress and remaining problems in achieving gender equality and implementation of certain aspects of gender budgeting in Belarus; calculation of the composite indicator on gender budgeting and comparison of its value with OECD countries; development of a set of measures (action plan) for the implementation of gender budgeting in Belarus. The author makes a **conclusion** that at the moment gender budgeting is practically not applied in Belarus, however, some basis for its implementation already exists. Despite a relatively good position of Belarus in specialized international ratings, the problems of inequality remain relevant, to a greater or lesser extent, for many sectors of the economy and aspects of life of women and men. Comprehensive implementation of a gender approach in the budget process is to be an effective tool for solving such problems. Promising areas for further research are a comprehensive and detailed analysis of the impact of activities and the existing distribution of state programs expenditures on gender equality in Belarus, and implementation of gender budgeting at the level of local budgets.

Keywords: gender budgeting; gender equality; budget process; state program; Belarus

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INTRODUCTION

The problem of gender inequality remains relevant to different extents in all countries of the world and spheres of public life. Despite the measures taken by governments, international and non-governmental organizations, gender differences persist in the labor market, representation in senior positions in the private sector and public service, in access to health care, education, and other areas [1], and problems of violence towards women remain widespread ensuring their autonomy in decision-making.

Existing gender inequalities can have a significant impact on future economic growth and development. A study by the McKinsey Global Institute[1] in 2015 found that if women reached their full potential in the economy on par with men, annual global GDP could increase by another $ 28 trillion (or 26%) by 2025. Other estimates show that women are lagging behind in the field of employment and entrepreneurship, per capita income losses may amount to about 15% for the OECD countries and about 17% for developing countries in the long run [2, p. 22]. According to OECD calculations, focusing on a number of Eurasian countries, a gradual decrease in gender discrimination in social institutions by 2030 could increase the region's annual GDP growth rate by 0.4%.[2]

The COVID-19 pandemic has become a new factor in the growth of gender inequality in the world: the decline in employment has occurred to a greater extent in professions traditionally occupied by women (tourism, healthcare, social security, catering); cases of domestic violence have increased.[3] McKinsey estimates that women's jobs were 1.8 times more vulnerable than men's jobs during the COVID-19 crisis.[4] At the same time, in most countries of the world, men were characterized by a higher incidence of severe COVID-19 and higher death cases.[5]

The implementation of gender budgeting as a direction or set of public policy measures has the potential to correct existing imbalances and promote gender equality. At the same time, the benefits from its implementation are not only economic in nature, but also imply increased awareness of civil servants and the public about the problems associated with gender inequality, the measures taken to eliminate them and the results obtained, establishing clear links between high-level political goals and funding for specific activities.

In addition, the effective implementation of gender budgeting contributes to the achievement of the UN Sustainable Development Goals (SDGs), and the inclusion of indicator 5.c.1[6] among the global SDG indicators allows tracking the progress made by countries. Today, more than 90 countries around the world implement gender budgeting in one form or another [3].

Belarus is characterized by a relatively equal position of women and men in the economy and access to public goods and services, as well as good positions in international dimensions of gender equality. At the same time, many problems remain unresolved.

The gender pay gap in 2016–2020 increased in most types of economic activity and in the economy as a whole for 2020 amounting to 26.7%. Women still have disproportions in making decisions in the household, spending on family needs, there are problems in the balance of work and personal life, and the volume of unpaid work. Among men, the cases of

[1] McKinsey Global Institute. 2016. The economic benefits of gender parity. URL: https://www.mckinsey.com/mgi/overview/in-the-news/the-economic-benefits-of-gender-parity (accessed on 03.02.2022).

[2] OECD. SIGI 2019 Regional Report for Eurasia. 2019. URL: https://www.oecd-ilibrary.org/development/sigi-2019-regional-report-for-eurasia_f6dfa21d-en (accessed on 03.02.2022).

[3] IMF, UN Women. Gender Equality and COVID-19: Policies and Institutions for Mitigating the Crisis. 2021. 14 p. URL: https://www.imf.org/-/media/Files/Publications/covid19-special-notes/en-special-series-on-covid-19-gender-equality-and-covid-19.ashx (accessed on 03.02.2022).

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[5] OECD. Gender Gaps in Eurasia: Negative Consequences of COVID-19. 2021. 51 p. URL: https://www.oecd.org/eurasia/Gender%20gaps%20in%20Eurasia_Mar%202021RUSCover.pdf (accessed on 03.02.2022).

[6] Indicator "Proportion of countries with systems to track and make public allocations for gender equality and women's empowerment".

industrial injuries, alcohol dependence, and deaths from accidental alcohol poisoning are higher; sports and physical activity are less common.

The introduction of gender budgeting tools could help correct existing gender imbalances, but so far, such tools have not been used in the country. At the same time, for the republican government bodies and the population as a whole, a weak understanding of the relevance of the gender agenda and ways of its practical implementation is typical, there is no consistent plan for its reflection in the budget. This paper is intended to make a certain contribution to the solution of these problems.

The following sections of the article reveal the essence of gender budgeting and describe the approaches to its implementation used in international practice, present the research methodology; analyze the achievements and problems existing in Belarus in the field of gender equality; present the results of the calculation of the composite indicator for gender budgeting and recommendations in the form of an action plan for the implementation of gender budgeting in Belarus; at the end, brief conclusions are given.

THE ESSENCE OF GENDER BUDGETING AND ITS BENEFITS

Gender budgeting is usually defined as a gender budgeting assessment that includes a gender perspective at all levels of the budget process and restructuring of revenues and expenditures to promote gender equality.[7] The OECD defines gender budgeting as the systematic application of analytical tools and processes as a normal part of the budgeting process in order to identify gender equality issues and prioritize, fund, and inform about gender-responsive policies.[8] Sometimes researchers also use the concept of "gender budget", which is understood as a system for allocating a social component in the state budget, resources aimed at a policy of equal rights and opportunities, taking into account gender.[9]

Gender budgeting does not mean creating a separate budget for women or simply listing items related to "women's issues"[10] and does not necessarily involve allocating additional funds to address inequalities; for its implementation, methods and procedures already existing in the budget process are used [4, p. 39].

The idea of introducing gender budgeting is to identify and raise awareness among politicians and the public about the existing problems of gender inequality, including the unequal distribution of resources in the state budget, as well as to develop and implement measures that contribute to closing the gender gap [5]. The fact that activities to support women (girls, mothers, or men) are funded does not yet indicate that a gender perspective is taken into account in the budget process: without the use of gender budgeting analytical tools, it is impossible to accurately judge the impact of a budget or program on gender equality.

The theoretical basis for gender budgeting is the idea that public spending decisions and the underlying public financial management systems can have a significant and different impact on economic and social outcomes for different genders [6].

The state budget, as the central program document of the government, plays a decisive role in the allocation of resources for solving socio-economic problems, so it is logical that in order to achieve gender equality, it is necessary to implement a gender approach as a cross-cutting priority in the budget process [7]. Gender-sensitive fiscal policy measures, like any other fiscal policy measures, can influence the behavior of economic actors and, thus, output, economic growth, and equity [8].

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[7] Council of Europe. Final report of the Group of Specialists on Gender Budgeting (EG-S-GB). 2005. URL: https://rm.coe.int/1680596143 (accessed on 04.02.2022).

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[10] Gender budgeting: A tool for achieving equality. URL: https://www.gendereconomy.org/gender-budgeting-a-tool-for-achieving-equality/ (accessed on 03.02.2022).

Key benefits of implementing gender budgeting include:

- improving the distribution of resources to meet the needs of individual groups and the population as a whole;
- assisting public authorities in identifying and prioritizing policy measures to achieve greater gender equality; the possibility of systemic reflection of the gender factor in the budget process;
- improving the efficiency and effectiveness of spending related to gender equality, especially when implementing gender budgeting in combination with the program-based budgeting (performance budgeting);
- increasing transparency of budgets and accountability of government activities; citizens' involvement in the adoption of budget decisions;[11]
- the ability to verify the compliance of allocations and their results with political commitments and the desired impact [9]; the ability to differentiate the impact of actual expenses and incomes on women and men (girls and boys) [4, p. 38];
- gender budgeting can be introduced by stages, in separate elements, and simultaneously with other reforms in public finances; it can be implemented by countries regardless of their economic development level [3];
- greater equality between women and men and the economic empowerment of women contribute to increased productivity and economic growth;[12]
- the use of gender budgeting tools can neutralize the negative impact of the COVID-19 pandemic on gender equality[13] [10]; the result of reducing gender inequality can be an increased social cohesion [11];
- contributing to the implementation of the commitments made by countries under the SDGs, the Beijing Declaration and Platform for Action, and the UN Convention on the Elimination of All Forms of Discrimination against Women.

INTERNATIONAL PRACTICE IN IMPLEMENTING GENDER BUDGETING

The international community is increasingly aware that gender equality is essential for sustainable economic growth and social development [1]. Gender budgeting as a tool for achieving gender equality is not yet widely adopted around the world, but a growing number of governments are beginning to see public budgeting as a way to promote a fair distribution of resources from a gender perspective.

The limited data on the effectiveness of the implementation of gender budgeting is explained by the relatively short duration of its implementation in international practice, significant differences between countries in the approaches used for its implementation, and the degree of coverage. However, while there is (albeit sparse) evidence of the positive effects[14] of gender budgeting or its absence, there are no examples in the scientific literature of the negative effects of its use.[15]

Globally, countries have signed the Beijing Declaration and Platform for Action (BDPA) on gender equality and the empowerment of women, adopted by the 4th World Women Conference in 1995, and the 2030 Agenda for Sustainable Development (2030 Agenda). "Achieve Gender Equality and Empower All Women and Girls" is one of the SDGs under the 2030 Agenda.

Since the vast majority of the world's countries have committed themselves to the 2030 Agenda and are involved in tracking

[11] EIGE. Three reasons why gender budgeting is crucial in the EU Funds. URL: https://eige.europa.eu/gender-mainstreaming/toolkits/gender-budgeting/three-reasons-gender-budgeting-crucial-eu-funds (accessed on 04.02.2022).

[12] European Institute for Gender Equality. Economic benefits of gender equality in the EU: economic benefits of gender equality in the EU policy context. 2017. URL: https://data.europa.eu/doi/10.2839/77976 (accessed on 03.02.2022).

[13] IMF, UN Women. Gender Equality and COVID-19: Policies and Institutions for Mitigating the Crisis. 2021. 14 p. URL: https://www.imf.org/-/media/Files/Publications/covid19-special-notes/en-special-series-on-covid-19-gender-equality-and-covid-19.ashx (accessed on 03.02.2022).

[14] For example, a study among Indian states with widely divergent policies found statistically significant results that states practicing gender budgeting made more progress in achieving gender equality in primary school enrollment than states without it [12].

[15] Combaz E. Impact of gender-responsive budgeting. Helpdesk Research Report. GSDRC; 2013. 14 p. URL: http://www.gsdrc.org/docs/open/hdq977.pdf (accessed on 04.02.2022).

relevant statistics, it is possible to compare the results of the work and actions taken by countries. UN data show that of the 68 developing countries that received responses for 2018, 14 reported no mechanisms for indicator 5.c.1, 41 countries (including Belarus[16]) — reported partial compliance with the indicator, and 13 reported full achievement of the indicator.[17]

The 2016 International Monetary Fund (IMF) surveys identified government gender budgeting initiatives in 86 countries (out of 193),[18] with 23 countries demonstrating outstanding initiatives (including Sweden, Austria, Australia, Mexico, Republic of Korea[19]).

According to the 2018 Organization for Economic Co-operation and Development (OECD) Budget Practices and Procedures Survey, 17 participating countries[20] said they practice some form of gender budgeting, and in France and Turkey, the authorities were about to implement it soon.[21] At the same time, there were only 12 positive answers in the 2016 report [13].

It is worth noting that there are notable differences between countries in the extent, forms and approaches applied to the implementation of gender budgeting. For example, in Austria, it was part of large-scale reforms in the field of public finance, and in Belgium, implementation began with the adaptation of international obligations — the adoption of a law on monitoring the implementation of the BDPA [14]. Depending on the approach to the implementation of gender budgeting, the focus may be on budget expenditures or revenues, income tax, or other types of taxes.[22]

There are also differences in how spending on gender equality is allocated in the budget: reflecting gender equality indicators and activities can be a cross-cutting topic in many or all sections of the state budget (as in Austria[23]), in other cases, gender equality activities and related funding can be collected in one chapter of the budget (following the example of Sweden[24]).

Questions from the 2018 OECD Budget Practices and Procedures Survey allow for a more detailed look at possible instruments and other aspects of gender budgeting implementation (*Table 1*). All of them are collected in three large blocks: the legal basis, specific ways in which gender budgeting is implemented, administrative tools and approaches to support the implementation.

By the frequency of implementation of different aspects, one can indirectly judge the complexity of its implementation. Thus, it can be seen that the adoption of national strategies on gender equality, *ex ante* gender impact assessment, the inclusion of gender approach in the instructions of the central budget authorities, and the collection of gender disaggregated data are typical for most analyzed countries. At the same time, the constitutional entrenchment of gender budgeting is taking place only in two countries — Austria and Mexico. *Ex post* gender impact assessments are conducted less often than *ex ante* assessments, and gender audits of the budget are even rarer. At the same time, *ex ante* and *ex post* gender impact assessments are often limited to individual policies.

In post-Soviet countries, the implementation of gender budgeting has been slower com-

[16] At the same time, there are no data on this indicator in the National list of SDG indicators. URL: http://sdgplatform.belstat.gov.by/sites/belstatfront/index-info.html?indicator=5.c.1.1 (accessed on 04.02.2022).

[17] UN SDG Indicators Database. URL: https://unstats.un.org/sdgs/UNSDG/IndDatabasePage (accessed on 15.11.2021).

[18] Gender Budgeting and Gender Equality. URL: https://data.imf.org/?sk=AC 81946B-43E 4–4FF3–84C 7–217A6BDE 8191 (accessed on 15.11.2021).

[19] Belarus and Russia were noted as countries not practicing gender budgeting.

[20] Austria, Belgium, Canada, Chile, Finland, Germany, Ireland, Iceland, Israel, Italy, Japan, Republic of Korea, Mexico, Norway, Portugal, Spain, and Sweden.

[21] OECD. Government at a Glance 2019. URL: https://www.oecd-ilibrary.org/governance/government-at-a-glance-2019_8ccf5c38-en (accessed on 03.02.2022).

[22] Gender Budgeting and Gender Equality — IMF Data. URL: https://data.imf.org/?sk=AC 81946B-43E 4–4FF3–84C 7–217A6BDE 8191&sId=1472754305172 (accessed on 15.11.2021).

[23] Handbuch Wirkungsorientierte Steuerung. URL: https://www.oeffentlicherdienst.gv.at/wirkungsorientierte_verwaltung/berichte_service/Handbuch_Wirkungsorientierte_Steuerung_Mai_2013.pdf?8a9rsb (accessed on 04.01.2022).

[24] Utgiftsområde 13. Jämställdhet och nyanlända invandrares etablering. URL: https://regeringen.se/4a70ae/contentassets/cdd922ce835e4da0a87edcb38aafef65/utgiftsomrade-13-jamstalldhet-och-nyanlanda-invandrares-etablering.pdf (accessed on 04.01.2022).

pared to the best world practices, but in recent years, interest in gender issues has intensified in some of them. According to national reviews of the implementation of the BDPA,[25] almost all countries in the region have approved national strategies (programs or action plans) in the field of gender equality, defined goals, and prescribed measures to introduce some elements of gender budgeting; state bodies responsible for the policy of achieving gender equality have been identified, interdepartmental advisory bodies have been created. A number of countries are piloting projects and conducting gender equality budget assessments,[26] as well as independent assessments of the gender component in budget expenditures.[27]

RESEARCH METHODOLOGY

The methodological basis of the study was a set of criteria from the 2018 OECD Budget Practices and Procedures Survey in terms of the use of gender budgeting tools and the creation of appropriate legal, institutional, organizational, and other conditions.[28]

The premise of the study was that by analyzing the presence or absence of certain tools and conditions in the country, it is possible to determine the priorities and directions for further work of government bodies and other stakeholders on the development of gender budgeting in the country. A similar approach was taken to develop the Gender Budgeting Action Plan for Thailand [15] and recommendations on future directions for equality budgeting in Ireland [16].

In the academic literature, there are a number of approaches to the systematization of tools and methods for the implementation of gender budgeting [17]. However, the OECD approach mentioned above was taken as the most complete albeit not the most detailed one, which allows for determining the directions of reforms and quantitatively comparing the results achieved by countries.

The research methodology consisted in the analysis of the legal acts of the Republic of Belarus, state programs, scientific publications, Internet sources, official statistical information, and OECD survey data for compliance of state policy measures implemented in Belarus with international practice on the implementation of gender budgeting.

Additionally, in order to assess, as a first approximation, the extent to which the gender factor is taken into account in the areas of budget (program) expenditures, the analysis of state programs included the search for tasks, indicators, and activities related to gender issues, containing the following keywords (their parts and forms): “gender”, “equality”, “woman”, “female”, “mother”, “man”, “male”, “father”, “young woman ”, “girl”, “young man”, “boy”.[29] At the same time, if the activity did not imply a differentiated impact on men and women, then it was not taken into account.

In the course of the study, according to the methodology developed by the OECD, the “Composite index on gender budgeting” (CIGB) was calculated for Belarus. This indicator measures the extent to which the implementation of gender budgeting in the analyzed country complies with the recommendations and best practices of the OECD [7]. The CIGB calculation allows not only to quantify the progress made but also to visually compare different countries with each other. Those countries that score high on the composite indicator are expected to develop a comprehensive gender budgeting framework.

The CIGB consists of 15 individual indicators, reflecting criteria from the OECD survey, and grouped into three blocks: strategic framework, tools of implementation, and enabling environment. These blocks and their constituent indicators are included in the calculation of the composite indicator with different weights

[25] CSW64 preparations. URL: https://www.unwomen.org/en/csw/csw64–2020/preparations#reports (accessed on 04.01.2022).

[26] In Georgia, Kyrgyzstan, Moldova, and Ukraine.

[27] Rzhanitsina L.S. Expertise in social expenditures of the draft budget for 2013–2015, gender component. URL: http://genderbudgets.ru/biblio/rzhanicyna_soc_raskhody_bjudzheta_na_2013.pdf (accessed on 05.01.2022).

[28] 2018 OECD Budget Practices and Procedures Survey. URL: https://www.oecd.org/governance/budgeting/OECD-2018-Budget-Practices-and-Procedures-Survey.pdf (accessed on 04.01.2022).

[29] Based on the approach taken in the study on Slovenia [18].

Table 1

Characteristics of OECD countries on the application of certain aspects of gender budgeting

Implementation aspect (survey question)	Number of practicing OECD countries	Share of all practicing OECD countries, %
Legal basis		
Constitutional requirement	2	12
Budget law	6	35
Other specific legislation	5	29
High level political commitment/convention	8	47
Compliance with international law or instrument	2	12
Administrative practice (e.g. Budget Circular)	8	47
Specific tools (methods) of gender budgeting		
National/federal gender equality strategy	12	71
Gender resourcing needs assessment	9	53
Gender dimension in performance setting	10	59
Gender budget baseline analysis	8	47
Ex ante gender impact assessment of all major policies included in the budget	9	53
Ex ante gender impact assessment of selected policies included in the budget	13	76
Gender dimension in resource allocation	9	53
Gender budget statement with one or more of the following elements:		
general statement (descriptive)	7	41
progress statement (structured narrative)	5	29
gender allocations report (quantitative)	6	35
gender incidence analysis of specific measures	7	41
gender incidence analysis of budget as a whole	3	18
Ex post gender impact assessment of all major policies	3	18
Ex post gender impact assessment of selected policies	10	59
Gender audit of the budget	5	29
Gender dimension to performance audit	5	29
Audit of gender budgeting systems/processes	4	24
Gender dimension in spending review	4	24
Administrative tools and approaches to support the implementation		
Standard guidelines from central budget authority on how to apply gender budgeting	12	71
Annual budget circular includes details and instructions on the application of gender budgeting	9	53

Table 1 (continued)

Implementation aspect (survey question)	Number of practicing OECD countries	Share of all practicing OECD countries, %
Structured engagement with civil society on gender equality issues	7	41
Expert / consultative group advises on the application of gender budgeting	7	41
Inter-agency group(s) to ensure coordination and/or exchange of good practices on gender budgeting	9	53
Training and capacity-development in the application of gender budgeting	10	59
General availability of gender disaggregated data	11	65
Sector-specific availability of gender disaggregated data	11	65

Source: compiled by the author based on the OECD data. URL: https://qdd.oecd.org/subject.aspx? Subject=BPP_2018 (accessed on 15.11.2021).

Note: questions of type "Other, please specify" are not given.

depending on their significance for the gender budgeting framework.[30]

At the same time, it should be taken into account that the composite indicator is of a normative nature — only the formal existence of a particular instrument or enabling measure for gender budgeting is taken into account; CIGB does not measure how effectively they are implemented. The authors of the methodology argue that success is best measured by examining the extent to which the way governments allocate resources helps to achieve gender goals, which cannot be reflected in the proposed index.

The gaps identified as a result of the analysis in the implementation of certain aspects of gender budgeting in Belarus, according to the relevant OECD survey, formed the basis for the formation of a set of state policy measures for the further development of gender budgeting in the country.

THE GENDER AGENDA IN BELARUS

Among all countries, Belarus is characterized by relatively good positions in the area of gender equality. According to the World Economic Forum's Global Gender Gap Report 2020, Belarus ranks 33rd out of 153 countries in terms of the gender gap index and 6th in the Eastern Europe and Central Asia region. According to this indicator, Belarus lags far behind in the political component and occupies high positions in education and healthcare.[31]

In the Human Development Report 2020, Belarus was included in the group of countries with high equality in achievement on the Human Development Index between men and women. In the Gender Inequality Index, Belarus ranks 31st among 189 countries (27th in the 2019 report).[32] According to the OECD Social Institutions and Gender Index (SIGI), Belarus belongs to the group of countries with a low level of discrimination (21% — 35th place out of 180 countries in 2019).[33]

Ensuring equal opportunities for men and women is an integral part of the social policy in Belarus. According to Art. 32 of the Constitu-

[30] Composite indicators and their weights for calculating the composite indicator are not given due to the limitations on the volume of the article. They can be found in the original work in annex 1 [7].

[31] Global Gender Gap Report 2021. URL: https://www3.weforum.org/docs/WEF_GGGR_2021.pdf (accessed on 04.01.2022).

[32] 2020 Human Development Report. URL: http://hdr.undp.org/en/2020-report/ (accessed on 04.01.2022).

[33] SIGI 2019 Global Report. URL: https://www.oecd.org/publications/sigi-2019-global-report-bc56d212-en.htm (accessed on 04.01.2022).

tion, "women are provided with equal opportunities with men in obtaining education and training, in labor and promotion (work), in socio-political, cultural and other spheres of activity, as well as the creation of conditions for the protection of their labor and health." The general principle of equality is also enshrined in the Marriage and Family Codes, the Criminal, Civil, Labor, Education Codes, and other normative legal documents.[34]

The 6th National Action Plan for Gender Equality in the Republic of Belarus for 2021–2025 (GEAP) provides a strategic framework for achieving gender equality in Belarus. The Ministry of Labor and Social Protection was instructed to coordinate and control its implementation, ensure that its activities are reviewed at meetings of the National Council for Gender Policy under the Council of Ministers of the Republic of Belarus (NCGP), annually submit information on the implementation of the National Plan to the Council of Ministers.

One of the tasks of the National Plan is "to develop mechanisms for ensuring gender equality by introducing elements of gender analysis into the development of legislation and the formation of state programs, and the improvement of gender statistics".[35] In total, the National Plan provides for the implementation of 61 measures in five areas.

As part of the preparation of the previous GEAP for 2017–2020. The National Center of Legislation and Legal Research (NCLLR) conducted a gender analysis of the legislation to determine whether it complies with the provisions of the Convention on the Elimination of All Forms of Discrimination against Women and whether it contains provisions that discriminate against women. The examination showed that the national legislation is basically gender-neutral and does not contain provisions that would be discriminate against women.[36] However, independent experts express doubt that the examination carried out fully complied with international practice and standards.[37]

Gender equality issues are also reflected in high-level strategic and forecast documents. In the National Strategy for Sustainable Development of the Republic of Belarus for the period up to 2035, a whole subsection is devoted to ensuring equal rights and opportunities for men and women in all spheres of society.[38] The Program of Socio-Economic Development of the Republic of Belarus for 2021–2025 provides for measures to support mothers of large families and reintegrate women into the labor market.[39]

The Ministry of Labor and Social Protection of the Republic of Belarus (MLSP) is developing a draft Concept for Ensuring Gender Equality. As part of this work, in accordance with the decision of the NCGP in 2018, the concept was supplemented with a section on gender budgeting.[40] However, the draft concept has not yet been made public.

In Belarus, the issues of the status of women and gender equality are dealt with by the following state bodies: the NCGP; the Permanent Commission of the Council of the Republic of the National Assembly on Demographic Security and Social Development; the Permanent

[34] Eighth periodic report of States parties due in 2016, Belarus. CEDAW/C/BLR/8. United Nations, Committee on the Elimination of Discrimination against Women. New York; 2016. 48 p. URL: https://undocs.org/ru/CEDAW/C/BLR/8 (accessed on 04.01.2022).

[35] Decree of the Council of Ministers of the Republic of Belarus dated December 30, 2020 No. 793 "On the National Action Plan for Ensuring Gender Equality in the Republic of Belarus for 2021–2025". URL: https://pravo.by/upload/docs/op/C 22000793_1609880400.pdf (accessed on 04.01.2022).

[36] Decree of the Council of Ministers of the Republic of Belarus dated February 17, 2017 No. 149 "On Approval of the National Action Plan for Ensuring Gender Equality in the Republic of Belarus for 2017–2020". URL: https://www.mintrud.gov.by/system/extensions/spaw/uploads/files/Nats-plan.pdf (accessed on 04.01.2022).

[37] National Action Plan for Gender Equality: New or Well Forgotten Old? URL: https://eeprava.by/2017/03/nation-gender-plan/ (accessed on 04.01.2022).

[38] National Strategy for Sustainable Development of the Republic of Belarus for the period up to 2035. URL https://www.economy.gov.by/uploads/files/Natsionalnaja-strategija-ustojchivogo-razvitija-Respubliki-Belarus-na-period-do-2035-goda.pdf (accessed on 04.01.2022).

[39] Decree of the President of the Republic of Belarus dated July 29, 2021 No. 292 "On Approval of the Program of Social and Economic Development of the Republic of Belarus for 2021–2025". URL: https://www.economy.gov.by/uploads/files/macro-prognoz/Ukaz-292–1.pdf (accessed on 04.01.2022).

[40] Report on the implementation of the activities of the plan of the Ministry of Foreign Affairs of the Republic of Belarus in 2018. URL: https://www.mfa.gov.by/kcfinder/upload/files/GUMDI/20.04.15_plan_2018.pdf (accessed on 04.01.2022).

Commission of the House of Representatives of the National Assembly on Health, Physical Culture, Family and Youth; the Department of Education and Social-cultural sphere of the apparatus of the Council of Ministers, MLSP (Department of Population, Gender and Family Policy); local authorities for labor, employment and social protection at the regional level and other entities [19]. The key bodies for ensuring gender equality in the country are the MLSP and the NCGP.

The issue of gender equality, and in particular gender budgeting, is present to a certain extent in the public space of the country — informational, educational, and scientific.[41] In recent years, a number of educational and scientific seminars on gender budgeting,[42] round tables, and training on gender equality in public administration have been held [20, p. 338].

On the basis of the Academy of Public Administration under the President of the Republic of Belarus, a gender module for the formation of professional competence, a system for retraining and advanced training of managerial personnel was developed and included in the educational process of training highly qualified specialists in the field of public administration [20, p. 338]. The international public association "Gender Perspectives" offers to hold seminars and training on the inclusion of the gender factor in project and program activities.[43]

In the public domain, one can find the results of sectoral gender studies, in particular, devoted to the analysis of gender equality in the system of local government and self-government [19], in the justice system,[44] and in higher education legislation [21]; however, there are as yet no studies specifically addressing gender factor in the budget process.

At the national level, Belarus is actively developing a statistical base on gender equality issues. Thus, the National Statistical Committee of the Republic of Belarus (Belstat) in 2013, 2016, and 2018 published statistical digests "Women and Men of the Republic of Belarus"; in 2018, with the support of the World Bank, the brochure "Women Entrepreneurs in the Republic of Belarus" was published. The country conducted a multi-indicator cluster survey to assess the situation of women and children in 2019 and the first stage of the demographic study "Generations and Gender". An important event was the launch of the Gender Statistics web portal in 2021, which provides information across eight areas by 167 indicators.[45]

In the context of the gender agenda, Belarus cooperates with international organizations and institutions (UN Women, International Public Organization "Gender Perspectives"), and has signed the Convention on the Elimination of All Forms of Discrimination against Women of the UN General Assembly and its Optional Protocol, as well as the BDPA.

In 2021, a number of UN agencies in Belarus launched a new two-year SDG funding program..[46] It is planned that within the framework of this program, UN-Women, in close cooperation with the MLSP, will work to develop the competencies of civil servants in applying gender-sensitive budgeting tools in planning and budgeting. The Agency plans to conduct training on gender analysis, and promote the use of the principle of equal rights and opportunities in the development of state programs.

[41] Official website of the Ministry of Labor and Social Protection of the Republic of Belarus. URL: https://www.mintrud.gov.by/ru/new_url_semenari_konferencii (accessed on 04.01.2022).

[42] International educational seminar "New approaches to public financial management: inclusiveness and broad public involvement. Gender Budgeting and Other Aspects of Gender Policy". URL: https://www.minfin.gov.by/ru/journal/stuff/archive/2016/bef924084d4e4094.html (accessed on 04.01.2022); International Scientific Seminar "Gender Budgeting: World Experience, Prerequisites and Prospects for Implementation in the Republic of Belarus". URL: https://www.mintrud.gov.by/ru/news_ru/view/mezhdunarodnyj-nauchnyj-seminarnbspgendernoe-bjudzhetirovanie-mirovoj-opyt-predposylkinbspi-perspektivy-vnedrenija-v-respublike-belarus_2824/ (accessed on 04.01.2022).

[43] The site of the International Public Organization «Gender Perspectives». URL: https://www.genderperspectives.by/programs/gendernoe-ravenstvo/activity/ (accessed on 11.16.2021).

[44] Gender equality and justice in the Republic of Belarus. URL: https://rm.coe.int/prems-189819-rus-2019-gender-ok-web/16809ef14a (accessed on 04.02.2022).

[45] Gender statistics of the Republic of Belarus. URL: http://gender.belstat.gov.by/home (accessed on 04.02.2022).

[46] UN agencies are joining forces to promote new approaches to financing sustainable development in Belarus. YRL: https://belarus.un.org/ru/136304-agentstva-oon-obedinyayut-usiliya-dlya-prodvizheniya-novykh-podkhodov-k-finansirovaniyu (accessed on 04.02.2022).

It is expected that the United Nations Population Fund will help improve the efficiency of budgeting and spending in the health system.

One of the indicators of the National List of SDG indicators is 5.c.1.1 "Existence of mechanisms for tracking and publishing public spending on gender equality and women's empowerment".[47] To date, such a mechanism has not been developed and the corresponding indicator is not monitored.[48] Nevertheless, the achievement of the SDGs is one of the state priorities, which is reflected in the introduction of a number of indicators of the National List in state programs and in the development of a separate annex in them on the relationship between target indicators of programs with SDG indicators.

In accordance with paragraph 12 of the previous GEAP for 2017–2020, The Research Institute of Labor has developed methodological guidelines for taking into account the gender factor in the formation and implementation of state programs. Some elements of the gender factor from these recommendations were tested in the formation of the state program "Labor Market and Employment Promotion"[49] for 2021–2025. However, these methodological recommendations have not yet found wide and mandatory practical application. In addition, it is necessary to further develop methodological guidelines to gender analysis and evaluation of state programs to track budget expenditures for gender equality.

State programs are the most convenient source of information for conducting gender analysis and assessing budgetary expenditures, since the activities underlying them detail the amount of funding and are structurally interconnected with target indicators of results, and the coverage of the consolidated budget expenditures by state programs is at the level of 70%.[50] Through state programs in Belarus, the program-target method of budgeting (or performance-based budgeting) is being implemented, which, according to experts, is positively associated with the introduction of gender budgeting.[51]

Keyword analysis of the texts of the current state programs of the Republic of Belarus for 2021–2025 showed that only three of the 29 publicly available contain tasks, indicators, or activities that are directly related to the achievement of gender equality. In particular, the program "Labor Market and Employment Promotion" reflects measures to promote the employment of women with minor children and children with disabilities; the program "Small and Medium Entrepreneurship" has an activity to strengthen the capacity of the center for support and development of women's entrepreneurship. The program "Health of the People and Demographic Security" defines one task and 10 activities, including legal regulation measures.

In general, despite certain limitations of this approach to the analysis of state programs,[52] its results indicate a rather weak reflection of gender issues in budget expenditures.

EXISTING PROBLEMS IN THE SPHERE OF GENDER EQUALITY AND INTRODUCTION OF GENDER BUDGETING

The analysis of normative legal acts, documents of the budgetary system, state programs and strategies showed, that gender factor is not formally taken into account in the process of drawing up and executing the republican and

[47] National Review of the Implementation by the Republic of Belarus of the 1995 Beijing Declaration and Platform for Action on Gender Equality and the Empowerment of Women. URL: https://www.unwomen.org/sites/default/files/Headquarters/Attachments/Sections/CSW/64/National-reviews/Belarus.pdf (accessed on 04.02.2022).

[48] National platform for monitoring the achievement of the Sustainable Development Goals in Belarus. URL: http://sdgplatform.belstat.gov.by/sites/belstatfront/home.html (accessed on 04.02.2022).

[49] According to the results of the gender analysis, this program was recognized as gender-neutral.

[50] Consolidated final report on the implementation of state programs (subprograms) for 2016–2020, including an assessment of the effectiveness of their implementation. URL: https://www.economy.gov.by/uploads/files/gos-progr-2016–2020/itogovyj-otchet-2016–2020.pdf (accessed on 04.02.2022).

[51] IMF. Gender Budgeting in G7 Countries. IMF Policy Paper. 2017. URL: https://www.imf.org/-/media/Files/Publications/PP/pp041917gender-budgeting-in-g7-countries.ashx (accessed on 03.02.2022).

[52] State programs may contain activities that promote gender equality and do not meet the search criteria used.

local budgets, in the formation, monitoring and evaluation of state programs, in conducting spending reviews and in the work of the supreme audit institution (State Control Committee — SCC).

Gender budgeting issues are practically not reflected in the legislation, GEAP, activities of the state program "Public Financial Management and Regulation of the Financial Market" for 2020 and for the period up to 2025, in the Strategy for Reforming the Public Financial Management System of the Republic of Belarus,[53] in the Main Directions of Fiscal and Tax Policy of the Republic of Belarus. The Law on Gender Equality (on Ensuring Equal Rights and Opportunities for Men and Women) has not yet been adopted, the Concept for Ensuring Gender Equality in the Republic of Belarus has not been approved, and there are no specialists on budgeting in the working group for its development.[54] There is no (at least in the public domain) information about the implementation of GEAP and the work plans of the NCGP.

Belarus lacks trained specialists who would deal with issues of gender equality and gender expertise; systemic gender education is not developed; there is no understanding of the gender approach and the relevance of its application in the work of civil servants [19].

The researchers note that, despite the relatively high level of education and qualifications of women, a noticeable wage gap remains in the labor market. Belstat's statistics show that the gender gap in monthly wages in the economy as a whole for 2016–2020 increased by 5.2% and amounted to 26.7% in 2020 (*Table 2*). The wage gap widened in 13 out of 18 economic activities; in eight activities it was more than 25%, and in three it exceeded 40%. In many cases, these are sectors where the majority of jobs are occupied by women: health care, culture and sports, hotel and restaurant activities, wholesale and retail trade, financial and insurance activities.

There is still a gender gap in the choice of specialty for education in the country. If in aggregate in such areas as pedagogy, the humanities, social protection, economics, law, communications, art and design, women make up 72% of graduates, then in specialties related to engineering and technology, architecture and construction, agriculture and forestry — only 31%.[55] Women make up about a third of individual entrepreneurs and owners (founders) of companies in the country.[56] Disproportions remain in advancement along the scientific path: if among the researchers of the country the share of women is 41%, then among doctors of sciences it is only 22%.[57]

While women make up 53.8% of the country's population, they hold less than 35% of parliamentary seats (although they form almost half of senior civil servants and about 70% of all civil servants). There are disparities in household decision-making and family spending, and problems persist with domestic violence, work-life balance, and the amount of unpaid work. For example, women spend on average twice as much time as men on housework and childcare.[58]

Official statistics show that there are practically no differences between the status of men and women in access to education, health care, and ICT services; according to some indicators, the situation of men is even somewhat worse, which also requires an appropriate analysis and implementation of follow-up measures.

[53] Defined by the Decree of the Council of Ministers of the Republic of Belarus dated December 23, 2015 No. 1080 "On reforming the public finance management system of the Republic of Belarus".

[54] Order of the Ministry of Labor and Social Protection of the Republic of Belarus dated 01.09.2011 No. 90 "On approval of the composition of the working group to develop a draft Concept for Ensuring Gender Equality in the Republic of Belarus". URL: https://mintrud.gov.by/system/extensions/spaw/uploads/files/sostav-rabochej-gruppy-po-razrabotke-koncepcii.pdf (accessed on 04.02.2022).

[55] Women and men of the Republic of Belarus, 2018. URL: https://www.belstat.gov.by/ofitsialnaya-statistika/publications/izdania/public_compilation/index_9283/ (accessed on 04.02.2022).

[56] Women Entrepreneurs in the Republic of Belarus. URL: https://www.belstat.gov.by/upload-belstat/upload-belstat-pdf/oficial_statistika/Women_biznes_Belarus.pdf (accessed on 04.02.2022).

[57] Statistical review for the World Science Day. URL: https://www.belstat.gov.by/ofitsialnaya-statistika/publications/izdania/public_reviews/index_41719/ (accessed on 04.02.2022).

[58] How we use our time. URL: https://www.belstat.gov.by/upload-belstat/upload-belstat-pdf/oficial_statistika/time_rus.pdf (accessed on 04.02.2022).

Table 2

Gender wage gap and share of women in the total number of employees in Belarus in 2020

Economic activity	Monthly gender wage gap		Share of women in the total number of employees, %
	Wage gap in 2020, %	Difference between 2016 and 2020, p.p.	
All types of economic activities	26.7	–5.2	52.5
Transportation and storage	4	4.6	31.9
Real estate transactions	8	–5.6	50.9
Education	8.3	7.5	80.9
Agriculture, forestry and fishing	11.2	–4.9	37.8
Administrative and support service activities	13	1.6	52.3
Water supply; sewerage, waste management and remediation activities	14.3	0.3	29.2
Construction	14.9	1.1	17.4
Electricity, gas, steam and air conditioning supply	16.5	–1.1	27.3
Accommodation and food service activities	19.7	–10.9	69.8
Human health and social work activities	21	–6.2	84.8
Professional, scientific and technical activities	25.6	–6	56.1
Industry as a whole	26.2	–4.2	39.2
Manufacturing	27.2	–4.3	41.9
Financial and insurance activities	27.6	–8.1	72.4
Mining and quarrying	29.9	–5.3	20.1
Wholesale and retail trade; repair of motor vehicles and motorcycles	30.7	–16.6	64.1
Other service activities	40.6	–3.6	66.8
Arts, entertainment and recreation	42.7	–2.6	60.7
Information and communication	44.7	–9	41.2

Source: compiled by the author based on the Belstat data. URL: http://gender.belstat.gov.by/home; URL: https://www.belstat.gov.by/upload/iblock/0f6/0f69557d173046e0f934285302bdc434.pdf (accessed on 12.01.2022).

Men tend to have shorter life expectancies, higher rates of unemployment, and industrial injuries; among men, tobacco consumption, alcohol abuse, the number of HIV-infected people and those who died from accidental alcohol poisoning are noticeably higher, as well as the number of those who have committed crimes, and those convicted.

In general, despite some progress in the field of gender equality, and the development of an appropriate legislative, institutional and statistical framework, the issues of introducing gender budgeting in Belarus are currently poorly developed. In addition, in this area, there is no necessary educational and methodological literature, and practically no work is being done to change the values of women's participation in public life and the economy.

RESULTS AND RECOMMENDATIONS

Comparison of the results of the analysis of legal, statistical, and other information with the criteria from the OECD survey made it possible to calculate the CIGB index for Belarus and compare the obtained level with the OECD countries (see *Figure*). Depending on the CIGB values, countries are classified as having advanced gender budgeting practice (values of 0.9 and above), mainstreamed (from 0.5 to 0.9), introductory (from 0.2 to 0.5), and limited practice (up to 0.2) when gender budgeting is practically not developed. The CIGB values show that almost half of the OECD countries that have implemented gender budgeting are in the "basic" category, with no country reaching the advanced level in 2018.[59]

Of all the underlying variables, Belarus received three points: for having a National Strategy for Gender Equality (GEAP), sectoral and general statistics disaggregated by sex. The final CIGB value was 0.195. Thus, Belarus has the simplest, most basic aspects of gender budgeting and, compared to OECD countries, there is significant potential for further development.

Based on the identified gaps and an approximate assessment of the necessary labor and time costs to eliminate them, promising directions for the development of gender budgeting in Belarus were identified, taking into account the existing specifics of the state structure and the recommendations of the OECD and the IMF. Structurally, these areas were formalized in the form of a set of measures (action plan), presented in *Table 3*.

The objective of this action plan is to organize and coordinate the work of the republican government bodies and other organizations and citizens on the implementation of gender budgeting in the Republic of Belarus. To this end, in the action plan and relevant regulatory legal acts, gender budgeting (taking into account the gender factor in the budget process) can be defined as a method of managing budget funds that contributes to the achievement of gender equality at all stages of the budget process.

The timing of the implementation of activities in *Table 3* was determined based on the most probable minimum required time for their implementation and without reference to a specific year of the beginning of implementation. The composition of the participants in individual measures can be adjusted depending on the decisions made regarding the functions and responsibilities in the implementation of gender budgeting. In the future, the action plan can be reviewed and refined depending on the current situation, the capabilities, and needs of the participants, and the coordinating body. In particular, a column describing the expected results of the implementation of measures may be provided.

In order to introduce gender budgeting, it is necessary first of all to establish the future roles and responsibilities of state bodies in this process. Up to this point, the key coordinating and methodological role can be assumed by the MLSP and the NCGP, which directly follows

[59] Since 2018, gender budgeting practices in the OECD countries reviewed may have changed. In particular, according to a more recent IMF survey, some gender budgeting tools have already been introduced in France. However, more recent data on the OECD methodology are not available, and recalculation of the indicator values is not possible due to differences in the IMF and OECD surveys and the lack of free access at the time of preparation of this article to the source data on the IMF methodology for countries outside the G20. At the same time, in general, the approaches of the IMF and the OECD to assessing the degree of implementation of gender budgeting are quite close.

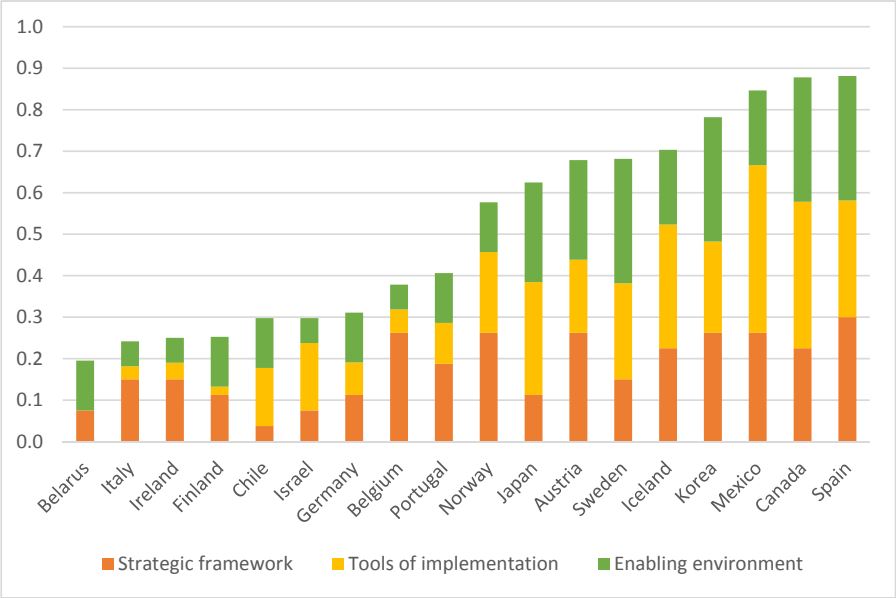

Fig. **Composite indicator on gender budgeting for selected countries**

Source: compiled by the author based on [7], own analysis and the OECD data. URL: https://qdd.oecd.org/subject.aspx? Subject=BPP_2018 (accessed on 15.11.2021).

from their goals, objectives, and functions,[60] and since the MLSP still has the greatest competence in this area.

After defining the responsibilities and training of civil servants, some of the functions of gender analysis and evaluation can be transferred to assigned employees in line ministries and departments. Based on the results of meetings of state bodies, a decision can be made to create a separate permanent collegial authority (working group, commission, or council) on gender budgeting.

It is recommended to first test gender budgeting tools on a limited set of state programs to identify problem areas before undertaking larger reforms and extending a gender perspective to all state programs.

The full implementation of gender budgeting in many countries began with individual pilot projects that were limited in time and tested in individual government bodies, regions, programs, or sectors. The experience of OECD countries shows that gender-responsive budgeting particularly stimulates the development of policies to improve gender equality in the following areas: education, the labor market, income inequality, citizen security, childcare and family health, welfare, foreign and development policy [13].

Based on the above conclusions from the analysis of state programs and existing problems in the country in the field of gender equality, we can conclude that the following state programs for 2021–2025 are the most relevant for the implementation of the pilot project on the introduction of gender budgeting: "Health of the people and demographic security", "Social Protection", "Labor Market and Employment Promotion", "Education and Youth Policy". At the same time, the implementation of the pilot project should not be limited to social programs: many state programs are aimed at developing various types of infrastructure, the real sector, or ensuring the functioning of government agencies in areas where there are also problems with inequality. Therefore, it is proposed to include in the pilot project the state programs "Small and Medium Enterprises" and "Public Finan-

[60] Regulations on the Ministry of Labor and Social Protection of the Republic of Belarus. URL: https://etalonline.by/document/?regnum=C 20101589 (accessed on 04.02.2022); Decree of the Council of Ministers of the Republic of Belarus dated 30.06.2012 No. 613 "On approval of the Regulations on the National Gender Policy under the Council of Ministers of the Republic of Belarus and its composition". URL: https://www.mintrud.gov.by/system/extensions/spaw/uploads/files/Polozhenie-o-Natsionalnom-sovete.pdf (accessed on 04.02.2022).

Table 3

Action plan for the implementation of gender budgeting in Belarus

Action	Timeline	Participants
Direction 1 — Development of a strategic, legal, and methodological framework		
1. Determination of clear roles and responsibilities of government bodies in the field of gender budgeting (GB); determination of the scope and approaches to the introduction of GB in Belarus	During the year	NCGP, Council of Ministers, MLSP, Ministry of Finance, Ministry of Economy, National Assembly; scientific institutions (SIs), public organizations (NGOs), international organizations (IOs)
2. Determination of a permanent collegial authority that would take on the main coordinating role in the implementation of GB (NCGP or the formation of a separate body)	During the year	Council of Ministers, NCGP, Ministry of Finance, MLSP, Ministry of Economy
3. Inclusion in the work plans of the NSGP of measures for the implementation of the GB in the budget process and state programs (SP)	During the year	NCGP
4. Inclusion in the NCGP of representatives of the Ministry of Finance and the Ministry of Economy dealing with the organization of the budget process and the SPs	During the year	NCGP, the Ministry of Finance, the Ministry of Economy
5. Formation of a national plan (strategy) for the introduction of GB in Belarus or a comprehensive reflection in the GEAP of the policy on the implementation of GB in the budget process and the SPs	During the year	Council of Ministers, the MLSP, the Ministry of Finance, the Ministry of Economy, line ministries and agencies
6. Strengthening control over the implementation and reporting on the implementation of the GEAP	During the year	Council of Ministers
7. Harmonization of gender equality indicators from the GEAP, the National List of SDG indicators, Belstat, and SP gender statistics	During the year	NCGP, Belstat, Ministry of Economy, line ministries and agencies
8. Reflection in the Main Directions of Fiscal and Tax Policy of the Republic of Belarus of measures for the implementation of the GB into the budget process	During the year; as needed	Ministry of Finance
9. Development of new or modification of existing instructions (guidelines, procedures) to reflect gender aspects in the budget process, in the formation and evaluation of the SPs	Within 1–2 years	Ministry of Finance, Ministry of Economy, MLSP
10. Introduction of the GB concept into the regulatory legal framework (into the Budget Code, into existing legal acts, or through the adoption of new ones). A requirement may also be introduced for government bodies to set goals, indicators, and expenditures aimed at achieving gender equality	Within 2 years	Council of Ministers, Ministry of Economy, Ministry of Finance, MLSP, National Assembly
Direction 2 — Creating a supportive environment for the development of gender budgeting		
11. Publication of educational and methodological literature on GB, preparation of training courses, and inclusion of GB issues in curricula in EIs	Within 2 years	Educational Institutions (EIs), SIs, NGOs, IOs
12. Training and capacity building in the field of GB for representatives of government bodies and other persons professionally related to issues of gender equality, budget policy, implementation and evaluation of the SPs	Every year	EIs, MLSP, Ministry of Finance, Ministry of Economy, NGOs, IOs
13. Conducting round tables, seminars, and other advisory activities on the subject of GB with the participation of civil servants, civil society, and international and public organizations	Every year	MLSP, the Ministry of Finance, the Ministry of Economy, line ministries and agencies, SIs, EIs, NGOs, IOs

Table 3 (continued)

Action	Timeline	Participants
14. Intensify work with the population to reflect the gender factor in the SPs and evaluate the results of the SP in terms of achieving gender equality	Every year	MLSP, Ministry of Economy, Ministry of Finance, NGOs, IOs
15. Introduction in the reports on the implementation of the SPs of gender disaggregated statistics, where possible and relevant. Increasing the availability of reports from line ministries and agencies on the implementation of the C	Every year	Ministry of Economy, Ministry of Finance, line ministries and agencies
16. Expanding the number of areas in which gender statistics are collected and published	Within 2 years	Belstat, Ministry of Finance, line ministries and agencies
Direction 3 — Introduction of gender budgeting tools		
17. Analysis of the impact on gender equality of the existing distribution of public expenditures and activities of SPs	During the year; periodically	MLSP, Ministry of Finance, Ministry of Economy; SIs, NGOs, IOs
18. Determining the needs for budget resources, and clarifying the scope of activities, tasks, and indicators to achieve gender equality. Determination of the list of pilot SPs for the implementation of the GB (if the GB is not implemented immediately in all or many SPs)	After the implementation of paragraph 17; during a year; every year	MLSP, Ministry of Finance, Ministry of Economy, line ministries and agencies, NCGP; SIs, NGOs, IOs
19. Inclusion in the SPs (all or pilot) of targets, activities, and other elements related to the achievement of gender equality	After the implementation of paragraphs 17, 18; during the year	Ministry of Economy, line ministries and agencies, Council of Ministers
20. Tagging state programs (all or pilot) and (or) their elements in terms of compliance with the goal of achieving gender equality	After the implementation of paragraph 9; during a year; as needed	MLSP, the Ministry of Economy, line ministries and agencies; SIs, NGOs, IOs
21. Ex ante gender impact assessment of activities included in the SPs	After the implementation of paragraph 9; during a year; as needed	MLSP, NCLLR; SIs, NGOs, IOs
22. Publication of a statement (report) on gender aspects of the republican budget	After the implementation of paragraph 10; every year	Ministry of Finance
23. Conducting spending reviews, taking into account the analysis of the compliance of expenditures with the goals of gender equality	Periodically	Ministry of Finance; IOs
24. Accounting for the gender factor and analysis of the implementation of gender budgeting during inspections (audits) of the execution of the republican budget and SPs	Every year	SCC
25. Carrying out ex post SPs gender impact assessments and publishing their results	After the implementation of paragraph 9; every year and in general for 2021–2025	MLSP, Ministry of Economy, NCLLR; SIs, NGOs, IOs
26. Conducting gender resourcing needs assessment, ex ante gender impact assessment, and the formation of SPs for 2026–2030 taking into account the gender factor	2025	MLSP, Ministry of Economy, Ministry of Finance, line ministries and agencies, NCLLR; SIs, NGOs, IOs

Source: compiled by the author.

cial Management and Regulation of the Financial Market".

In the absence of the competence of state bodies and the need for additional expertise, international organizations, as well as educational and scientific institutions and non-governmental organization can assist in the implementation of paragraphs 1, 17, 18, 20, 21, and 25 of the set of measures at the initial stage of the gender budgeting implementation (up to before developing instructions, procedures or guidelines at the national level).

Gender labeling is proposed not for state programs as a whole, but either by labeling relevant elements of programs or by forming special annexes, as happened with SDG indicators. At the same time, as a result of consultations between state bodies, a decision can be made to implement a separate program dedicated to gender equality issues. In this case, it is recommended to give it a cross-cutting (intersectoral) feature, so that the activities of the program are reflected in a wide range of other state programs and, possibly, cover areas of the economy and public life beyond them.

Publication of the results of the gender analysis and subsequent assessment of the gender impact of the activities of the state program can be made in the form of an appendix to the consolidated annual report on the implementation of the state program.

It is also important to take into account the gender factor at the level of local budgets, which involves the use of gender budgeting tools in relation to regional programs (regional sets of measures), the inclusion of relevant indicators and activities in them.

However, to achieve gender equality, it is not enough to implement the gender factor in state programs; this requires a whole-of-government approach that more comprehensively covers the budget process [7, p. 68]. The starting point for the development of gender budgeting is the awareness of its relevance at the government level, which is expressed in the setting of certain goals (and indicators) for ministries, and the adoption of a separate legal act on gender budgeting (law, decree, or resolution), amendments to existing documents (Budget Code, Instructions of the Ministry of Finance on the procedure and deadlines for submitting materials for the preparation of a budget application, Instructions on the requirements for the structure of the state program and the content of reports on the results of the implementation of the state program,[61] Regulations on the formation, financing, implementation and evaluation of the effectiveness of state programs[62]).

Further steps in gender mainstreaming may include introduction of the gender factor in public procurement, impact assessment of regulations; the adoption of a law on gender equality; strengthening the role of the Parliament (National Assembly of the Republic of Belarus) in the formation and execution of the republican budget. In the future, the gender approach can be extended to other groups of the population, in addition to women and girls: the elderly, children and youth, and rural residents [22, p. 508]. Particular attention should be paid to budget expenditures and activities of state programs in the context of overcoming the consequences of the COVID-19 pandemic in order to provide support to especially vulnerable and affected categories of citizens.

It is recommended that gender statistics be further developed to cover more areas and be collected more frequently, and that gender disaggregated public expenditure and revenue data are also available.[63]

In order to successfully achieve gender equality, in addition to formal measures (legal, institutional), informal tools aimed at changing culture, thinking, and behavior, combating stereotypes, and demonstrating positive role models are also important [3].

It should be noted that the methodological tools used in the article do not allow drawing more detailed conclusions and recommendations specific to each state program, activity, or

[61] Approved by the Decree of the Ministry of Economy of the Republic of Belarus dated August 19, 2016 No. 51.

[62] Approved by Decree of the President of the Republic of Belarus dated July 25, 2016 No. 289.

[63] This refers, for example, to data on budget expenditures aimed at achieving gender equality, the distribution of expenditures between women and men (girls and boys), as well as information on the impact of tax policy on the situation of men and women.

aspect of gender budgeting. The results of the study allow, as a first approximation, to formulate directions for further work on the implementation of gender budgeting in Belarus and can serve as a basis for further discussion and development of more specific recommendations.

CONCLUSION

Gender budgeting is an important tool for managing the budgetary resources of the state, which contributes to achieving gender equality, increasing the efficiency and transparency of the state budget. Successful implementation of gender budgeting contributes to the achievement of the Sustainable Development Goals and gender equality, which in turn leads to increased social cohesion and economic well-being.

Belarus, in comparison with OECD countries practicing gender budgeting, demonstrates great potential for further development. Some elements of the future system have already been created: official gender statistics are being collected and published, the National Action Plan for Gender Equality is being implemented, and relevant analytical and methodological materials are being developed. In addition, the use of the program-based budgeting makes it possible to link budget expenditures with specific results of socio-economic policy, and some state programs already contain separate measures aimed at achieving gender equality. However, the work done so far by state bodies is not enough to talk about the real reflection of the gender factor in the budget process: gender budgeting is not only not practiced, it is not reflected in regulatory legal acts and documents of a strategic and program nature, there is no understanding of the need for its implementation among politicians and the public.

Belarus is characterized by a relatively equal position of women and men in society and the economy, and good positions in the relevant international rankings, but many issues related to inequality remain unresolved. Government agencies, public organizations, civil society, and other stakeholders have yet to work together to effectively implement specific gender budgeting tools in the country. The set of measures and recommendations outlined in the article is an attempt in general terms and at the same time to systematically describe the necessary steps to implement gender budgeting in Belarus, adapting the experience of other countries and the recommendations of international organizations.

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Trends in the Evolution of the Digital Financial Assets Market in the Context of the Digital Transformation of the Global Economy

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ABSTRACT

The study focuses on identifying the driving forces behind the digital transformation of the economy in the financial sector and the development of the digital financial assets (DFA) market. The **subject** of the research is the factors of digital transformation and the DFA market. The **relevance** is due to the transformation of the world economy, associated, among other things, with the active development of the DFA market, the expansion of the possibilities of using distributed ledger technologies (DLT) and blockchain against the background of high growth rates of the cryptoasset market. The **aim** of the paper is to summarize the main trends in the development of the global cryptoasset market, determine the main factors of investment attractiveness of cryptocurrencies and explore the conditions for the successful implementation of various models of digital currencies of central banks (CBDC). In the course of the work, the **methods** of systematization and classification of information, multivariate statistical analysis were used. As a **result** of the study, 5 clusters of cryptocurrencies were identified, depending on the dominance in the market and the dynamics of price changes. The resulting functions can be used to predict the attribution of cryptocurrencies to the corresponding clusters. Among the factors that have a significant impact on the development of CBDC projects in general and with the wholesale model in particular, one can single out "capital". At the same time, CBDC projects with a retail model are actively and successfully implemented in countries with a high level of technical knowledge and entrepreneurial talent, ahead of the capital factor in their importance. Taking into account the review of global trends, the development of fintech technologies, it was **concluded** that the processes of digitalization of financial assets are inevitable, the emergence of new forms of digital assets that dictate the need for the advanced development of their legal regulation.
Keywords: digital financial assets; cryptocurrency; digital currency; digitalization; fintech

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INTRODUCTION

Huge interest in the development of blockchain technologies in the financial sphere and the emergence of digital financial assets (DFA) is connected with the active phase of the V technological order based on digital technologies. The pandemic has also accelerated the digitalization of both the global and Russian economies.

In order to monitor processes and assess the effectiveness of digital transformation, various global institutions are monitoring them, resulting in a large number of different indices and ratings.

For example, according to the Maturity Index GovTech 2020 of World Bank's, Russia is not among the group of leading countries in the field of digital transformation of the public sector, but the process is highly valued as focused on GovTech [1]. The methodology for calculating the index involves the following stages in the evolution of the public sector, depending on the state of the technological base and the organization of processes: analog government, e-government, digital government, GovTech government. The last stage is characterized by a system-wide public approach to the introduction of digital technologies, capable of ensuring universal access to services for citizens, a simple, efficient and transparent system of government.

Another indicator that measures the scale of the digital transformation of the economy is the Digital Competitiveness Index IMD. By this indicator, Russia moved from 38th to 43rd place in 2020, improving position in 2021 to 42nd place (*Fig. 1*).

According to the given rating in Russia the situation has improved on the factor of "knowledge" and "readiness for the future", and worsened — by factor "technology" due to deterioration of rating by sub–factor "capital" and "technological structure".

Similar to the previous UN rankings, the rating of e–government development is EGDI, which is represented by three factors: online services index (OSI), telecom infrastructure index (TII) and human capital index (HCI).[1] Russia ranked 36th on this indicator in 2020.

Thus, the digitalization of all fields of activity has become central to the global competitiveness of national economies.

DIGITAL FINANCIAL ASSET DEVELOPMENT

The financial sector responded to this process with the emergence of digital financial assets [2] and fintech, including technology–based distributed registries and blockchains [3]. While there are "Blockchain 1.0" — operations with cryptocurrency; "Blockchain 2.0" — transactions outside of cryptocurrencies; "Blockchain 3.0" — operations in the spheres of state and municipal administration, health care, education, Internet of things [4].

However, the emergence of a new type of financial asset — digital — and the new technological base have created some difficulties in its regulation and application.

Can be identified the following main problems that constrain the development of the DFA market in Russia at present:

- insufficient legal framework for the regulation of certain types of DFA [2, 5];
- initial stage of development of the DFA turnover infrastructure;[2]
- cautious attitude financial regulator to blockchain platforms, prohibition on the use as a means of payment and exchange of the most important type of DFA — cryptocurrency [2];
- initial state of standards and infrastructure for interoperability of blockchain platforms;[3]

[1] UN research: e-government 2020. URL: https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20-%20Russian.pdf (accessed on 19.10.2021).

[2] Currently there are no certified DFA market operators. Masterchain "Fintech" Association's blockchain platform is certified by the Federal Security Service of the Russian Federation and in the future may become the first information system — certified operator of the Russian DFA market.

[3] At the same time, the Visa payment system made the first transfers with cryptocurrencies and launched in a test mode on the basis of the Ethereum Ropsten network a prototype of the universal payment channel (UPC), in the future allowing for the conversion of various digital assets (tokens, stablecoins, CBDC).

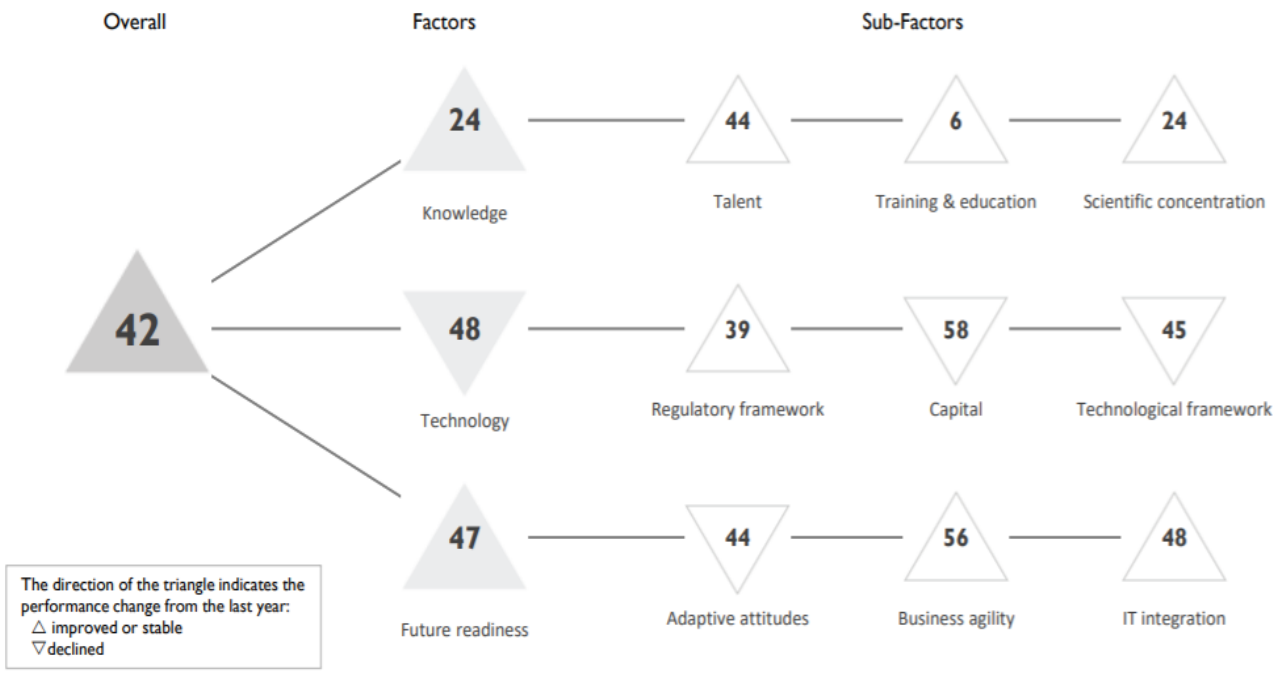

Fig. **Profile of Russia by IMD Global Digital Competitiveness Ranking 2021**

Source: Institute for Management Development (IMD). World digital competitiveness ranking 2021. URL: https://www.imd.org/centers/world-competitiveness-center/rankings/world-digital-competitiveness/ (accessed on 19.10.2021).

- high risks associated with non-compliance with international standards on combating money laundering and the financing of terrorism (CML/FT) and enforcement capacity [6];
- risks to the stability of the financial system and the provision of information security measures at the introduction of the national digital currency [7];
- high volatility and speculation of the cryptocurrency market [8];
- relatively few Russian startups in the field of application and distribution of DLT technology.[4]

At the same time, the global market of DFA is actively developing — there is a high rate of growth of the market of crypto assets and investment in research to expand the opportunities for practical application of DLT-technologies.

According to CoinGecko, the market capitalization of the crypto market in 2020 demonstrated a historic maximum of 732 bln USD: capitalization growth of the top — 30 coins amounted to 308%, and the capitalization growth of the top-5 stablecoins-439%.[5]

Tether remained the dominant stablecoins with market share over 76%. Stablecoins growth in 2020 exceeded the previous year's growth (107%) due to strong demand from traders using stablecoins for trade and cross-border settlements. Bitcoin (BTC) in 2020 showed a return of 303% and significantly outperformed all major classes of financial assets.[6]

In 2020, there was also a boom in financial innovation related to decentralized finance — DeFi (flash credits, automated market makers, pharming income, algorithmic stablecoins). Capitalization of DeFi market at the end of the year amounted to 20.4 bln USD, average price increase DeFi-tokens — 718%. The 2021 year was marked by explosive growth of memcoins.[6]

As a result of the rapid development of the crypto market, the total number of crypto-

[4] Based on the Skolkovo projects.

[5] Data from CoinGecko. 2020 Yearly Cryptocurrency Report. 2021. URL: https://assets.coingecko.com/reports/2020-Year-End-Report/CoinGecko-2020-Report.pdf, (accessed on 19.10.2021).

asset accounts for service providers for the period 2016–2020 increased by 4 times, to 191 million new accounts [9].

Based on the results of the review of the literature, the following trends characteristic of the development of the world crypto market were identified:

- cryptocurrency market is characterized by the transition from monopolized to competitive [10];
- predictability of cryptocurrencies returns decreases with their market liquidity [11];
- cryptocurrency price dynamics depend on bitcoin price dynamics. And bitcoin is the safest asset in the cryptocurrency ecosystem [10];
- disproved the hypothesis that cryptocurrencies are considered an alternative to fiat currencies or regulated finance [12];
- due to the high volatility of cryptocurrencies are seen more as investment speculative instrument than as monetary units [13, 14];
- active development of blockchain platforms that extend the scope of DLT technology: 19 of the top 20 tokens are built on Ethereum;
- Ripple was able to attract more than 100 banks to its platform, Western Union [10] and Visa, invested 250 mln USD in support of Non-Fungible Tokens (NFT);[6]
- rapid development of decentralized finance services (DeFi), decentralized applications (DApps), NFT [15];
- use of DLT by regulators in SupTech and RegTech (47% — share of the technology)[7];
- the possibility for investors to use bitcoin to diversify their investment portfolio during economic and political crises, in case of significant oil price fluctuations [11];
- most ICOs are in information goods industries with marginal production costs near to zero, and in innovative industries where entrepreneurship plays an important role. In financing preference should be given to token, rather than equity in case of low volatility [16];
- ICO is expected to be more distributed for businesses:

– developing information and products with low marginal production costs;

– demanding entrepreneurial efforts;

– developing products with relatively low demand volatility;

– working in industries with moderate information asymmetry between entrepreneurs and external investors [16];

- monopoly on the mining market: mining pools (10% of all miners) control 80% of cryptocurrency production. 30% of miners considered that the leadership of the pools determines the decision [9];
- 51% attack threat for blockchain projects based on Proof-of-Work (PoW) consensus algorithm. Development of projects on the Proof of Stake (PoS) protocol will mitigate these risks and increase transaction security;[8]
- cryptocurrency exchanges are mainly used for fiat transfers (conversion of fiat currencies into cryptoassets and back);
- retail customers of crypto exchanges constitute the vast majority (from 63 to 75% depending on the region), the share of business and institutional customers ranges from 10 to 30%. Crypto–hedge–funds account for the largest share of institutional and business clients,[9] miners and online–shop [9];
- the overwhelming share of service providers in the cryptomarket of the Asia-Pacific and North American regions has reserves of cryptoassets, which increases customer confidence in them;
- the largest share of licenses of legal entities operating in the cryptomarket were issued by regulatory authorities of the UK and the US (23%). 72% of licensees or applicants have received or applied for a license/registration in their country. Among the types of licenses ob-

[6] RRC article. Ripple has launched a $ 250 million fund to support the NFT industry. 2021. URL: https://www.rbc.ru/crypto/news/61548d199a79472745fb1bac (accessed on 19.10.2021).

[7] Data of the Bank of Russia. Main directions of development of technologies SupTech and RegTech for the period 2021–2023. 2021. URL: http://www.cbr.ru/Content/Document/File/120709/SupTech_RegTech_2021–2023.pdf, (accessed on 19.10.2021).

[8] Despite the fact that BTC is based on the protocol Proof-of-Work, to carry out the attack 51%, experts estimate that miners will need about 1 billion USD, which makes this event unlikely and indicates the BTC's stability to this threat.

[9] Excluding Middle East and Africa.

tained, the largest share are licenses for cryptocurrency operations (42%), payments and e–money (29%) [9];

- before the introduction of restrictive measures for cryptocurrency mining, China ranked first with a share of 52%, the share of the US and Canada was 12 and 9%, the share of Russia and Kazakhstan — 4% each [9];
- the overwhelming number of cryptomarket service providers supports BTC (90%), the share of support providers of the most popular types of cryptocurrency (ETH, LTC, BCH, XRP) ranges from 74 to 47% [9];
- among the most significant risks to miners in Europe and North America are the risk of centralized capacity in the hands of criminals, the concentration of equipment and miners in a certain geographical area;
- among the most significant risks for service providers in the cryptomarket are identified risks in the field of IT-security and increasing the burden normative regulation of the market [9];
- the most attention of regulators are: consumer protection, the KYC process (know your customer) for remote identity, lack of understanding and awareness of risks, cyberstability and reliability of technological platforms;[10]
- 43% of countries identify fintech as a financial stability risk. In low–income countries, this figure is 57%;[11]
- there is no ban on crowdfunding in 77% of jurisdictions, primary coins and cryptocurrency issuance (mining) is allowed in 67% of, crypto exchanges — in 61% of countries;[11]
- anonymous participation in crowdfunding is prohibited in 13% of countries, the initial release of coins and the issuance of cryptocurrencies (mining) — in 3 and 2% of countries respectively. At the same time, the proportion of countries banning anonymous participation in crowdfunding and crypto exchanges is significantly higher among high-income countries — 16%;[11]
- among the countries that have established regulatory "sandboxes", 66% of these are owned by central banks or other regulatory authorities. In most countries (67%) "normative sandboxes" are separated from payment systems. Testing in "sandbox", as a rule, lasts from 6 months to a year;[11]
- 54% of countries study the pros and cons of Central Bank Digital Currency (CBDC), but have not yet made a decision, and 15% have already decided not to issue CBDC after studying the technological, monetary and financial aspects of stability.[11] High-income and lower middle-income countries are more active in CBDC [17];
- Among the instruments of fintech regulatory are the most popular: issuance of recommendations and standards on individual risks related to fintech-services (54%), and monitoring of providers according to requirements CML/FT (51%), formation of requirements to operational unprofitability and information security (49%);[11]
- "fintech" is considered by most low–income countries as a means of financial integration into the global economy [18];
- those who will cryptocurrency transactions, inherent in the following motivation [19][11]: participate in gambling — 47%, investment portfolio expansion — 25%; desire to acquire a new type of financial asset — 22%; long-term savings — 17%, ideological reason[12] — 17%;
- 31% of consumers who own but are not currently going to buy more cryptocurrencies report that this is due to the fact that they consider the purchase too risky;
- 73% of consumers who do not currently own cryptocurrencies, but plan to buy it in the future, said that the lack of regulatory protection affected their decision not to buy cryptocurrencies today;
- 29% of consumers who do not currently own and do not plan to buy cryptocurrencies,

[10] International Bank for Reconstruction and Development / The World Bank. Summary outcomes of the fifth Global payment systems survey. 2020. URL: https://www.worldbank.org/curated/en/115211594375402373/pdf/A-Snapshot.pdf, (accessed on 20.10.2021).

[11] Based on a survey of cryptocurrency consumers in the UK.

[12] For example, distrust of the ideological system.

Table 1

Rating by categories of cryptocurrencies

Rating by rate of the average weighted price		Rating by market capitalization	
1	Real estate	1	Smart-contracts
2	Doggone Doggerel	2	Stablecoins
3	File sharing	3	Decentralized finance (DeFi)
4	Distributed computing	4	Exchange tokens
5	Memes	5	Binance Smart Chain ecosystem
6	Media	6	Centralized exchange token (CEX)
7	VR/AR	7	Solana ecosystem
8	Retail	8	Polkadot ecosystem
9	Earning game	9	Polygon ecosystem
10	Solana ecosystem	10	Cosmos ecosystem
11	Smart-contracts	11	Management
12	Collaborative economy	12	Decentralized exchange token (DEX)
13	Hacken Foundation	13	Farming
14	Identity	14	Memes
15	Pantera Capital's Portfolio	15	Non-fungible tokens (NFT)

Source: data from Coinmarketcap and Coingecko on 03.10.2021. URL: https://coinmarketcap.com/cryptocurrency-category/; https://www.coingecko.com/en/categories# (accessed on 03.10.2021).

agreed with the statement that they will consider buying cryptocurrencies in the future, if this is regulated [19];[13]

- among the information sources from which consumers learned about cryptocurrencies, the most popular are: traditional media (27%); news and blogs on the Internet (27%); social media (15%). In 45% of cases, advertisement affected the acquisition of cryptocurrency. Those affected by the advertisement are more likely to later regret the purchase;
- 85% of all current owners of cryptocurrencies did not regret their purchase, 17% of cryptocurrency owners reported negative experience of ownership/purchase of cryptocurrencies (exchange fees, transaction time, stolen cryptocurrencies and volatility of cryptocurrencies) [19];
- 77% of respondents bought cryptocurrency through online-exchanges [19];
- among cryptocurrency options: 47% never used cryptocurrency, 27% used it to purchase goods and services, 25% used cryptocurrency to exchange for other cryptocurrencies [19];

[13] Based on a survey of cryptocurrency consumers in the UK.

Table 2

Component scoring coefficient matrix

Indicators	Components	
	1	2
Market capitalization, mln USD	0.558	0.000
Trading volume (24 ч), mln USD	0.558	–0.001
Price changes (24 hours), %	–0.001	0.639
Price changes (7 day), %	0.000	0.639

Source: compiled by the author with SPSS statistical package.

Table 3

Final centers of clusters

	Cluster number				
	1	2	3	4	5
Market dominance	59.14327	–0.02775	34.71369	–0.02102	–0.01739
Dynamics of price changes	0.03651	2.10307	–0.07868	–0.15378	10.18622

Source: compiled by the author with SPSS statistical package.

• cryptocurrency consumer portrait is as follows: their owners are more educated; men tend to invest more in cryptocurrencies than women; among the various cryptocurrencies, owners of XRP and Ether are the most educated, and owners of Litecoin — the least educated, owners of cryptocurrency have a level of family income above the average, and owners of XRP, Ether and Stellar are the richest [12]; higher income, higher education and digital financial experience increase of acquiring at least one cryptocurrency [12];

• in the market capitalization rating by categories of cryptocurrencies, the leading platforms are smart contracts, stablecoins and DeFi, while in the rating on the price increase criterion — cryptocurrency by categories of real estate, Doggone Doggerel, file sharing (*Table 1*);

• intensifying regulatory requirements has had a strong impact on cryptocurrency prices and transaction volumes, resulting in the recommendation to apply technologically neutral regulation to this class of assets, applying "built-in supervision" and using the potential of the technology itself in the oversight process [12].

Despite a large number of recent research on blockchain and crypto assets to ensure the development of DLT applications, opportunities, boundaries and risks, related to the spread of private and the issue of national cryptocurrencies, forecasting the state of the crypto market, the economy of the blockchain, systematic research on digital financial assets is still insufficient.

The author's own study on the cryptocurrency market focused on the investment attractiveness of cryptocurrencies based on a classification of 6056 cryptocurrencies by capitalization criteria, trading volume and price dynamics.[14] For this purpose the methods of factor, cluster and discriminant analysis were used.

[14] Data from Internet sources as at 06.08.2021. URL: https://ru.investing.com/ (accessed on 06.08.2021).

Table 4

Coefficients of the Fisher classification discriminant function

	Cluster number				
	1	2	3	4	5
Market dominance	3145.760	–1.943	1846.398	–1.092	–2.703
Dynamics of price changes	–10.302	6.401	–6.326	–0.399	28.558
Constant	–93049.866	–8.958	–32057.475	–1.650	–147.442

Source: compiled by the author with SPSS statistical package.

Based on the application of factor analysis of the main component using varimax rotation, were identified 2 factors, which, taking into account the values of the estimates of the coefficients of components, can be characterized as domination of the cryptocurrency market (1 component) and dynamics of price change (2 components) (*Table 2*).

By hierarchical cluster analysis the structure of data on cryptocurrencies in the section of the selected components was studied and it was found that the most acceptable is the allocation of five clusters. Next *k*–average sampling method was divided into five clusters, their centers (*Table 3*) and belonging to clusters of each cryptocurrency.

The first and third clusters are cryptocurrencies with absolute market dominance and moderate price dynamics. Cryptocurrencies belong to the second cluster are characterized by positive moderate price dynamics with little market dominance. The fourth cluster is represented by cryptocurrencies with little dominance and negative price dynamics. Cryptocurrencies are included in the fifth cluster with significant price increases and also slight market dominance.

In this case, the first cluster represents Bitcoin (BTC), the second cluster includes 259 cryptocurrencies, the third cluster — Ethereum (ETH), stablecoin Tether (USDT),[15] to the fourth — 5743 currencies, to the fifth — 23 cryptocurrencies (FIS, YFIII, DBIX, ETGP, ZUM, WTN, ZET, IRA, AAA, GR, AVC, TCFX, SVN, LMCH, KIWI, TAVITT, TRONX, DGMT, HP, KTN, ETHV, KMW, YFIKING).

Thus, it can be noted that cryptocurrencies of the first, third and especially fifth classes were of significant investment interest to consumers in the period under review.

Discriminant analysis was used to determine the rules for classifying cryptocurrencies to the selected groups (*Table 4*). However, 99.4% of the observations were correctly classified.

Wilks' lambda test with significance $p \leqslant 0.001$ indicates a difference in the average values of the discriminant functions received. Calculation of canonical correlation (0.991) and (0.802) also showed a strong correlation between factors and indicators of cluster membership.

These functions can be used to predict the assignment of cryptocurrencies to the appropriate classes — observation (cryptocurrency) belongs to the group that corresponds to the highest value of the discriminant function.

The next question the study examined was the conditions under which countries are successful in releasing CBDC. Then, authors were applied methods of correlation and discriminant analysis.[16]

[15] Originally released on the Bitcoin blockchain, since 2017 it is released on the Ethereum blockchain, is linked to the US dollar.

[16] The application of factor analysis to reduce the sample size of indicators was not satisfactory.

In the research used a set of 74 indicators for 167 countries from the following data sets:

- information base for the research of national digital currencies — Auer R., Cornelli G., Frost J. (2020) [20];
- World Bank data on digital–projects of National Governments;[17]
- UN research on e-government in 2020;[18]
- World Bank research on global financial development in 2020;[19]
- data for the World Bank research on global digital competitiveness in 2020.[20]

Assessment of the relationship between the level of development of CBDC [21] projects and the selected variables was assessed using the Spearman's correlation coefficient, because some of the variables involved in the analysis were sequential and not properly distributed.

Correlation analysis (*Table 5*) found that the level of development of national CBDC projects is statistically significant correlated with the factors that characterize:

- Indices of development of online public sector services, e–participation, open and e–government; human capital development index and years of learning; telecommunication infrastructure development index, including active population using the Internet, mobile and fixed broadband, mobile phones for payments; level of availability of financial services (availability of the population with debit and credit cards, salary cards, accounts in a financial institution, accounts used for the acceptance of state payments, ATMs) — positive below-average correlation;[22]
- Payments and obligations for Government digitalization projects, including information and communication technology projects (ICT) and e-government — weak positive correlation;[23]
- Ratio of bank overhead costs to total assets; inflow of money transfer to GDP; Countries ranked on the World Digital Competitiveness Index (IMD, 2020) and its sub–factors in 2020 — negative correlation below average;[24]
- Bank's net interest margin — weak positive correlation.[25]
- The same factors are also related to the level of development of the CBDC retail model. However, the correlations for this model are weaker than in the overall assessment of CBDC's level of development. Even weaker correlation with CBDC wholesale project status assessment.
- By a step-by-step discriminant analysis, an attempt was made to construct classification functions for predicting the state of various CBDC models. Thus, the following functions have been given the best result in terms of correctly classified values:
- for an overall assessment of the CBDC project status, coefficients of the Fisher classification discriminant function are presented in *Table 6*.

However, the share of correctly classified observations in the use of these rules was 50.8%.

Wilks' Lambda test with significance criterion p = 0.001 indicates a very significant difference in the average values of the discriminant functions received. However, calculation of canonical correlation (0.463) showed a fairly low level of correlation between factor and state group CBDC.

Quality of Fisher's classification discriminant functions (*Table 6*) is rather

[17] Digital Governance Projects Database. URL: https://datacatalog.worldbank.org/search/dataset/0038056/ (accessed on 20.10.2021).

[18] UN Study: e-government 2020. URL: https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20-%20Russian.pdf (accessed on 19.10.2021).

[19] Global Financial Development Database. URL: https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database; (accessed on 20.10.2021).

[20] IMD World Competitiveness Center. IMD World digital competitiveness ranking 2021. URL: https://www.imd.org/centers/world-competitiveness-center/rankings/world-digital-competitiveness/ (accessed on 19.10.2021)

[21] Rating scale: 0 — the project is not formed; 1 — the initial level of development of the project; 2 — the project is successfully developing; 3 — the digital currency is launched.

[22] 0.3 < Coeff. correlations ⩽ 0.5.

[23] 0 < Coeff. correlations ⩽ 0.3.

[24] — 0.5 < Coeff. correlations ⩽ — 0.3.

[25] — 0.3 < Coeff. correlations ⩽ 0.

Table 5

Spearman's correlation coefficients

Criteria	Overall evaluation of the CBDC project	Retail evaluation of the CBDC project	Wholesale evaluation of the CBDC project
E-government development index (EGDI), 2020	0.472**	0.423**	0.233**
Online Services Index, 2020	0.511**	0.472**	0.276**
Telecom infrastructure index, 2020	0.431**	0.371**	0.212**
Human capital index, 2020	0.376**	0.354**	0.132
Income level (per capita GDP), 2020	0.315**	0.256**	0.154
Number of mobile cellular per 100 people	0.333**	0.292**	0.131
Percentage of individuals using the Internet	0.394**	0.333**	0.177*
Number of fixed (wired) broadband cellular per 100 people	0.380**	0.340**	0.188*
Number of active mobile broadband cellular per 100 people	0.381**	0.319**	0.197*
Adult literacy (%)	0.176*	0.181*	0.016
Gross enrolment rate	0.402**	0.377**	0.142
Expected length of education (in years)	0.407**	0.377**	0.158*
Average length of learning (years)	0.342**	0.319**	0.149
E–participation index (EPI)	0.485**	0.441**	0.289**
Open government development index, OGDI	0.473**	0.418**	0.318**
Account with a formal financial institution (% aged 15+)	0.408**	0.360**	0.281**
Account used to accept government payments (% aged 15+)	0.418**	0.406**	0.121
Accounts to receive wage (% aged 15+)	0.388**	0.325**	0.220*
ATMs for 100 000 people	0.345**	0.288**	0.259**
Bank's net interest margin (%)	–0.311**	–0.251**	–0.274**
Bank's overhead to total assets (%)	–0.239**	–0.170*	–0.214**
Credit card (% aged 15+)	0.423**	0.370**	0.239**
Debit card (% aged 15+)	0.397**	0.336**	0.269**
Electronic payments used to make payments (% aged 15+)	0.378**	0.331**	0.213*
GDP per capita (in constant 2005 prices, USD)	0.375**	0.311**	0.217**

Table 5 (continued)

Criteria	Overall evaluation of the CBDC project	Retail evaluation of the CBDC project	Wholesale evaluation of the CBDC project
Mobile phone for payment (% aged 15+)	0.348**	0.290**	0.157
Inflow of money transfer to GDP (%)	–0.310**	–0.275**	–0.199*
Stockmarket capitalization relative to GDP (%)	0.490**	0.342**	0.498**
Obligations for closed DG–projects, mln USD	0.198*	0.197*	0.148
Obligations for opened DG–projects, mln USD	0.251**	0.260**	0.089
Total obligations for DG–projects, mln USD	0.254**	0.255**	0.133
Payments for closed DG–projects, mln USD	0.189*	0.188*	0.129
Payments for opened DG–projects, mln USD	0.256**	0.265**	0.095
Total payments for DG–projects, mln USD	0.241*	0.242*	0.130
Investment in ICT and E–government in open projects, mln USD	0.224*	0.233*	0.082
Investment in ICT and E–government in carryover projects, mln USD	0.221*	0.225*	0.041
Total investment in ICT and E–government, mln USD	0.201*	0.212*	0.063
Index IMD 2020	0.429**	0.340**	0.233
Rank for IMD 2020	–0.429**	–0.340**	–0.233
Knowledge, 2020	–0.440**	–0.409**	–0.212
Talent, 2020	–0.368**	–0.241	–0.293*
Training & education, 2020	–0.356**	–0.356**	–0.010
Scientific concentration, 2020	–0.345**	–0.409**	–0.195
Technology, 2020	–0.454**	–0.293*	–0.321*
Regulatory framework, 2020	–0.410**	–0.246	–0.293*
Capital, 2020	–0.454**	–0.270*	–0.436**
Technological framework, 2020	–0.381**	–0.300*	–0.201
Future readiness, 2020	–0.390**	–0.315*	–0.189
Adaptive attitudes, 2020	–0.352**	–0.336**	–0.138
Business agility, 2020	–0.361**	–0.290*	–0.106
T-integration, 2020	–0.367**	–0.240	–0.217

Source: compiled by the author with SPSS statistical package.

Note: * – correlation is significant on 5%-level (2-way); ** – correlation is significant on 1%-level (2-way).

Coefficients of the Fisher classification discriminant function

Factors	Status of overall evaluation of the CBDC project		
	0	1	2
Capital, 2020	0.152	0.099	0.082
Constant	–4.259	–2.425	–2.011

Source: compiled by the author with SPSS statistical package.

Table 7

Coefficients of the Fisher classification discriminant function

Factors	Status of retail evaluation of the CBDC project		
	0	1	2
Knowledge, 2020	0.112	0.078	–0.089
Talent, 2020	0.027	0.019	0.170
Constant	–3.796	–2.420	–2.948

Source: compiled by the author with SPSS statistical package.

Table 8

Coefficients of the Fisher classification discriminant function

Factors	Status of wholesale evaluation of the CBDC project status		
	0	1	2
Capital, 2020	0.130	0.081	0.056
Constant	–3.453	–2.025	–1.538

Source: compiled by the author with SPSS statistical package.

low, which does not allow them to be used to determine the status of the CBDC project on the basis of the value of the "capital" factor, but shows that this factor has a significant impact on the state of affairs of CBDC projects;

• Fisher classification discriminant functions were obtained for the CBDC retail model (*Table 7*).

The proportion of correctly classified observations in their use was 61.9%. Wilks' Lambda test with significance criterion p = 0,004 and p = 0,000 indicates a sufficiently significant difference in the average values of the discriminant functions received. However, calculation of canonical correlation (0.495) and (0.271) shows a low level of correlation between factors and indicators of CBDC state group affiliation, which does not allow the resulting functions to be used for prediction.

However, the fact that both factors in the classification model account for more

than half of the variation in retail CBDC condition traits may indicate that retail model projects are active and successful in countries with a high level of technical knowledge and entrepreneurial talent, ahead in its importance for the development of retail CBDC even capital factor;

• Fisher classification discriminant functions were obtained for the CBDC wholesale model (*Table 8*).

Likewise for the general model for determining the status of the project by wholesale CBDC, the capital factor was significant. However, the share of correctly classified observations was slightly higher for the model — 60.3%. Wilks' Lambda test shows a significant difference in average values of discriminant functions obtained ($p = 0.002$). However, the calculation of canonical correlation remains quite low for this model (0.438). The use of the obtained functions for prediction, as in previous cases, is undesirable, but very significant for explaining the factors of development of the CBDC wholesale model.

Noteworthy is the fact that no other factors from the 74 indicators studied provided a higher quality classification function to explain the success of CBDC projects, indicating the relevance of the research findings.

CONCLUSION

Thus, taking into account the global trends in digitalization, the development of fintech, the dynamics of the crypto market and, in particular, the development of projects to launch CBDC, it can be concluded about the inevitability of the processes of digitalization of financial assets, the emergence of new forms of digital assets, which require the accelerated development of regulatory and legal regulation of this market and its infrastructure.

According to the author, measures aimed at curbing the development of certain types of DFA are ineffective from a historical point of view and contradict the logic of the evolutionary development of the world economy.

In this context, the presented research makes a significant theoretical and practical contribution to generalization of the main trends in the world market of cryptoassets, identification of the main factors of investment attractiveness of cryptocurrencies and conditions, contributing to the successful implementation of CBDC.

The results obtained can be demanded by the participants of the financial market when assessing the investment attractiveness of cryptocurrencies using the functions for the forecast of the assignment of cryptocurrencies to the selected clusters. In addition, the research of the conditions for the successful implementation of CBDC can form the basis of regulatory projects that develop concepts of their own national digital currencies.

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Application Deep Learning to Predict Crypto Currency Prices and their Relationship to Market Adequacy (Applied Research Bitcoin as an Example)

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ABSTRACT

Predicting currency rates is important, for everyone who is trading and trying to build an investment portfolio from a range of crypto currencies. It is not subject to the same restrictions as fiat currencies. In this study, we seek to predict the exchange rate of BIT-COIN against the US dollar. The short-term data (365 observations) is processed using the LSTM model as one of the neural network models. Modeling is conducted by training a sample size of 67%, taking into account sharp fluctuations in the price of trade and a certain level of market efficiency. The GARCH model is used to select appropriate historical periods for how the LSTM model works and to test proficiency at the weak, semi-strong, and strong levels. The data series obtained from the website (Investing.com) have been processed. The researchers have found that the performance of the neural network improves as the EPOCH value increases with a training (research) period of 50 days before, which is consistent with the results of the proficiency test at the weak level. It agrees with the results of the sufficiency test at the weak level, which indicates that in the case under study (the Bitcoin market is effective at the weak level). It is advised that crypto-currency investors rely more on the historical trend of the price of the currency than on its current price, taking advantage of the artificial neural network model (LSTM) in dealing with little data of high volatility.

Keywords: cryptocurrency; GARCH model; deep learning; artificial neural networks; LSTM model

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INTRODUCTION

In a world characterized by rapid digital growth, the encrypted (digital) currency is one of the worthy investment opportunities for many people in different parts of the world, as it can be considered a new type of financial asset. It needs a careful study, as it has restrictions that differ from the restrictions imposed on traditional currency. Investors in this type of asset (cryptocurrency) must understand the market, learn to deal with its volatility and take into account modern forecasting methods that can align with some type of value chain for these assets over time. Money experts believe that Bitcoin can be considered the first digital currency in the world, as it has taken the lead since the inception of cryptocurrency trading as the highest value among its cryptocurrency competitors when comparing its declared values on trading platforms. The options available to investors to build their investment portfolios should not be overlooked, such as the inclusion of many other cryptocurrencies, which seems interesting, even if its values are somewhat low or not highlighted with interest such as Bitcoin. However, it can share the latter with competition as promising investment opportunities, with positive guidance by investors, and to be taken into account, such as Ripple, Ethereum and Bitcoin Cash. The shortcomings of most view investors are the primary means of investing in the cryptocurrency market. It is manifested in the fact that it does not exceed the purchase of these currencies, keeping them, or storing a percentage of them until a later trading date. To surprise them with the rapid development of its digital confidence (the inability to break its code or the development of generations of quantum computers) and the increase in the demand for investment in it, it is made clear to them that the aforementioned investment methods are not the only ways in front of them, and it becomes clear to them that investing in contracts for differences for encrypted currencies is one of the most promising ways that is possible to invest in this type of assets. It summarizes that the value of the mark can be considered a commodity, and here comes the role of predicting its fluctuations, meaning predicting the differences in its previous values from the current ones. Gains in common with other methods allow the investor to trade over time, with the added advantage that they do not allow for losses (going down on the value of the underlying commodity). It gives forecast a major role in dealing with currency fluctuations and gives it an exceptional advantage that may outweigh the importance of the decision to invest in this type of assets, especially if it departs a little from traditional methods, and models that often need assumptions that may not be achievable. This leads to treating them in ways that may lose credibility, so to speak, in reference to simulating machine learning of the series of fluctuations of those currencies over time, with a special reference to their digital dealing with both the prediction method and the origin of the currency code. It is worth noting, that there are many reasons that have led to an increase in investor options, such as the expansion of the currency market as a result of the multiplicity of alternative cryptocurrencies, which has fueled competition in terms of the large number of traders or the increase in their value on the one hand, and the increase in the desire of countries trying to lead the world as governments or banks supported by them (such as China) which is looking forward or initiating the issuance of its own cryptocurrency, similar to its global counterparts. The value of Bitcoin has reached about $ 20 thousand (a boom in late 2017), with investors cautiously anticipating such kind of booms that they hope to happen again, and they want them to be the result of an interaction of natural factors, to bring their confidence down to its lowest levels as a result of the sudden collapse shortly after the boom time. Most of the investors have found that their intuition is true when they expected that the process is nothing more than a misleading manipulation, and some others guessed, that unsystematic manipulation in the market could be considered a possible cause of the market crash. A few of them saw that the occurrence of the boom in any form or time is the result of coordinated manipulation currency rates. The vast majority of them are assured that the occurrence of a negative boom over time is a natural thing, and that the dwindling of opportunities does not mean that there is no possibility of profit. In the event that things proceed normally for those investors who do not prefer to risk, bearing in mind not to expect a repeat of the boom (2017), and we should not fail to mention, in addition to the importance

of predicting currency fluctuations, and ensuring the success of the investment process in crypto currencies (encrypted) must be noted. Taking note of the most important matters related to the market before the intention to invest in the currency, as well as the assets with few fluctuations over time, which the investor thinks of acquiring in his investment portfolio by increasing diversification to reduce risks, especially with a modern type in the world of investment based on rapidly developing technology and a world that abandoned barter long ago and wants by giving up tangible currency.

RESEARCH PROBLEM

Deep learning models have proven their ability to make predictions much better than traditional standard models, but this is closely related to the number of observations. Better prediction, as the artificial neural network model is used in many areas, the most important of which is the prediction of cryptocurrency prices. Researchers use daily data, and over a large period, these models have proved the ability to perform the task of forecasting accurately. Their superiority over the classical models is witnessed. The difficulty of our task is ability of neural networks models to deal with short data to get the best prediction, taking into account the type of neural network used and previous periods, depending on an economic point of view. The research problem can be posed through the following questions:

1. Can Vanilla LSTM Simple Deep Learning Model give accurate Bitcoin price predictions?
2. Does the prediction performance of artificial neural network change model improve?
3. Does a change in the LOOK UP period change the predictive accuracy of the model?
4. Does increasing Epochs improve the predictive ability of the model?

RESEARCH HYPOTHESES

Based on the research problem, the following hypotheses can be formulated:

1. The VANILA LSTM simple deep learning model does not give accurate Bitcoin price predictions.
2. Does the prediction performance of artificial neural network change model improve?
3. A change in the LOOK UP period does not change the model's predictive accuracy.
4. Increasing EPOCHES does not improve the predictive ability of the model.

SIGNIFICANCE OF RESEARCH

The importance of the research stems from attempting to find a way to process little data in the field of financial markets using neural networks, to maximize the performance of the model, when there is not enough data, or to limit the knowledge of the beneficiary to part of the data. This opens a horizon to help future researchers and beneficiaries to choose the appropriate model with Parameters that can improve the model's predictive accuracy, in particular the network type, size of EPOCHES and LOOK UP periods. It is also a review of previous studies in this context, and an addition to our Arab library with a kind of dealing with this type of technology in the field of encrypted digital currencies, and encouraging researchers to probe the depths of such complex problems in a modern scientific and technical manner.

LITERATURE REVIEW

Neural network technology is a relatively new field, where investors pin their hopes on it in the field of trading in the electronic markets. It has attracted increasing attention from researchers, where J. Brownlee [1], and (S. Galeshchuk and S. Mukherjee 2017 [2] presented a study in the field of Neural Network to address the problem of traders' dependence on this technology, and the result was always positive? The study aims to demonstrate the correct understanding of neural network technology, and considering it vital in order to apply it correctly as a new approach and method for technical analysis and opportunity detection by analyzing price data to make profit using this network. It can provide more accuracy and reliable information about the trading idea, and concludes that neural networks can rival the classic methods according to the preferences of the trader and encourage the development of the idea to use with money management rules to succeed as a profitable strategy. The positive results indicate that the neural network supports the idea of the trading strategy without over-fitting the strategy of the market. It is possible to develop strategies similar to the euro against the US dollar and develop according to historical and accurate data. The researchers see the possibility of generalizing the

prediction of neural networks on crypto currencies to predict their fluctuations, because forex is a trading platform whose trades fluctuate faster than digital currencies. However, in most cases, it stands unable to play its role when one of its assumptions is violated, to give results that do not suit the investors' orientations despite the accuracy of most of them when the rationale of the model is integrated in terms of mathematical and temporal terms. In 2019, the researchers Ionela and Alina [3] conducted a study to emphasize the importance of forecasting the exchange rate using Box-Jenkins time series models (Automatic Regression Moving Average Models (ARIMA). They applied the classic and modern methods that depend on advanced tools in forecasting for the purpose of analyzing the exchange rate. EUR/RON exchange and forecast. They employed several candidate processes (AR, MA, and ARMA) to select the best model based on a strategy summarized using an initial time series. To test the specifications of the models that were employed to determine the best ones, to detect the quality of performance and prediction of the EUR / RON exchange rate and then compare the accuracy of this prediction with the real level recorded by the real exchange rate. The empirical results of the fitness tests have shown good predictive power, which is very close to the expectations of financial analysts in the financial market. In 2019, Derbentsev et al., [4] employed machine learning approaches such as classical classification algorithms, regression trees (C&RT) and ARIMA autoregressive models, to build a short-term (5–30 day) prediction model for the prices of certain cryptocurrencies (Bitcoin, Ethereum, and Ripple). The researchers have found that the proposed approach is more accurate than the ARIMA-ARFIMA models in predicting the prices of these currencies within periods of slow rise (fall) and also within periods of transitional dynamics, i.e. changing the trend from decline to rise. Lu et. al. [5] (2020) proposed a method for forecasting the stock price for the next day by employing neural network techniques such as CNN-LSTM by closing the stock price. The researchers have relied on the advantage of combining the advantages of a convolutional neural network (CNN) for its ability to extract efficient features from the data used, and long-term memory (LSTM) for its ability to automatically detect the best fit for the relevant situation related to the data, thus improving the accuracy of the stock price prediction accurately. In fact, the CNN-LSTM model uses CNN to extract the features of the input time data and uses the LSTM to predict the closing price of a stock on the next day. To show the effectiveness of the model, daily transaction data for 7,127 trading days are adopted. In the same year, Xue et al. [6] (2020) presented a financial forecasting model based on the deep LSTM network. It is compared with the traditional RNN and the BP neural network. The results of the proposed model (LSTM deep neural) have demonstrated a high quality of effective prediction for high-resolution stock market time-series forecast. Chaudhari et al. [7])2020) presented their study entitled "Forecasting cryptocurrency exchange rates using machine learning", as a model of cryptocurrency prices, especially currencies (Bitcoin, Ethereum and Litecoin) by employing traditional models to predict the future of time series such as ARIMA model, and machine learning models such as LSTM deep learning algorithm. When testing the models on the data series based on the historical price of the aforementioned currencies, it is found that the LSTM model has a clear superiority over the models under study. Machine learning models have achieved substantial results that have proven their ability to perform well for various forecasts and other predictions, and can be employed in various other sectors such as forecasting stock prices or financial markets. Maleki et. al. [8] (2020) presented a paper aimed at predicting the price of Bitcoin based on analysis of price data for four different cryptocurrencies in order to understand the main trends and see if their chain is stable. Practically, the price behavior of each digital currency follows a random walk process, which makes it difficult to predict. Because it is an unstable behavior, researchers have overcome this obstacle by using many different ways to create a stable time series, through many statistical tests such as the Dickey test Fuller (DF), DF-GLS test, Augment Dickey-Fuller test (ADF), ERS-point primal test and Ng-Peron test, Phillips-Perron test on equations to test their related hypotheses. In an effort to make the Bitcoin daily price data series constant, the cross-integration is examined to enable the use of different models. Their approach ensures co-integration by returning the first variable

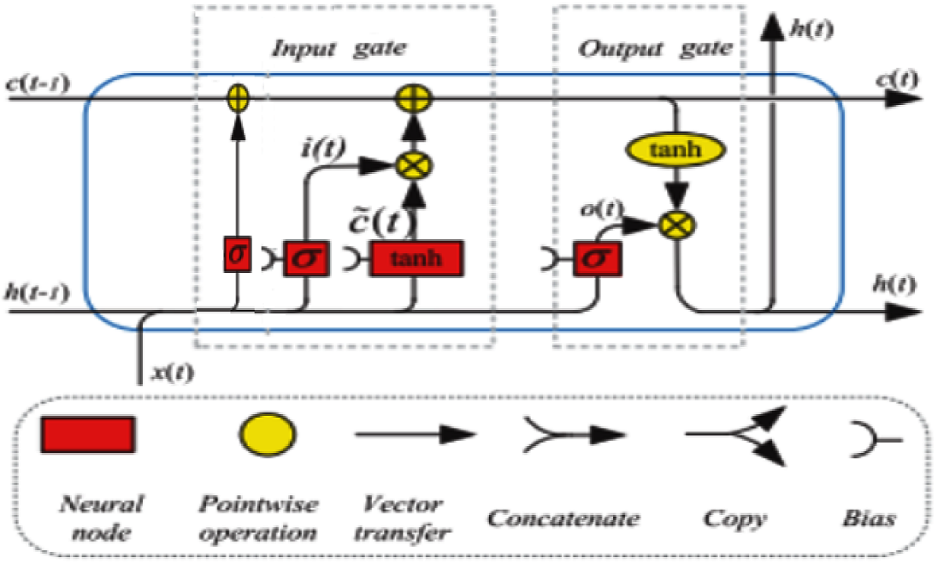

Fig. 1. **LSTM network redundancy module has four interacting layers**
Source: Yu Y. et al. [11]. URL: https://arabicprogrammer.com/article/4117317328/ (accessed on 19.07.2022).

(Y) to the second variable to obtain the equation Y-bX. They employed the enhanced Dickey-Fuller test to check whether the random behavior is sustainable or not. The best delay in the model is found based on several different achievement criteria. They have found from analysis with statistical models such as AR, MA, ARIMA and ANFIS which have been applied as smart methods that combine fuzzy and artificial neural networks that Z-cash has the best bitcoin price prediction compared to bitcoin price prediction with Ethereum and Litecoin. The current study is distinguished from previous studies in that it deals with few views, as the number of views reached (365) observations. It attempts to take advantage of the investment and economic point of view in determining the value of a key parameter, which is LOOK UP or the number of previous observations. This is not dealt in the previous studies mentioned. In 2021 Derbentsev et. al. [9], studied the short-term prediction problems of the time-series of cryptocurrencies (Bitcoin (BTC), Ethereum (ETH) and Ripple (XRP)) by using a Supervised Machine Learning (ML) approach. They focused in their quest on the best methods of clustering as a stochastic gradient boosting machine, (SGBM) and random forests (RF). The expected price accuracy rate is calculated using RF and GBM. The results validate the applicability of the ML clusters approach to cryptocurrency price prediction. They have concluded that the short-term forecast obtained by SGBM and RF is the best in terms of absolute average, with the MAPE for currencies (BTC, ETH and XRP) being within 0.92–2.61%. In this paper, we propose a model based on machine learning, to address the shortcomings of neural network models in dealing with short data strings. The model depends on the study of the fluctuations of short-term time series data (365) observed by the GARCH model. The LSTM model is used as one of the neural network models, with a training sample size of 67%, taking into account the sharp fluctuations in the prices of the cryptocurrencies under study and a certain level of market efficiency. Our paper is organized as follows; first section relates to an introduction that deals with the importance of cryptocurrencies as an option to show the investment portfolio for investors. The second section includes a brief literature review, as the efforts have made by researchers in building cryptocurrency price prediction models. The third section includes an explanation of the long-term memory network of neural networks (multiple layers), especially the LSTM model, to process the information received for the proposed model. The fourth section consists of the practical application of the proposed model. Finally, in the fifth section, the researchers have come out with a set of conclusions, and several recommendations based on the results they reached from the application of their model.

LSTM. NETWORK

A Long Short-Term Memory (LSTM) refers to the long memory networks, which were introduced by Hochreiter and Schmidhuber [10]. It is considered as a special type of motor neural network capable of learning in long term sequences. The goal is to design it as a special kind of motor neural network. It is the ability to learn in long-range sequences and to overcome gradient latency as the most important technical problem for training a neural network (RNN). This enables it to deal with a wide range of practical problems, due to its ability to avoid the long-term dependency problem, i.e. it has a memory that can overcome long-term time dependency and input sequence problems, with a good advantage. It has the ability to process the input sequence and the output sequence in reasonable steps and time. *Figure 1* illustrates the structure of LSTM to find a clear difference with standard RNNs, which consist of repetitive units with a very simple structure meaning that they have a single) (*tanh*) layer.

Obviously, LSTM has the same architecture as a chain, with a repeating module having a different architecture, i.e. with four layers operating in a rather special way, rather than a single (neural network) layer. As shown in *Fig. 1*, each line is a complete vector, which comes as an output from one node to the input of the other nodes. The yellow circles are point operations, and function as a mechanism for adding vectors, while the red squares are layers of a neural network, which have taken the information from the previous ones (*i.e.,* ... It learned). As for the merged lines, they refer to the sequence, while the branching lines indicate the transcription and movement to different locations in the same stage.

WORKING PRINCIPLE OF LSTMS

The operation of a network for LSTM is illustrated by *Fig. 1*. LSTMs have a key that represents the state of the cell, i.e. the state of the information reaching it represented by the horizontal line that passes through the upper part as in *Fig. 2*. That state (the state of the cell) is more like a conveyor belt to pass the information to a later stage. It reaches directly to the end of the entire chain with only simple linear interactions, indicating that information can flow along the chain unchanged.

The second part is shown in *Fig. 3*. It refers to organizing information carefully as a new addition or removal in order of precedence by structures called *logic gates*, which are a means of allowing the passage of optional information. The LSTM consists of a neural network layer and an inside point-multiplying process to process the incoming information. The output of the neural network layer is numbers between zero and one that describe how much to pass each component. The zero value is the instructing of not to allow any information to pass through, while the value of one is to allow every process able to the information to pass through. The LSTM network includes three gates, which protect the state of the cell and control information when performing its work.

LSTM NETWORK WORK STEPS

To clarify the working mechanism of the LSTM network, it is necessary to start with the very normal version of the LSTM, where the information that is thrown away from the state of the cell is determined. This process is a decision made through the neural network layer, which is called the forgetting gate layer. The task is to search in h_{t-1} and x_t, extracting a number between 0 and 1 that is the induction of a number in the case of the cell C_{t-1}, the number 1 indicates to keep this information completely, while the 0 indicates to get rid of this information completely as shown in *Fig. 4*.

Then comes the role of defining the new information that must be stored in the cell state to deal with later, and this is conducted by defining the neural network layer called the input gate layer, which contains the information values that are to be updated. In the meantime, a (*tan h*) layer is created, as in *Fig. 5*, which gives a vector of new candidate values for the *C_t* cell where they can be added to the cell's state, and these parts are then combined to do a state update.

The state of the old cell C_t — 1 is updated to the state of its cell C_t. In the previous step, what needs to be done and all that is done, after restoring the old state by qualifying it as a candidate value and adding it to $* C \sim t$ which is the forgotten value as in *Fig. 6*.

Afterwards, the output has to be defined (what we produce), as shown in *Fig. 7*, and this depends on the state of the special cell in the LSTM network, which is a filtered version. Here, the neural network layer is started by defining the parts of the state of that cell that we will output, by placing the state of the cell through tanh whose role is to push the

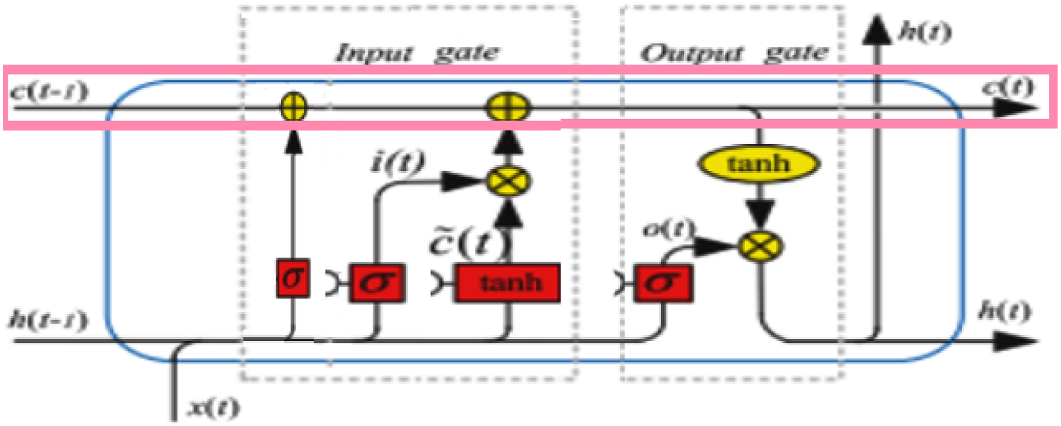

Fig. 2. **The first part represents the LSTM network case model**

Source: Yu Y. et al. [11]. URL: https://arabicprogrammer.com/article/4117317328/ (accessed on 19.07.2022).

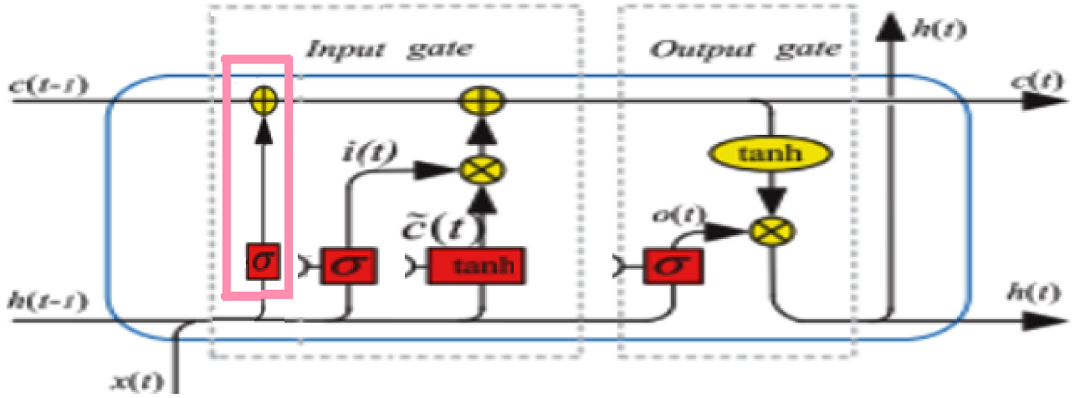

Fig. 3. **The second part is a mechanism for organizing information in the LSTM network**

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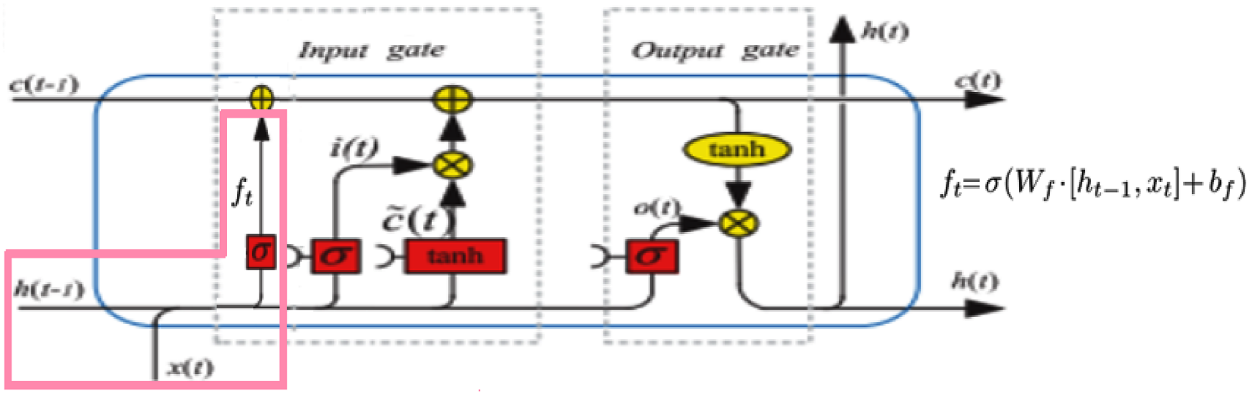

Fig. 4. **The information processing mechanism in the LSTM network**

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values to be between (1 — and 1), and multiplying them by the neural network gate. Here, we have decided what we get out, meaning the parts that we just decided.

Several improvements have been made to the structure of the LSTM network, most notably Cho *et al.* (2014) [12], who present the LSTM network as a Gated Recurrent Unit (GRU). It is a single update portal that brings the forgetting and input portals together. Its role is to merge the cell state and its previous hidden state, while making some other changes to produce a model that is simpler

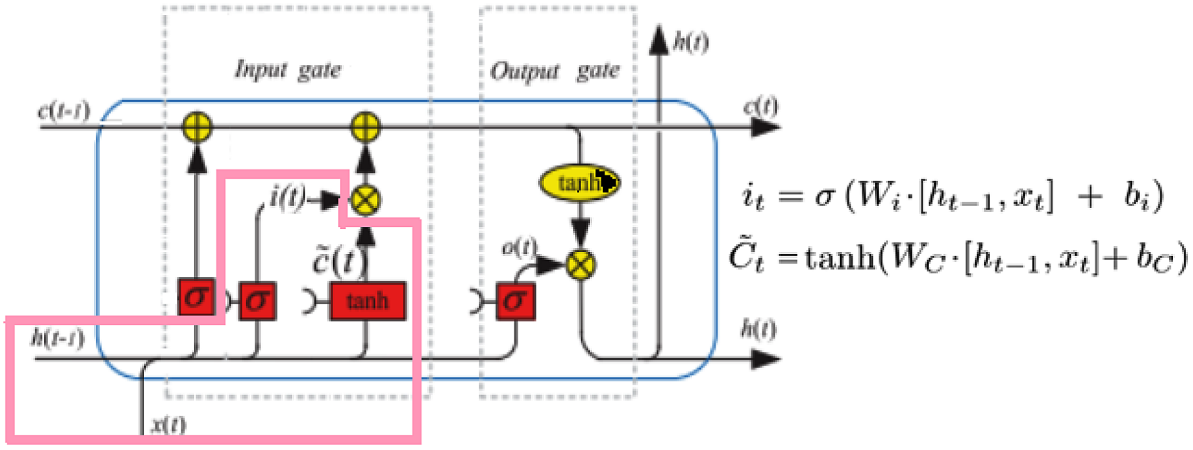

Fig. 5. **The mechanism for storing information in the LSTM network**

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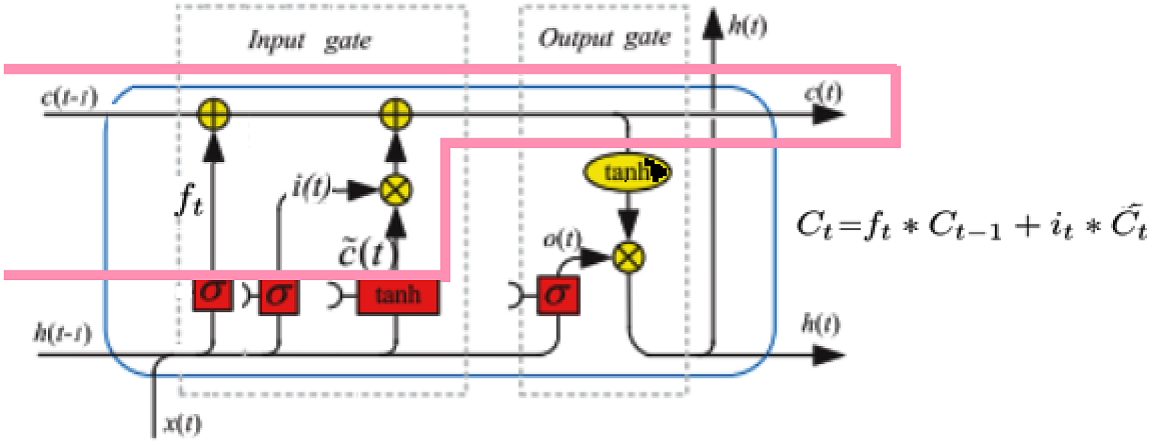

Fig. 6. **Updating the information in the LSTM network**

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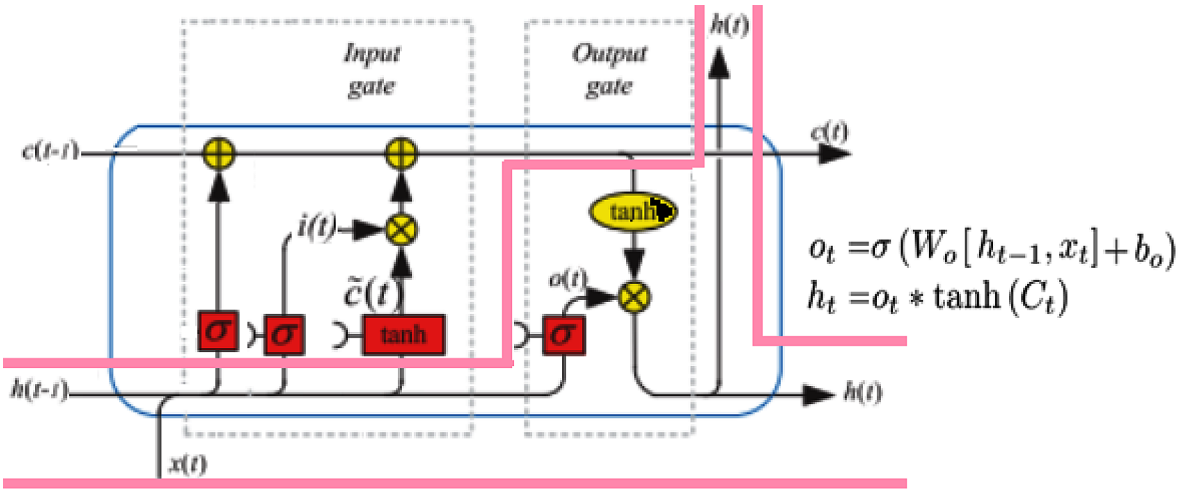

Fig. 7. **The output of the LSTM network**

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than the standard LSTM models. It is worth noting that what has been mentioned is only a few of the most common LSTM variants, as there are many of these variants to distinguish the best, by revealing important differences. Greff *et al.* (2015) [13] have conducted a good comparison of common variants, and come to the conclusion that they are quite similar. Jozefowicz *et al.* (2015) [14] tested different architectures up to more than ten thousand RNN architectures, where many are found to perform better than LSTMs in certain tasks, while LSTMs outperform others based on their flexible architecture.

VANLILA LSTM MODEL

According to the architecture of this model in its original 1997 release, a simple LSTM network consists of a cell, an input gate, and an output gate. Initially, a forgotten gate is not part of the LSTM network, until it was proposed by Gers and Schmidhuber (2000) [15] allowing the resetting of the network state of the simple vanilla LSTM model, and have taken the name vanilla to distinguish it from the more powerful LSTM model (See Van et al., 2020) [16]. It has a large set of details and configurations, in order to reduce sequence prediction problems, as the vanilla LSTM model has:

1. Input layer.
2. The LSTM hidden layer is the input layer.
3. Result layer with the hidden layer.

THE GARCH MODEL AND ITS RELATIONSHIP TO THE IDENTIFICATION OF PREVIOUS PERIODS

In traditional standard analysis, the variance stability hypothesis states that the variance of the random bound must be constant over time. In fact, the chain of any stock in the financial markets, as an example of financial chains, is described according to volatility, with high volatility, or low volatility. This means, in financial terms, that the expected value and periods of volatility are at the point of random error. It is also volatile (greater or less) across different time periods as a description of the variation in risks or uncertainty. We should not fail to mention, that what is known as data accumulation in the analysis of financial markets, refers to the periods of risk that are represented by great volatility or great variance centered in certain time periods, followed by periods of less volatility (less variance) concentrated in other periods of time. Here, it is better to test the variance pattern, to show the variance of the stock's value depending on its temporal behavior, and more precisely the conditional variance test for the model under study. For more information on the GARCH model and neural networks (see Shen et al., 2021) [17].

The researchers believe that there is a possibility to use the GARCH model to test the efficiency at the weak level, for its ability to detect any concentration in the fluctuation of the data. The idea of the model is that any increase or decrease in the price of the currency today leads to an increase in its price fluctuations in the future, and accordingly the model determines the efficiency at the weak level when the sum $(\alpha + \beta)$ is less than 1, indicating continued volatility. The market is described as inefficient if the result is close to or greater than one. In order to explain the achievement of efficiency at the weak level in economic terms, it is found that the shocks occurring in the price of the security disappear quickly if the sum of the transactions $(\alpha + \beta)$ of the exchange rate of one currency against another currency is less than 1, indicating that the efficiency is achieved at that level. On the other hand, when it is close to 1, this refers to the fact that the price of the security continues to fluctuate, and accordingly, the market is described as inefficient. In the case under study (the Bitcoin currency), the financial market is affected by current values more than by the previous values of that currency when there is efficiency at the average level. This requires giving less prior periods in the LSTM model, while providing efficiency at the weak level and lacking it at the average level which necessitates an increase in the number of previous periods as the investor relies more on previous prices than on current prices.

PRACTICAL FRAMEWORK

The research is conducted in several steps and mechanisms in order to answer the research questions as follows:

1. Collecting data on the price of Bitcoin against the US dollar during a full year.

2. Conducting a statistical description of the data, including the arithmetic mean and standard

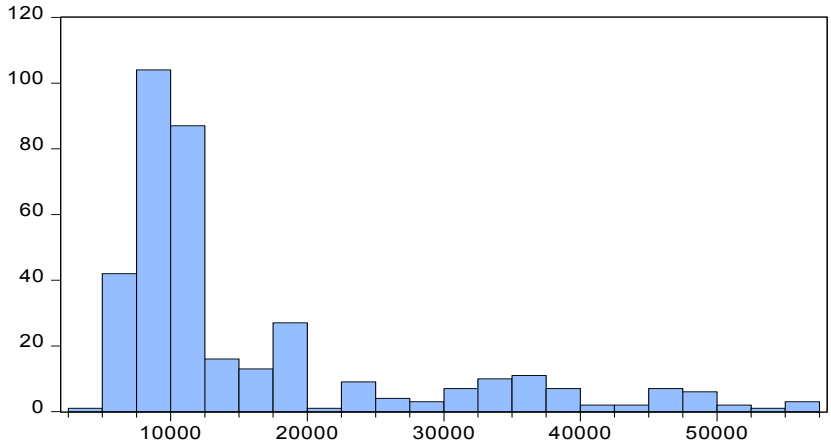

Fig. 8. **Statistical description of the data**

Source: prepared by researchers based on the outputs of the E_VEIWES-10 program.

deviation, which explains the nature of the data in terms of its dispersion.

3. Proficiency test at all levels (weak, medium and strong) in order to choose the appropriate number of previous periods (choosing LOOK UP or previous periods). Where the test was done according to three values: (one day) that is, the model (it will look at the price on the previous day to predict the price on the current day), and five days, that is, the model (it will look at prices during the previous five days to predict the price on the current day). This is the case with the value (50.), which is set depending on the behavior of some investors. Some of them see the price in the previous day as important to anticipate its direction in the future, while some of them tend to evaluate the direction of the currency price within a short period, let it be five days. Others characterized by their patience, evaluate this trend by looking at the price of the currency for a relatively long period.

4. CNN Model Test.

5. Choosing the LSTM model, due to its proven ability and flexibility in dealing with time-series data, as it takes into account the previous values of the observations. This is consistent with those data, and the researchers have justified the use of the simple model (VANILA LSTM), due to the small number of observations. This type of artificial neural network has some hidden layers, which, from the point of view of the researchers, may suit the few observations.

6. Integration of CNN with LSTM.

7. Using the MIN MAX SCALER method to make the data confined between (0–1) in order to facilitate the processing process by the artificial neural network.

8. The study sample is divided into a training sample of 67%, amounting to (244) observations, and the sample of the Buaqy test, which amounts to (121) observations, noting that the control sample is not taken into account due to the small number of observations.

9. RMSE is chosen to assess the accuracy of the predictive model and is used in many studies.

STATISTICAL DESCRIPTION OF THE DATA

The statistical description of the data is performed to clarify the behavior of the data in terms of its distribution and spread, as shown in *Fig. 8*. The currency price ranges between the lowest value and amounts to (4,826 $), while the highest value reaches (57,433 $), and this indicates the great development taking place in currency rate. The arithmetic average amounts to 16,165 $, with a standard deviation of approximately (11,768 $), which indicates a large dispersion in the data, indicating the extensive cases of speculation on the currency. The skew coefficient of (1.69) indicates that most prices are greater than the arithmetic average, which amount to (16,165 $), and this reflects the state of speculative interest in the currency. The probability value corresponding to the Jarque-Bera test is (0.00) which is less than (0.05), and this means that there is no normal distribution for the variable.

The researchers believe that the absence of a normal distribution of the variable and the

Table 1

An efficiency Test

Variable	Coefficient	Std. Error	z-Statistic	Prob.
PRICE(−1)	1.011791	0.005665	178.6082	0.0000
C	−84.72958	74.74266	−1.133617	0.2570
	Variance Equation			
C	3290.836	835.7257	3.937698	0.0001
RESID(−1)^2 … (α)	0.106643	0.021111	5.051449	0.0000
GARCH(−1)…(β)	0.907800	0.016699	54.36159	0.0000
R-squared	0.993378	Mean dependent var		16185.96
Adjusted R-squared	0.993359	S.D. dependent var		11777.51
S.E. of regression	959.7599	Akaike info criterion		15.49140
Sum squared resid.	3.33E+08	Schwarz criterion		15.54493
Log likelihood	−2814.435	Hannan-Quinn criter.		15.51268
Durbin-Watson stat	1.957392			

Source: prepared by researchers based on the outputs of the E_VEIWES-10 program.

Table 2

Forecasting at different previous periods according to LSTM model

	Period	RMSE Standard for Training Sample	RMSE Standard for Test Sample
LSTM	1	1162.19	475.67
	5	1153	610.13
	50	773.39	819.63
CNN	1	1200	900.29
	5	1116.42	981.67
	50	1000.24	988.54
CNN+LSTM	1	950.27	1100.12
	5	890.29	985.01
	50	900.22	968

Source: Table and figure prepared by researchers based on the outputs of the E_VEIWES-10 program.

Note: We choose the best model through RMSE for training and testing data.

Table 3

Forecasting at 50 preceding periods and EPOCH according to LSTM model

Period	at EPOCH 100 RMSE	at EPOCH 150 RMSE
50	747.80	707.84

Source: Table and figure prepared by researchers based on the outputs of the E_VEIWES-10 program.

presence of a large dispersion in the currency price, in addition to the shortness of the sample, leads to great difficulties in forecasting.

Financial Market Efficiency Test:

The following *Table 1* shows the results of the aptitude test.

It is clear from the previous table that the level of efficiency is weak, as it is a group of alpha (**RESID** (−1))$^{\wedge 2}$ and beta (**GARCH** (−1)) 1. This refers to the fact that there are large fluctuations in the data, meaning that the impact of the shock continues.

PREDICTION USING ARTIFICIAL NEURAL NETWORK MODELS

Models are estimated using Vanilla LSTM, CNN+LSTM and CNN with a change in the basic data of the model (look up, epoch). *Table 1* shows the results of the LSTM model with the number of previous periods (1). It is clear from *Table 2* that the best model has largest number of previous periods used (50 views). This means that the model used (50) previous days to predict the current price so as to help investors evaluate the price movement of the currency under study for a relatively long period.

In fact, periods (1) and (5) do not constitute a good basis for forecasting; therefore, this result helps to warn investors not to speculate by relying on the currency price movement for a relatively short period, especially when there is a large volatility in its price. Forecasting based on long previous periods gives good results. In principle, the best model is the model with previous periods estimated at (50) days, and to improve the results, the value of the EPOCH is improved from (100) to (150).

Table 3 shows the prediction results. From this table we find that increasing the number of EPOCHES leads to greater convergence between the sample training and test sample. Based on the above, it can be said that the best model is the model with lag periods (50) and EPOCH (150).

HYPOTHESES TESTING

The hypotheses of the model are tested through the practical side on an electronic computer of the type Acer (core i5–6200u, with 4GB DR 4 memory and 500 GB HDD). The mechanism of the model is applied and computerized to process a data series of cryptocurrencies compared to dollar prices, on the first premise that: "The prediction of the simple deep learning model VANILA LSTM does not give accurate predictions of the price of Bitcoin". Here, it is clear by reviewing *Table 2* that the ability of the simple model is to give accurate results compared to the nature of the data on the price of the currency (Bitcoin), such as the dispersion of the data and the lack of a normal distribution of the variable. The second hypothesis states that: "The change of the previous period does not LOOK UP leads to a change in the model's predictive accuracy." In fact, when following up on the results obtained from the practical part, it is found that the model's predictive ability has improved from (1,162.19, 475.67) for the training and testing sample, to (773.39, 819.63) for the training and testing sample, respectively. The practical results have proved the practical path to test the third hypothesis which states that: "Increasing EPOCHES does not lead to an improvement in the model's predictive ability". It is concluded that increasing from 100 to 150 has led to a convergence in the accuracy results between the two samples of training and testing, which in turn is a positive aspect in achieving the hypotheses and objectives of the research. The researchers believe that the model has been able to deal with the data in the volume that the researchers have by dealing carefully with the data series that enables the model to find the results that have led to obtaining fair predictions that are very close to reality depending on the error criterion mentioned. In fact, it is a positive aspect in achieving the hypothesis and objectives of the research.

CONCLUSIONS

After obtaining the results using the VANILLA LSTM model, it is confirmed that the hypotheses of the model are verified and discussed. The researchers have come up with a number of conclusions, the most important of which are: The ability of the simple model to give accurate results compared to the nature of the data on the price of the currency (Bitcoin), such as the dispersion of data and the lack of a normal distribution of the variable. Thus, an increase in the preceding data period leads to an improvement in the predictive ability of the model for the training and testing sample, respectively. Also, the increase of EPOCHES 1.5 times leads to a convergence in the accuracy results between the training and testing samples, which helps investors evaluate the

investment movement for a relatively long period to know the current price trend in the later stages.

RECOMMENDATIONS

Based on the foregoing from the theoretical and practical sides, the researchers recommend the adoption of the VANILLA LSTM model by increasing the previous and somewhat short periods (50 previous views) for prediction, and adhering to its parameters that are installed in practical application, to deal with Bitcoin data, which directs investors to rely on relatively long time periods to assess the direction of the price of the currency and its future, and to emphasize the increase in the number of EPOCHES to obtain more predictive accuracy.

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Quantitative Market Risk Assessment for Insurance Companies

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ABSTRACT

The business strategy, the underwriting policy, the investment strategy of insurance companies and some external factors influence their ability to meet liabilities. The risk management mechanism, based on regulatory requirements and the best expertise, should allow to identify and assess all significant risks, including the market risk. The purpose of this research is comparing the European and Russian regulatory requirements for capital calculation for market risks of insurance companies. The methodological base is the comparison analysis of different capital calculation approaches for interest rate, FX, real estate and equity risks in accordance with Solvency II for the European insurers or Regulation 710-P for the Russian insurers. As a result, the author has found the compatibility of regulations to vary depending on the type of the risk in question. Regulations diverge the least when it comes to FX and real estate risks, yet the most in regards to interest rate and equity risks since the Central Bank of Russia has accounted for some national market peculiarities. Overall, the research results have a practical value and could be used by the Russian insurers in transition to the risk-oriented regulation.

Keywords: market risk; risk-based regulation; Solvency II; capital at risk; open foreign exchange position

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INTRODUCTION

The main objective of a insurance company is to provide protection to insured persons. To fulfill obligations to insurance companies that accumulate risks of customers, it is important to be aware of their own risks, their causes and consequences. An inverted business cycle in insurance, where a company first receives money for a service and then realizes it, does not make the insurer invulnerable to a range of risks, including market risk. Insurance companies build market risk management systems to control losses or negative changes due to fluctuations and volatility of market prices for assets and liabilities. On the other hand, insurance companies are institutional investors in the capital market. The investment policy of insurers is generally conservative due to the basic function of insurance — providing protection to insured persons in insured risk probability. However, the pro–cyclical behavior of insurers in times of financial crises can increase systemic risk in the financial industry. The desire to control systemic risks and the level of solvency of insurers helps to draw the attention of the regulator to the market risk of insurers.

Development trends of risk management of insurers are explained by the emergence of regulatory requirements (local and international), and the desire of insurers to make business decisions taking into account the concept of risk. In the European Union, the European Insurance and Occupational Pensions Authority (further — EIOPA) is responsible for the institutional insurance environment in terms of rules and regulations, for the Russian Federation the insurance supervisory body (regulator) is the Bank of Russia from 1September 2013. The International Association of Insurance Supervisors (IAIS) promotes financial stability in the global insurance market, which, since 1994, has been compiling the experience of insurance supervisory bodies and developing and publishing principles, standards and guidelines. The IAIS in the "Basic Principles of Insurance"[1] document recommends that supervisory authorities establish requirements for a risk management mechanism, including the inclusion of market risk in the list of risks to be considered by the insurer.

In 2011, at the time of development of the requirements, IAIS recognized the different level of maturity of regulators and insurance markets worldwide in terms of risk management, however, it assumed that the development of local requirements will be in the direction of the stated principles. At the identification stage, the insurer is expected to determine the nature of the risk, to analyse internal and external factors, possible effects and to assess the relationship between risks (in normal practice and under conditions of stress).

IAIS Glossary[2] defines market risk as the risk of negative changes in capital due to unattainable changes in the level or volatility of market value of assets and liabilities.

Market risk issues in insurance companies have long attracted the attention of researchers. With regard to market risk, researchers examine the activities of insurance companies under different interest rates [1–4]. Life insurance companies have to forecast interest rates on the 30–40 year horizon. In the lower interest rates scenario, life insurers incur losses if the current rate is below the rate of reserve and they lack the funds to pay the guaranteed return. J.H. Holsboer [1] concluded that government regulation of the level of reserve obligations, as well as the use of risk management tools, can reduce the negative effect of low interest rates on life insurers. In particular, starting in 2001, German insurance companies should, at the request of the regulator, create a certain reserve for the low–rate scenario. According

[1] Insurance Core Principles and Methodology. International Association of Insurance supervisors. URL: https://www.iaisweb.org/page/supervisory-material/insurance-core-principles-and-comframe//file/89018/iais-icps-and-comframe-adopted-in-november-2019 (accessed on 25.04.2021).

[2] IAIS Glossary. International Association of Insurance supervisors. URL: https://www.iaisweb.org/index.cfm?event=getPage&nodeId=25241 (accessed on 25.03.2021).

German Actuarial Association (DAV), the regulatory approach, relevant until 2018, led to over-reservation, which, on the contrary, could create obstacles to the protection of insured persons. In the work C. Eckert [2] it has been proven that the new approach proposed by the DAV and adopted by the German regulator to create a reserve for protection against low interest rates does not have the disadvantages of the old method and contributes to better protection of insurers. Higher interest rates can bring higher returns on fixed-income financial assets to insurers, increase the attractiveness of shares and, at the same time, reduce the value of bonds estimated at fair value. In the work T.K. Jensen et al. [3] the authors conclude that for American insurers, the negative effect of interest rate increases prevails over possible bonuses.

The introduction of Solvency II stimulated the emergence of studies on the valuation of capital at market risk [5–9]. In particular, in the work N. Gatzert et al. [5] is carried analysis of credit and market risk assessment of capital using standard formula and internal model. The authors note that the calculation of the standard formula may be supplemented by calculations of the internal model in cases of imperfection, namely — under capital requirements for bonds with low ratings (e.g., government bonds of Spain, Greece) and over-capital for bonds with good credit quality. In addition, the authors stressed the important role of the internal model in its own assessment of risks and solvency. In the work A. Braun et al. [8] the authors highlight the disadvantages of the standard formula Solvency II, which estimates capital at market risk, and emphasize the usefulness of the internal model, including the expected return on assets and their temporal comparability with liabilities.

A number of foreign research [10–12] were aimed at finding optimal investment strategies for insurers in the face of changing regulatory capital requirements.

Articles of Russian authors in the recent period can be divided into three groups. The first group focuses on specific risk groups (credit, operations) [13–14]. In particular, in the work E.V. Aldukhova et al. [13] it was determined that the credit risk requirements of Russian insurers are based on European regulatory practices, with the exception of a number of features explained by the state of the national market. In the work K.E. Tourbina [14] the author analyses the peculiarities of the insurer's operational risks, compares the norms of foreign regulation in the field of insurance (Solvency II Directive) with the practice of managing the operational risks of other financial institutions. The second group of works is devoted to the problems of bankruptcy of insurance companies [15–17]. In research by A.V. Larionov, E.S. Salina [15] was present a complex system of indicators, the use of which helps to predict the insurance company's default at an early stage. In the work K.S. Eremina, J.A. Tarasova [16] shown the influence of factors of the macroeconomic environment on the number of cases of bankruptcy of insurance companies, the inverse proportional dependence of bankruptcy on the size of the company and confirmed the influence of problems with auditing, high reinsurance costs and deficiencies in corporate governance at risk of bankruptcy. Results of another research by J.A. Tarasova and E.S. Fevraleva [17] showed, that the insurers' bankruptcy is significantly affected by the insurance coefficient, which is equal to the ratio of insurance premiums to net profit, and coefficients from the group of indicators of financial sustainability. In the third group of research [18–24] the authors considered the prospects of development of the Russian insurance market in the context of a risk-oriented approach to its regulation.

According to the representatives of the Bank of Russia, the main purpose of capital formation is to ensure financial stability and fulfillment of the obligations of the insurer [18]. The preceding approach to assessing the financial sustainability and solvency of insurers considered only insurance risk when determining regulatory capital requirements. V. Chistyukhin et al. [19] noted

the insufficiency of these requirements for the establishment by the Bank of Russia of an effective system of supervision of the activities of insurers, which has a preventive character and is able to take into account the risk profile of an individual company. S.V. Pushkarev [20] in his research, he stressed the appropriateness of tightening regulatory requirements if this would lead to increased financial stability of insurers and increased confidence of insurers.

In the work of V.V. Barabanova [21] it is indicated that to ensure the competitiveness of Russian insurers it is necessary to closely comply with international standards in terms of quantitative and qualitative parameters, as well as the structure and format of disclosure of information. In addition, in the work of [21] the author argues the need to implement a proportional regulation instrument within the risk-based regime in the insurance industry, because it simultaneously allows to comply with existing norms without additional pressure on the operational efficiency. Among the positive effects of risk-oriented regulation are increased financial stability of insurers, increased market transparency, among the negative consequence — continued concentration on the insurance market of the Russian Federation. In the work [23, 24] was stressed importance of prudential supervision. In particular, in the work L.D. Baklanova et al. [24] the authors noted that the tightening of regulatory requirements contributes to the exit from the market of unreliable players, but does not solve the problem of the loss of financial stability. Based on foreign experience, in order to complete the financial recovery of the insurance market, the authors proposed to supplement the existing control functions with a model of preventive supervision, which is based on a three-year horizon of continuous compliance with regulatory requirements and a projection of internal risks and solvency. However, there is still no work by Russian researchers on the assessment of market risk of insurance companies in different regulatory regimes, which confirms the scientific novelty of the article.

The article consists of three sections. The first section is considered the components of market risk and its valuation tools used by insurers. The second section is introduced market risk capital requirements in the standard formula for European insurers. The third section is devoted to the rules of estimation of capital under market risk of Russian insurance companies. Finally, conclusions on the comparability of national and European guidance on the market risk of insurers are presented.

CONCEPT OF MARKET RISK FOR INSURANCE COMPANIES

Directive 2009/138/EU of the European Parliament and of the Council of 25 November 2009 "On the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II)" (further — Directive Solvency II[3]) defines market risk as the risk of losses or negative changes in the financial condition of the insurer due to direct or indirect influence of volatility of market prices of assets, liabilities and financial instruments. Types of risks that are classified as market risks are reflected in *Table 1*.

The following factors influence the market risk of the insurance company:

- internal factors (differences in maturity and/or interest rate revisions for the insurer's assets and liabilities; differences in amount of requirements and liabilities denominated in currency or subject to exchange rate; structure of financial assets) [25, 26];
- external factors that determine the state of the financial market (crises, state policy regarding the interest rate, etc.).

Market risk is assessed using risk metrics for a range of risks (percentage, currency), capital calculations according to regulatory requirements and internal assumptions, and stress–testing and scenario analysis tools. Some indicators are discussed below.

[3] Directive 2009/138/EU of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II). URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02009L0138–20140523&from=EN (accessed on 21.04.2021).

Table 1

Types of market risks

Types of risks	Risk description
Interest rate risk	The sensitivity of the values of assets, liabilities and financial instruments to changes in the term structure of interest rates, or in the volatility of interest rate
Currency risk	The sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of currency exchange risk
Property risk	The sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of market prices of real estate
Equity risk	The sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of market prices of equities

Source: compiled by the authors using Solvency II.

The risk–metric of the investment portfolio interest rate is based on the sensitivity of the company's assets when the interest rate changes by 1 basis point (Dollar Duration, DV 01):

$$\text{DV 01} = -P^{*}\text{Dur}_{\text{mod}}{}^{*}\Delta i, \quad (1)$$

where P — value of the portfolio, which sensitive to interest rate fluctuations; Dur_{mod} — modified duration of portfolio; Δi — interest rate changes by 1 basis point.

Insurers use Open Foreign Currency Position to estimate foreign exchange risk (OFCP). OFCP is used to reflect the sensitivity of the insurer's financial result to changes in exchange rates. OFCP in a separate currency is considered as the difference between assets and liabilities denominated in one currency other than the insurer's base currency. The positive value of OFCP indicates that when the exchange rate increases relative to the base company, the negative value of OFCP leads to losses when the foreign currency grows relative to the base currency. Positive OFCP value denoted by "long" position, negative — short. In addition to OFCP in currency, are also distinguished the balancing OFCP as the difference between the absolute sums of all short and long positions. If the insurer seeks to minimize currency risk in a separate currency and/or in general, he will take the effort to note the balancing OFCP to zero.

The next tool to assess market risk is stress–testing, which should assess the impact of the implementation of stress scenarios on the risk–metrics, positions and financial result of the insurer. Among the prevalent scenarios, the following should be highlighted:

- stress testing based on historical scenarios (crises 2008–2009, 2014–2015 years);
- analysis of interest rate sensitivity (interest rate increases of 1, 3, 5, 10%);
- analysis of sensitivity to changes in exchange rates (growth of foreign currency against ruble per 10, 20, 30 rub.).

The following sections are considered the requirements for measuring capital at market risk in different regulatory regimes.

ASSESSMENT OF THE MARKET RISK OF EUROPEAN INSURERS

Since 01.01.2016, the EU operates the solvency regime — Solvency II, which provides for the calculation by European insurers of regulatory capital requirements for all significant risks, including market risk. Solvency II's main purpose is to increase the reliability of the insurance market by providing more effective protection of the insured interests [27]. Capital measure can be estimated using a standard formula or an internal model that must be approved by the regulator. Consider further the provisions of the standard formula for the different components of market risk according to Solvency II.

Property risk

Article 174 of the Delegated regulation[4] prescribes for European insurers the definition of capital at risk of real estate price change as a loss of equity due to a 25% decline in real estate value.

Currency risk

In accordance with article 188 of Delegated regulation, capital under currency risk is calculated as the sum of claims against each individual foreign currency.

The main currency of listed shares is determined by the country of listing. For shares not listing, the main currency is determined by the country of presence of the issuing company.

The amount of requirements for each currency is determined by the maximum possible loss of its own funds under stress compared to the amount of its own funds (OF) in the base scenario (2). In the scenario of growth of own funds under stress, the required foreign exchange risk capital is assumed to be 0. As a stress, Solvency II requires a 25% decrease or increase in the base currency (euro).

$$\mathrm{MKT}_{\text{currency } i} = \max\left(\mathrm{MKT}^{\text{up}}_{\text{currency } i}; \mathrm{MKT}^{\text{down}}_{\text{currency } i}\right), \quad (2)$$

where $\mathrm{MKT}_{\text{currency } i}$ — estimation of capital requirements at foreign exchange risk for one currency; $\mathrm{MKT}^{\text{up}}_{\text{currency } i}$ — changes in the insurer's own funds due to currency increase; $\mathrm{MKT}^{\text{down}}_{\text{currency } i}$ — changes in the insurer's own funds due to currency reduction; $\mathrm{MKT}^{\text{up/down}}_{\text{currency } i} = \max((\mathrm{CC}_{\text{before shock}} - \mathrm{CC}^{\text{up/down}}_{\text{after shock}});0)$.

An example of calculating the currency risk according to Solvency II is presented in *Table 2*.

Interest rate risk

In accordance with article 165 of Delegated regulation capital at interest risk is calculated as the maximum loss of equity in the scenario of lowering or increasing the interest rate against the base scenario (3):

$$\mathrm{SCR}_{\text{int}} = \max\left(\mathrm{MKT}^{\text{up}}_{\text{int}}; \mathrm{MKT}^{\text{down}}_{\text{int}}\right), \quad (3)$$

where $\mathrm{SCR}_{\text{int}}$ — assessment of capital requirements at interest risk; $\mathrm{MKT}^{\text{up}}_{\text{int}}$ — changes in the insurer's own funds due to interest rate increase; $\mathrm{MKT}^{\text{down}}_{\text{int}}$ — changes in the insurer's own funds as a result of interest rate reduction; $\mathrm{MKT}^{\text{up/down}}_{\text{int}} = \max((\mathrm{CC}_{\text{before shock \%}} - \mathrm{CC}^{\text{up/down}}_{\text{after shock \%}});0)$.

To get your own funds in a base or stressful scenario is required from the discounted value of the assets exposed to interest risk, subtract the liabilities exposed to interest risk. An example of calculation for the risk module interest rate is presented in *Table 3*.

Equity risk

Equity risk sub-module reflects the sensitivity of financial instruments to various shocks. Solvency II proposes to divide financial instruments into two groups for capital calculation:

[4] Delegated Regulation. Commission Delegated Regulation (EU) 2015/35 of 10 October 2014 supplementing Directive 2009/138/EC of the European Parliament and of the Council on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II) Text with EEA relevance. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R 0035 (accessed on 03.05.2021).

Table 2

An example of currency risk calculation

	Value before shock	Value after shock		$MKT^{up}_{currency\ i}$	$MKT^{down}_{currency\ i}$	$MKT_{currency\ i}$
		Foreign currency appreciation	Foreign currency depreciation			
1*	2*	3*	4*	5*	6*	7*
Assets	90 $	112,5	67,5			
Liabilities	100$	125	75			
CC = Assets-Liabilities	–10 $	–12,5	–7,5			
Total				= –10 – (–12,5) = 2,5	= –10 – (–7,5) = –2,5 => = 0	2,5

Source: compiled by the author using Solvency II.

Note: * Column 1 — object type, column 2 — market value of the assets/liabilities before stress; columns 3&4 — market value of the assets/liabilities after stress in compliance with Solvency II; columns 5–7 show the results of currency risk calculation in line with the formula (2).

Type 1: shares included in listing of the European Economic Area (EEA) and the Organisation for Economic Cooperation and Development (OECD) countries;

Type 2: shares not included in Type 1.

Shocks applicable to different types of shares are reflected in *Table. 4*.

Classification criteria for strategic investments are reflected in article 171 of Delegated Regulation.

Estimation of equity requirements for two types of shares is calculated as a delta of equity due to applicable shocks. To calculate the final value of the capital at risk of change of the shares accumulate taking into account the correlation between the two types of shares (4):

$$SCR_{equity} = \sqrt{SCR^2_{type1} + 2*0,75*SCR_{type1}*SCR_{type2}}, \quad (4)$$

where SCR_{equity} — estimation of capital requirements at risk of changes in the value of shares; SCR_{type1} — estimation of capital requirements at risk of changes in the value of Type 1 shares; SCR_{type2} — estimation of capital requirements at risk of changes in the value of Type 2 shares.

ASSESSMENT OF MARKET RISK OF RUSSIAN INSURERS

Issues of financial sustainability and solvency of insurers have traditionally been paramount for the insurance supervisory authority. Risk–oriented regulation, in the opinion of the Bank of Russia, due to adequate and comprehensive risk assessment of insurers' activities should contribute to increasing the competitiveness and investment attractiveness of the insurance sector. Since the publication of the Concepts of introduction of risk-oriented approach to regulation of the insurance sector in the Russian Federation[5] (further — Concept)

[5] Concepts of introduction of risk-oriented approach to regulation of the insurance sector in the Russian Federation (approved by the Bank of Russia). Consultant Plus

Table 3

Example of calculation for the risk module interest rate

	T	Value before shock	Yield	Discounted cash flow before shock	After shock						CC before shock%ljr	MKT_{int}^{up}	MKT_{int}^{down}	SCR_{int}
					Interest rate growth			Interest rate decline						
					Shock	Yield	Discounted cash flow	Shock	Yield	Discounted cash flow				
1*	2*	3*	4*	5*	6*	7*	8*	9*	10*	11*	12*	13*	14*	15*
Bond 1	1	90000	5.96%	84938	70%	10.1%	81720	75%	1.5%	88679				
Bond 2	2	110000	6.13%	97660	70%	10.4%	90217	65%	2.1%	105428				
Bond 3	3	140000	6.37%	116324	64%	10.4%	103913	56%	2.8%	128859				
Bond 4	5	170000	6.76%	122576	55%	10.5%	103293	46%	3.7%	142100				
Bond 5	7	260000	7.02%	161703	49%	10.5%	129582	39%	4.3%	193866				
Assets		770000		583201			508724			658931				
Reserve 1	1	100000	5.96%	94375	70%	10.1%	90800	75%	1.5%	98532				
Reserve 2	2	90000	6.13%	79904	70%	10.4%	73814	65%	2.1%	86259				
Reserve 3	3	140000	6.37%	116324	64%	10.4%	103913	56%	2.8%	128859				
Reserve 4	4	200000	6.57%	155086	59%	10.4%	134447	50%	3.3%	175761				
Reserve 5	5	200000	6.76%	144207	55%	10.5%	121521	46%	3.7%	167176				
Liabilities		730000		589896			524495			656587				
Total											–6695	9075	Max (–9039;0) = 0	9075

Source: compiled by the author using Solvency II.

Note: * own funds Column 1 – object type; Column 2 – object duration; column 3 – market value of the assets/liabilities before stress; column 4 – zero-coupon yield curve as of 31/05; columns 5, 8, 11 – discounted cash flows before stress, after interest rate growth; after interest rate decline columns 6, 9 – interest risk shocks in line with 166 и 167 Delegated regulation; columns 7, 10 – discounting rates accounting for the respective shock scenarios (in columns 6, 9) column 12 – discounted cash flows of own funds before stress columns 13–15 show the results of interest rate risk calculation in line with the formula (3).

Table 4

Shocks for equity risk calculation in line with Solvency II

	Type 1		Type 2	
	Strategic equity investments	Non-strategic equity investments	Strategic equity investments	Non-strategic equity investments
Shock	22%	39% + SA*	22%	49% + SA

Source: compiled by the author using Solvency II.

Note: SA – SA – the symmetric adjustment based on the average level of the equity index for the last 3 years (the SA shall not be lower than –10% or higher than 10% in line with Article of 172 of the Delegated Regulation.

in 2017, Bank of Russia systematically began work on risk–based supervision. Modules of risk-oriented approach to regulation of the insurance sector in the Russian Federation are similar to the components of the European regime Solvency II. Against the background of significant asymmetry in the regional development of Russian insurers, the researchers confirm the need to introduce differentiated approaches to the regulation of federal and regional insurers in accordance with the principles of Solvency II, proposing to assess the quality and level of risks of all insurers, but following the principles of proportional regulation [28].

In the Concept the Bank of Russia announced plans of compatibility of future national legislation with international principles, in particular with the requirements of the European regime Solvency II.

Compliance with the requirements, prescribed in Regulation 710-P,[6] which the Bank of Russia approved in 2020, is a significant challenge for many insurers, as it may require a change in the structure of asset allocation. At the same time, according to the Bank of Russia, the information raised for calculate the capital for risks can be used by the companies themselves to improve the quality of management [18].

From 01 July 2021, in accordance with the requirements of the new Regulation 710-P, Russian insurers are obliged to calculate additional capital for the implementation of concentration risk. In the paper [13] the authors based on the definition of Solvency II Directive, referred the risk of concentration to credit risk. Below are the sub-modules related to market risk that will take effect for Russian companies from 01 July 2022, similar to the components of the standard formula Solvency II, discussed above.

Real estate price risk

In Regulation 710-P, this sub-module is calculated for residential and non-residential real estate, fixed-term real estate transactions. The estimation of the capital of changes in real estate prices is formed on the basis of the scenario of a fall of 25 and 10% of the value of non-residential and residential real estate, respectively.

Exchange rate risk

Foreign exchange risk sub-module in Regulation 710–P applies to assets, liabilities of the insurer, determined in foreign currency or dependent on the foreign exchange rate

(in accordance with the publication on the website of the Bank of Russia from 20 August 2017) (accessed on 20.04.2021).

[6] Bank of Russia Regulation No. 710-P "On individual requirements for financial stability and solvency of insurers". (approved by the Bank of Russia). Consultant Plus (in accordance with the publication on the website of the Bank of Russia from 23 April 2020) (accessed on 20.04.2021).

Table 5

Scenarios of foreign currency changes against RUB, %

Scenarios \ Date	01.07.2022	01.07.2023	01.07.2024	01.07.2025
Foreign currency appreciation	10	18	33	44
Foreign currency depreciation	0	–3	–7	–9

Source: Regulation 710-P.

according to the contract, as well as term transactions. Capital is defined as the maximum value of possible losses under conditions of depreciation or growth of the foreign exchange rate. Possible losses are calculated as a positive OFCP difference in the base scenario (no change in foreign exchange rate) and OFCP under stress, summarizing the difference in the value of forward transactions in the base and stress scenarios. Read more in the formula (5):

$$R_{1\ currency} = \max\{\left(\max(\Delta OFCP^{up};0\right) + \Delta D_{cur}^{up}) ; \left(\max(\Delta OFCP^{down};0\right) + \Delta D_{cur}^{down})\}, \quad (5)$$

where $\Delta D_{cur}^{up/down}$ — difference in the value of forward transactions in the base scenario and growth (up) /decline (down) scenarios of the foreign exchange rate; $\Delta OFCP^{up/down}$ — OFCP difference in base scenario (no foreign exchange change) and OFCP under stress; OFCP — difference in assets and liabilities determined in foreign currency or dependent on foreign currency under the contract.

Currency risk capital is calculated in the context of foreign currencies in accordance with the scenarios of the exchange rate against the Russian ruble (*Table 5*).

The approach is identical to the standard Solvency II formula, except for the shocks themselves.

Interest rate risk

Interest rate risk is determined for bonds, bank deposits,[7] loans and forward transactions, and the amount of the life insurance. Capital is defined as the maximum value of the loss obtained in the analysis of the decline or increase in the interest rate scenarios. In appendix 3 and 4 of Regulations 710-P, interest rate scenarios are presented by currency (ruble / other than ruble) and according to the road map for the gradual transition to new requirements for the regulatory calculation of capital at interest risk.

The assessment of capital in a scenario is carried out according to three components:

- interest rate exposure of assets;
- percentage risk exposure of life insurance reserves;
- change in the value of forward transactions as a result of the stress scenario.

More in formulas (6), (7):

$$R_{\%} = max\,(R_{\%}^{up}; R_{\%}^{down}), \quad (6)$$

where $R_{\%}$ — assessment of capital requirements at interest risk; $R_{\%}^{up/down}$ — assessment of capital requirements at interest risk as a result of interest rate increases or decreases.

$$R_{\%}^{up/down} = \sum_{m=1}^{M} (MD_m * P_m * * RF_m * St_{\%m}^{up/down}) + \Delta D_{\%}^{up} - \Delta Res_{\%}^{up/down}, \quad (7)$$

where MD_m — duration of assets; RF_m — interest rate depending on currency and period; $St_{\%}^{up/down}$ — shock depending on currency and period; $\Delta D_{\%}^{up}$ — difference in the value of forward transactions in the base scenario and growth scenarios (up) / decline (down) interest rates; $\Delta Res_{\%}^{up/down}$ —

[7] Exceptions are deposits, the conditions of which are provided for a return within 5 days from the date of presentation of the requirements.

Table 6

An example of interest rate risk calculation

	MD_m	P_m	RF_m	Shock (+)	Shock (–)	$R^{up}_{\%}$	$R^{down}_{\%}$	$R_{\%}$
1*	2*	3*	4*	5*	6*	7*	8*	9*
Bond 1	1	90 000	5.96%	58%	–31%	3 111	–1 663	
Bond 2	2	110 000	6.13%	55%	–29%	7 417	–3 911	
Bond 3	3	140 000	6.37%	54%	–28%	14 447	–7 491	
Bond 4	5	170 000	6.76%	48%	–27%	27 581	–15 514	
Bond 5	7	260 000	7.02%	42%	–26%	53 661	–33 219	
Total						106 217	–61 798	106 217

Source: compiled by the author using Regulation 710-P.

Note: * Column 1 — asset name, column 2 — modified duration, column 3 — market value of the asset; column 4 — zero-coupon yield curve as of 31/05; columns 5, 6 — in compliance with Appendices 3&4 of Regulation 710-P, effective as from 01.07.2025; columns 7–9 show the results of interest rate risk calculation in line with formulas 6 and 7.

Table 7

Example of Scenarios of increase in the term structure of interest rates, %

Relation \ Maturity in years	1	2	3	5	7	10
Solvency II	+70	+70	+64	+55	+49	+42
Regulation 710-P	+58	+55	+54	+48	+42	+34

Source: Directive Solvency II & Regulation 710-P.

difference between the life insurance reserves in the base scenario and the rate scenario; M — number of assets; P_m — cost of the asset.

The final value of the capital at the reporting date will depend on the amount of assets, life insurance reserves involved in the calculation (if relevant), temporary structure of the investment portfolio, the value of the coupon-free yield curve for government bonds, the value of the coupon–free yield curve for US government securities and the selected rate-change strategy according to Appendix 3 and 4 of the Regulations 710-P.

Example of calculation of interest risk capital under Regulation 710-P for property insurer is presented in *Table 6*.

Table 8

Comparative analysis of Solvency II and Relation 710-P. Market risk capital requirements

Type of risk	Similarities SII and 710-P	Differences SII and 710-P	Comparability
Interest rate risk	1. Module considered in standard formula 2.The final value of the capital depends on the duration of the asset	1. In SII more severe shocks to the interest rate 2. Regulation 710-P does not require the provision of stress testing for life insurance reserves other than life insurance	There are insignificant differences
Currency risk	1. Module considered in standard formula 2.The final capital value depends on the size of the open currency position	1. Regulation 710-P provides for more severe shocks in the foreign exchange growth scenario	Almost full compliance
Equity risk	1. Module considered in standard formula 2.The final value of the capital depends on the types of shares in the portfolio	1. SII introduces the concept of shares belonging to strategic investments 2. In SII, capital depends on the type of shares and the country of origin of the issuer 3. Capital in Regulation 710-P depends primarily on the country of origin of the issuer (Russian Federation or not. 4. In SII more severe shocks to interest rate risk	Significant differences
Property risk	1. Module considered in standard formula 2. The same stress–test to shock 25% of non-residential property prices	1. Regulation 710-P provides for capital to shock residential property prices by 10%	Almost full compliance

Source: compiled by the author.

Feature of the requirements of the Russian legislation on capital at interest risk is the absence of requirements for stress-testing of reserves for insurance other than life insurance. In addition, Regulation 710-P applies less severe shocks to changes in the interest rate compared with European regulation (*Table 7*).

Equity risk

In Regulation 710-P, capital at the risk of changes in the value of shares is calculated for shares, term transactions, issuer options and other contracts, the payment of which is determined depending on the value of the shares. Capital at risk of equity change is estimated using the formula (8):

$$R_{equity} = \sum_{m=1}^{M} P_m * I_m + \Delta Derivative_{equity}, \quad (8)$$

where R_{equity} — assessment of regulatory capital requirements at risk of changes in the value of shares; P_m — value of shares; I_m — rate of depression of share values rate by country;
$\Delta Derivative_{equity}$ — difference in the value of forward transactions, options, other contracts, the payment for which depends on the value of the shares as a result of stress.

The Central Bank of the Russian Federation sets the reduction coefficients of the share price, depending on the region of the issuer of the shares and the effective date of the requirements. The most severe testing shocks will expect to 01 July 2025 and account for 18 and 25% for issuers of the Russian Federation and other issuers respectively.

CONCLUSION

Comprehensive risk assessment of the insurance organization improves the quality of insurance protection and is an important condition for the sustainable development of the insurance industry. Changes in Russian regulation by the Bank of Russia will require insurers to improve risk management systems in general, approaches to capital valuation in particular.

The authors of domestic studies confirm the expediency of implementation of prudential risk–oriented supervision. Theoretical contribution of this article lies in the comparative analysis of the Russian and European regulation with regard to the assessment of capital under market risk for the first time in the academic domestic literature. The article identifies that the new requirements in Regulation 710–P largely repeat the standards in force for European insurers, however, differences have been identified and the degree of comparability of regulatory requirements has been determined (*Table 8*). The practical significance of the article lies in the possibility of using materials in educational activities when studying the features of risk management in the insurance industry.

The presence of discrepancies in the Russian regulation regarding Solvency II is due to peculiarities of the insurance market, which the Bank of Russia could not ignore when developing legislation on the solvency of insurers. Reduced requirements (compared to Solvency II) with regard to the percentage risk and equity risk for Russian insurance companies, they provide opportunities to build a less conservative investment strategy, taking into account a risk — return — equity balance. Insurance company needs to have sufficient capital to absorb losses in crisis situations to remain solvent. Since even the ruble's volatility has historically been higher than 25% in the recent outlook, more severe shocks to the currency risk assessment for Russian insurers are justified and should reduce the amount of foreign exchange risk losses.

Despite the partial equivalence of the Solvency II regime, it is important to note the positive trends in the development of proactive market risk management by insurance companies. Time to see how the structure of insurers' investment assets will change as a result of the entry into force of Regulation 710–P. However, insurance companies will increasingly adopt advanced risk management practices. Step-by-step transition to risk-oriented regulation allows Russian insurers to prepare in advance for the new coordinate system to increase the reliability of the protection provided.

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ORIGINAL PAPER

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Methods of Rating IT-Sector Companies by Level of Risks of Creditworthiness

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ABSTRACT

The subject of the research are the companies of the IT sector, as a strategically important sector in the information age. Their development of companies in the IT sector is associated with high risks and requires large volumes of investments, including attracting bank loans. In this regard, **the purpose of the study** was to develop an adequate sectoral methodology for rating companies in the IT sector by the level of creditworthiness risks using mathematical and statistical tools that make it possible to reliably assess the potential risks of investors. To achieve this goal, the study proposes a methodology for assessing the creditworthiness of IT companies based on a system of risk factors, which makes it possible to quantify the exposure of companies to two generalized risk groups: financial risk and business risks. Based on the cluster analysis, a rating table has been developed, according to which, depending on the calculated score, the category of the company's creditworthiness is determined. The **study concluded** that the key factors affecting the creditworthiness of companies are: indicators of financial stability, return on assets, liquidity ratio, online advertising market size, as well as the share of intangible assets in the structure of assets and the amount of research costs. development and capital investments. The constructed scoring model was tested on the Mail.ru Group company (from 12.10.2021 — VK). **Practical significance of the research results** includes in the fact that the developed model can be applied not only for assessing creditworthiness, but also as one of the express methods of risk management in an organization.
Keywords: creditworthiness; risk factors; financial risk; business risk; rating model; IT companies

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INTRODUCTION

IT-sector provides economic security of the country, as Russia's dependence on imported supplies of equipment and software is one of the key threats to national security.[1] Western experts consider that "not fully covered by statistics, but quite powerful IT-sector, especially in the field of contract software" would give Russia a chance to accelerate economic growth.[2] According to the Digital Evolution Scorecard rating, Russia is assigned to the group of "perspective countries" by criteria "level and pace of digital development", which indicates that there is a possibility of significant progress in these areas.[3] Indeed, the information technology sector in Russia is one of the fastest growing and developing in the current realities of the Russian economy [1], but its rapid development is associated with high risks and requires large volumes of investments, and in attracting bank loans [2]. In this regard, in the context of the large-scale growth of digitalization, it becomes extremely important to develop a model for assessing the creditworthiness of IT-companies with their industry-specific features [3].

The purpose of our research consisted in developing a complex method of rating companies in the IT-sector by the level of credit risk, with their specific industry, using mathematical and statistical tools. To achieve this goal, a number of objectives have been set:

- develop an algorithm for building a model of complex assessment of creditworthiness, justifying the inclusion of risk factors in the assessment system;
- conduct a regression analysis to assess the impact of risk factors on the creditworthiness of IT-companies;
- develop a creditworthiness rating scale based on the cluster approach;
- conduct an approbation of the developed method of assessing creditworthiness on the example of Mail.ru Group (from 12.10.2021 — VK).

The scientific novelty of the research consists in the development of a method of rating companies IT-industry, allowing to improve the tools of assessment of creditworthiness of companies taking into account their industry characteristics.

Assessing the creditworthiness of companies' means to determine the appropriateness of interaction with a potential borrower based on an analysis of the organization's ability to repay the creditor's debts in full and within the deadline set in the contract. In fact, the creditworthiness involves an analysis of the impact of different risk groups on the company's activities, i.e. is some forecast of the financial state of the organization for the expected crediting period under conditions of volatility of external and internal factors. On this basis, it is advisable to include several risk groups as basic indicators of the creditworthiness assessment methodology, which are likely to have a significant impact on the activities of the borrower companies under analysis [4]. Credit risk — factors affecting the company's ability to generate cash flow, the ability to meet its obligations to the credit institution in a timely manner, i.e. to repay the full amount of principal and accrued interest [5]. Credit rating — formed opinion on the level of the borrower's overall creditworthiness or its ability to service a specific credit product derived from risk assessment [6].

According to Basel III, new approach is being introduced based on banks' internal ratings to calculate credit risk. The IRB-approach is based on the assessment of credit risk by calculating the expected losses of the Bank in the event of the borrower defaulting on loan obligations (default) under the following formula:

$$EL = PD \times EAD \times LGD, \quad (1)$$

where: EL — Bank's expected losses;

[1] From the statement of D. Rogozin, according to the press service of GC "Roskosmos". URL: https://news.mail.ru/politics/45808571/?frommail=1 (accessed on 01.08.2021).

[2] MACROECONOMIC FORECASTING. URL: https://cebr.com/service/macroeconomic-forecasting (accessed on 01.08.2021).

[3] The world's most digital countries: rating of 2020. URL: https://hbr-russia.ru/innovatsii/trendy/853688 (accessed on 01.08.2021).

PD — probability of default of the Borrower;

EAD — amount at risk of default by the Borrower;

LGD — Bank's share of economic losses at the time of Borrower's default.

In turn, the probability of default of the Borrower (value of indicator *PD*) means the probability that due to the Borrower's financial problems there will be no sources of repayment of loan obligations to the Bank [7].

In particular, for the application of IRB-approach, credit organizations need to build a model of credit rating (scoring), which allows to assess the level of creditworthiness of the borrower and to determine the level of probability of its default (indicator *PD*), i.e. ability to meet obligations on time and in full.

In order to minimize credit risk, existing multi-factor models should be modified, which will mitigate the risk of decline in corporate loan portfolio of Russian commercial banks, taking into account the influence of various external macroeconomic factors [8].

Typically, a credit analysis involves a study of the impact of two groups of factors on credit risk — financial risks and business risks. Business risks include risk factors at the level of the economy, the sector in which the borrower operates, the business environment of the company. Financial risks — it's a risks of violation of the repayment terms envisaged by the Borrower, repayment in full of the indebtedness or full loan default.

The research of foreign authors also notes the need to update and improve the methods used to assess the creditworthiness of companies in the IT-sector in modern conditions.

According to V. Munguti and R. Ngali, developing technology companies are faced with difficulties in obtaining credit facilities, as standard creditworthiness assessment procedures do not apply to organizations in the industry, which are often characterized by a lack of liquidity, instability of cash flows, high mobility of business, etc. [9]. Accordingly, the authors confirm the need for a correct assessment of the level of creditworthiness of IT-sector companies, with their specifics. To solve this problem, analysts recommend to develop a platform of end-to-end assessment of creditworthiness with an available credit rating model based on forecasting and data aggregation to assess the state of the business at the 4th stage of the Industrial Revolution (Industry 4.0) [9].

According to research by R. Safi and Z. Lin in the context of economy digitalization, it is advisable to move to transaction models that use quality statistics to assess the creditworthiness of companies. The authors classify indicators reflecting the creditworthiness of technology companies into three groups: internal factors, external factors, B 2B- or B 2C-Platform factors [10]. Internal and external factors are classic and applicable in most assessment methodologies, including financial indicators, basic characteristics of companies (business ownership structure, litigation, etc.), and general economic factors. Proposed by scientists R. Safi and Z. Lin the group of factors B 2B/B 2C-Platform consists of three categories: presence on the platform (including the duration of the company's presence in online channels, its awareness), activity on the platform (degree of customization of the online-platform, the scope of activity in the Internet, etc.), customer base (number of users, including permanent and potential). Scientists used logistic regression to confirm their hypothesis about the impact of qualitative factors on the creditworthiness of technology companies [10].

The practical significance of the research is consist on the basis of the proposed model, that possible to assess the impact of risk groups on the level of creditworthiness of IT-industry companies. The developed model is an additional tool in the assessment of credit risk, as well as one of the express methods of risk management in the organization, allows to prevent the occurrence of financial problems of the company in the future. Accordingly, the developed methodology is

applicable not only in credit organizations, but also in the corporate sector.

DESCRIPTION OF THE AUTHOR'S ALGORITHM AND METHODS FOR RATING OF IT-SECTOR COMPANIES BY THE LEVEL OF CREDIT RISK

The main prerequisite for the transition to rating models of creditworthiness is the objective need to replace the expert assessment by automation and algorithmic of this process, which will increase its transparency [11, 12].

The author's algorithm of development of the method of rating of IT-sector companies by the level of creditworthiness risk (credit scoring) consists of the following stages:

1. Selection of risk factors affecting the creditworthiness of companies, their systematization by generalized groups.

2. Substantiation of indicator are included in the factors system and allow for the quantification of each of the risk groups; selection and substantiation of the result indicator of creditworthiness.

3. Selection of IT-sector companies based on public financial statements and industry reviews.

4. Construction of a regression model allowing assigning weights to each group of risk factors to take into account in the assessment of the force of the influence of the indicators of factors on the resulting indicator, as well as sensitivity when changing the factor variables.

5. Development of the final system (model) of assessment of creditworthiness of IT- sector companies on the results of construction of regression models.

6. Development of the rating system and its scale reflecting the rating of the IT- sector company by the level of creditworthiness risks, formed on the basis of a comprehensive risk assessment.

The author's development of an algorithm for the IT-sector companies rating is development of the methodology of assigning credit ratings to the companies of the largest credit rating agency in Russia (Expert RA JSC). According to the methodology of RA Expert the rating of the company is based on the analysis of block factors: independent creditworthiness of the company [taking into account internal factors of support (financial risks, business risks, corporate risks) and exposure to internal stress factors] and importance of external factors of support and stress factors. As a result of the assessment of the company is assigned one of 8 categories of creditworthiness from AAA (maximum level) to C (default).[4]

The first stage of construction of the proposed rating model of assessment of creditworthiness is formation of the system of risk factors that influence the level of credit risk for each borrower. Within the developed methodology will focus on two main risk groups: financial risks and business risks.

It is reasonable to be included business risk group in risk assessment model — risks due to the specifics and dynamics of the market or industry in which the analyzed companies operate. Each assessment area combines a set of factors that can influence development trends, position in the industry sector and the overall state of the borrower company. In addition, the researches note that in terms of increasing competition in financial markets, it is recommended to assess the quality of the commercial bank loan portfolio for each industry segmentation of the customer base [13].

The final set of factors and indicators that allow to quantify business risks inherent in the activities of IT-industry companies is presented in *Table 1*.

Financial risks are included in the model as the main stage of credit analysis is to assess the financial condition of borrowers [14]. Standard coefficient analysis indicators are proposed for assessment of financial risks: liquidity, financial sustainability, profitability and business activity. For the construction of the model it is important to use the values of these indicators in absolute values, as

[4] Methodology of creditworthiness ratings to non-financial companies of Expert RA JSC. Official site Expert RA. URL: https://www.raexpert.ru/ (accessed on 01.08.2021).

Table 1

The system of factors assessing business risks

Group of risk	Subgroup of risk	Justification for inclusion in the model	Indicators	Calculation formula
Business risks	Industry risk	Assessment of the stability of the company's activity directly depends on the state and inherent trends in the industry and the market, which is the main platform for doing business. Favorable structural changes in the industry have a significant impact on the growth of the company (including internet penetration, digital growth, and digital services popularity). Also at present, the main channel of sales of companies IT-industry becomes the advertising market (mainly in the online-segment). In addition, it is important to assess the industry-specific level of arrears to credit institutions	Number of active Internet users, per.	Statistical data
			Level of arrears to credit organizations, %	Statistical data
			Volume of the online- advertising market, bln rub.	Statistical data
	Market risk	The IT-sector is characterized by continuous development and continuous improvement, implementation of technological changes in all processes. This specificity is due to the rapid technology update, consumer preferences variability, nature of services offered The inability to innovate, provide popular products and services or respond quickly to market developments has a direct impact on the attractiveness of the company, as well as its profitability. The ability to adapt flexibly and effectively to the changing external market environment and offer the consumer innovative advanced product at the end of its own development — the main factor of sustainability of companies in the IT-sector	Share of intangible assets (IA) in balance sheet structure, %	IA/assets
			Cost on research or capital investment, mln rub.	Expenditure on IA
			Revenue growth rate, %	Revenue of the reporting period / Revenue of the same period last year
	Business reputational risk	Business reputation risk reflects the risk of losses to the company as a result of the formation of a negative image of the activity or as a result of the formation of significant claims on the part of government authorities (for example, enforcement proceedings for tax arrears), and from counterparty partners (various arbitration cases). It is also important to assess this risk in the course of the creditworthiness analysis due to possible deterioration of the financial condition of the company due to the performance of significant claims (claims, etc.). To be able to quantify this risk, it is proposed to use dummy variables (qualitative indicators are assigned a certain value depending on the specific level)	Share of active actions in net assets, %	Dummy variable: less 5% — 0, from 5 to 30% — 1, from 30 to 50% — 2, more than 50% — 3
			Share of value of enforcement proceedings in net assets, %	Dummy variable: less 5% — 0, from 5 to 30% — 1, from 30 to 50% — 2, more than 50% — 3

Source: compiled by the authors.

it is advisable to use the initial values for the correct assessment of creditworthiness, because the level of the assessed financial position of a company depends on the specific value of the estimate (for example, than higher the value of financial sustainability indicators, those higher the level of creditworthiness). The model construction algorithm does not provide a stage for converting the values of the indicators into single scores due to the above-mentioned problems, as well as the need to exclude subjectivity from the model (including business risk indicators, it is difficult to determine the required industry averages and the translation scale for them).

The totality of risk factors in the group of financial risks, as well as the appropriateness of including each of the subgroups in the common system and a specific indicator to assess the exposure of the company to financial risk, are presented in *Table 2*.

The final system of risk factors and indicators, allowing to conduct a comprehensive integrated assessment of the creditworthiness of IT-industry companies, is presented in *Table. 3*. Further, in the regression model construction, it is possible to exclude any indicators from the integral assessment due to their statistical inconsistency.

The next stage after the formation of the system of risk factors is the selection and substantiation of the result indicator, which allows to quantify the level of creditworthiness of the company.

As such an indicator, the market capitalization of companies or the market price of their shares was chosen, since the market value of a company can be considered as a key outcome of the organization's activities.

Based on the developed system of factors affecting the creditworthiness of the company, the authors are constructed a statistical regression model. The dependent variable is the indicator of market capitalization of Russian companies IT-industry, the shares of which are listed on the stock exchange.

As a result of the exclusion of statistically insignificant factors from the model, we will get an equation reflecting the relationship between the value of market capitalization (cost) of IT-industry companies in Russia and internal risk factors:

$$y = -3621{,}4 + 162{,}3*x_3 + 12402*x_4 - 1117*x_6 - 170*x_7 +$$

$$+156*x_8 + 162*x_9 + 19604*x_{12} + 499*x_{13}, \quad (2)$$

where y — market capitalization (cost) of the company; x_3 — absolute liquidity ratio; x_4 — autonomy ratio; x_6 — equity to loan ratio; x_7 — period of accounts receivable turnover; x_8 — period of accounts payable turnover; x_9 — financial cycle duration; x_{12} — return on assets (ROA); x_{13} — debt/EBITDA.

The multiple correlation coefficient (R) equal to 0.94 is indicate about close relationship between the factors. Determination coefficient (R^2) shows that 89% of the variation of the dependent variable is considered in the model and is due to the influence of included factors (*Table 4*). The equation and regression coefficients are statistically significant.

In order to correctly reflect the level of influence of each of the factors on the market value of companies it is necessary to calculate the coefficients of elasticity of variables.

The main internal risk factor that has the greatest impact on the market value of companies is the autonomy coefficient. With 1% increase of autonomy ratio, the organization's market capitalization is expected to grow by 4% on average. The revealed interconnection corresponds to the economic theory and is quite reasonable: the higher the coefficient of autonomy, the greater the financial independence of the company from external sources of financing and external creditors [15]. Generally, financially sustainable companies are valued more highly by the market and investors, which is reflected in their level of capitalization.

The second most influential factor is the length of the financial cycle. Market capitalization of IT-sector companies is expected to decline by 3.7% on average with 1% increase in the financial cycle duration.

Table 2

The system of factors assessing financial risks

Group of risk	Subgroup of risk	Justification for inclusion in the model	Indicators	Calculation formula
Financial risk	Liquidity and solvency	This group allows you to assess the risks associated with a possible decline in the liquidity and solvency of the company, i.e. the inability to repay current (short-term) liabilities through sales of current (working) assets on the market. Accordingly, the inclusion of this risk makes it possible to estimate the probability of the occurrence of cash gaps in the course of operations of the company	Working capital ratio	Own working capital / Working assets
			Current ratio	Current assets / Short-term liabilities
			Absolute liquidity ratio	(Cash + short-term financial investments) / Short-term liabilities
	Financial sustainability	This group of risks allows to assess the financial independence of the company from external sources of financing (lenders). Risk of weakening the financial sustainability of the company arises due to the high level of borrowing	Autonomy ratio in shares, un.	Equity / Balance Sheet Currency
			Financial sustainability ratio in shares un.	(Equity + Long-term Liabilities) / Balance Sheet Currency
			Equity to debt ratio, %	Equity / Borrowed capital
	Business activity (turnover)	This group of risks is designed to assess the effectiveness of cash flow management and the intensity of use of the company's assets, the duration of its operational and financial cycles. The long turnover of assets has a direct impact on the company's financial performance	Accounts receivable turnover (RT), days	Number of days in period * RT / Revenue
			Accounts payable turnover (PT), days	Number of days in period * PT / Cost
			Financial cycle, days	Inventory turnover period + RT turnover period – PT turnover period

Source: compiled by the authors.

Table 3

The system of factors evaluating the creditworthiness

Group of risk	Subgroup of risk	Indicators	Indicator X_i
Financial risk	Liquidity and solvency	Working capital ratio, in shares un.	x_1
		Current ratio, in shares, un.	x_2
		Absolute liquidity ratio, in shares, un.	x_3
	Financial sustainability (capital structure)	Autonomy ratio in shares, un.	x_4
		Financial sustainability ratio, in shares, un.	x_5
		Equity to debt ratio, %	x_6
	Business activity (turnover)	Turnover period of receivables, days	x_7
		Period of accounts receivable turnover (RT), days	x_8
		Financial cycle, days	x_9
	Efficiency of activity	Return on equity (ROE), %	x_{10}
		Return on sales (ROS), %	x_{11}
		Return on assets (ROA), %	x_{12}
	Debt burden	Debt (long-term, short-term and rental liabilities) /EBITDA (earnings before interest, taxes and depreciation), un.	x_{13}
		Earnings before interest and taxes (EBIT), mln rub.	x_{14}
		Debt / Average monthly revenue, un.	x_{15}
Business risk	Industry risk	Number of active Internet users, person	x_{16}
		Level of arrears to credit institutions, %	x_{17}
		Volume of the online- advertising market, bln rub.	x_{18}
	Market risk	Share of intangible assets (IA) in balance sheet structure, %	x_{19}
		Cost on research or capital investment, mln rub.	x_{20}
		Revenue growth rate (RGR), %	x_{21}
	Business reputational risk	Share of active actions in net assets, %	x_{22}
		Share of value of enforcement proceedings in net assets, %	x_{23}

Source: compiled by the authors.

Table 4

Regression statistics indicators of the model of internal factors

Indicators	Means
Multiple correlation coefficient (*R*)	0.9420
Determination coefficient (R^2)	0.8875
Normalized determination coefficient R^2	0.8274
Standard error	545.39
Observations	24

Source: compiled by the authors.

Reduction of financial cycle is a positive trend, indicating faster production or faster payment from debtors. In general, the acceleration of the financial cycle minimizes the risk of a decrease in the level of solvency of the company, as the growth of the financial cycle increases the need to attract additional financing to replenish working capital, which are often borrowed sources of finance, which can ultimately lead to reduced financial sustainability.

The next factor on the level of influence on the market value is the ratio of equity to borrowed capital, as with the increase of this coefficient by 1% the market capitalization of IT-sector companies is expected to decline on average by 0.9%. The revealed dependence can be explained by the influence of the financial leverage mechanism: the growth of the share of debt financing in the structure of liabilities can lead to an increase the return on equity (ROE). As a rule, business profitability is also an important factor providing better value to the company from market investors. But it is important to note that as the level of financial leverage increases, financial risk and the risk of weakening financial sustainability increases.

With 1% change in the remaining internal factors, the average change in the company's market value will be less than 1%. In particular, the increase in the absolute liquidity ratio by 1% will have a positive impact on the market value of the company and will lead to an increase of 0.16% overall. The revealed relationship can also be substantiated on the basis of economic theory. As the increase in the liquidity ratio indicates a reduction in the company's insolvency risk and its ability to repay short-term liabilities with the most liquid funds in the short term, this has a positive impact on the market valuation of its value.

According to the obtained elasticity coefficient value for the variable x_{12} — return on assets (ROA), its change by 1% will lead to a projected increase in the market value of IT-companies by 0.14%. This statistical relationship between variables can also be substantiated, because the level of profitability of a business directly depends on its investment attractiveness.

Thus, the regression model confirms the relationship between the embedded internal risk factors and the market value (capitalization) company IT-industry, serving as an indicator and allowing to quantification the level of creditworthiness [16]. Therefore, by confirming the statistical significance of the variables and the model as a whole, it is possible to use this equation as one of the stages of credit scoring for companies in the IT-industry [17].

The final regression equation, which reflects the influence of business risk factors on the level of market capitalization of IT-companies, is as follows:

$$y = -777 + 3320^{*}x_{17} + 29^{*}x_{18} + 1082^{*}x_{19} + 0,3^{*}x_{20}, \quad (3)$$

where y — market capitalization (cost) of the company; x_{17} — level of arrears to credit in-

Table 5

Regression statistics indicators of the model of factors of business risks

Indicators	Means
Multiple correlation coefficient (*R*)	0.8711
Determination coefficient (R^2)	0.7589
Normalized determination coefficient R^2	0.7081
Standard error	709.3
Observations	24

Source: compiled by the authors.

stitutions,%; x_{18} — volume of the online-advertising market, bln rub.; x_{19} — share of IA in the balance sheet,%; x_{20} — expenses on IA (research development / capital investments), mln rub.

The multiple correlation coefficient (*R*) equal to 0.87 is indicate about close relationship between the variables. Determination coefficient (*R* 2), shows that 76% of the variation of the dependent variable is accounted for in the model and is due to the influence of included business risk factors (*Table 5*). The findings of this research, the equation and the regression coefficients are statistically significant.

The biggest influence on the market value of IT-industry companies has the coefficient x_{18} — volume of online-advertising market. With a 1% increase in this ratio, the capitalization of companies is projected to increase by 1% of the average, other things being equal. This dependence corresponds to the current state of the market, today the key business trend is digitalization, and more industries are launching a strategy of active introduction of digital products in business processes. The research confirms the hypothesis that the greatest impact of digitalization is observed among technology companies [18]. Given this trend of increasing digitalization and the popularity of digital services, as well as the penetration of the Internet in all areas of society, one of the fundamental sources of income of IT-industry companies is income from online-advertising.

Next in terms of impact on the capitalization of companies indicators are the share of IA in the structure of assets (with the increase of this coefficient by 1% the expected increase in the value of IT-companies will be 0.12% on average) and the value of R&D and capital investments (1% increase in expenditures of this group will lead to 0.36% increase in capitalization of IT-sector companies on average). Intellectual capital is considered as a potential source of competitive advantages of companies and a factor of increase of their market value [19].

The revealed interconnection shows that investment is attractive for those companies IT-industry, which are able to respond flexibly to changes in the market. According to Salesforce, due to the global development of the pandemic, 88% of the population expects companies to intensify digital initiatives [20]. In order to introduce and offer innovative products, follow and match the main industry trends, IT companies need to invest in their own R&D.

Thus, taking into account the statistical significance of the constructed regression model, we confirm the hypothesis about influence of factors that allow assessment of business risks on the market value of IT-industry companies, therefore, on the level of their creditworthiness.

Taking into account the creditworthiness rating methodology applied by one of the largest credit rating agencies in Russia (Expert RA JSC), we will determine the

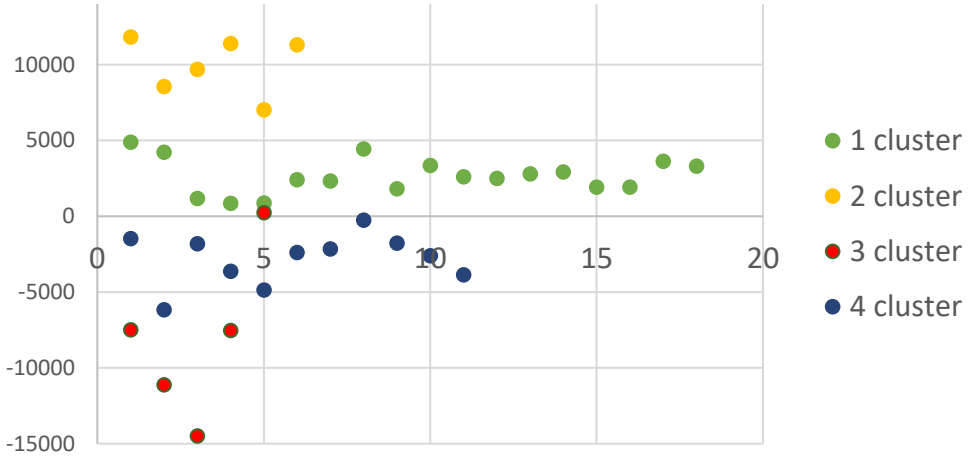

Fig. **Clustering ratings based on the results of cluster analysis**

Source: compiled by the authors.

weight of the impact of each generalized risk group on the overall integral rating of creditworthiness: financial risks — 60%, business risks — 40%.[5]

The final rating of the borrower will be based on weighting of points for each risk group and corresponding weight value. The risk group score is based on the calculation of the value for each group by substituting the specific indicators for the borrower company at the last reporting date and the relevant industry data in the regression model equations.

IMPROVING THE RELIABILITY OF THE METHODOLOGY USING THE CLUSTER ANALYSIS TOOLKIT

Data on IT-companies eliminated in the first half of 2021 have been added to the previously used regression model sample in order to increase the representativeness of the developed methodology. Thus, the final sample includes 40 observations, including 16 observations from failed IT-companies.

Therefore, based on the initial data for the IT-industry companies included in the sample, the integral rating value obtained from the assessment of the financial risk group (according to the data of the public reporting of companies for quarters) as well as the direction of business risk assessment by industry characteristics.

Further, in order to correctly divide the total of received rating values into 4 categories (ratings) with the appropriate level of creditworthiness, it is recommended to apply cluster analysis. The set of observations was divided into 4 clusters, each containing 19, 6, 4 and 11 observations, using the statistical software *R,* as a result of the application of *k* — average method.

Calculated cluster means, i.e. average values of parameters of each cluster: first cluster — 2523.6 un., second — 9952 un., third — (–10 170 un.), fourth — (–2828.5 un.). The third cluster with negative indicators includes rating values of failed companies. Graphical representation of cluster analysis results is shown in the *Figure*.

According to the clustering results, the rating values are divided into 4 categories (ratings), corresponding to the creditworthiness risk level: the first cluster corresponds to the rating level B, the second — A, the third — D, the fourth — C. By analogy with the rating matrix of rating agency Expert RA JSC each category was assigned the corresponding designation from A to D.[6]

The developed rating system and its scale reflecting the rating of the IT-industry

[5] Methodology of assigning credit ratings to non-financial companies JSC Expert RA. Official website Expert RA. URL: https://www.raexpert.ru/ (accessed on 01.08.2021).

[6] Methodology of assigning credit ratings to non-financial companies JSC Expert RA. Official website Expert RA. URL: https://www.raexpert.ru/ (accessed on 01.08.2021).

Table 6

Rating scale for evaluating the creditworthiness of IT companies

Category	Rating range	Definition of rating
A	> 4400	The company is characterized by the maximum level of creditworthiness / financial reliability / financial stability. There is no information on negative trends that could have a significant impact on the financial condition of the company
B	0–4400	The company is characterized by a moderate level of creditworthiness / financial reliability / financial stability. There is information about a low exposure of the company to negative changes in the economic environment
C	–7500 < x < 0	The company is characterized by a low level of creditworthiness / financial reliability / financial stability. Negative trends are reported to have a significant impact on the financial condition of the company, but it is still possible to fulfill the obligations in the prescribed amount and time limit
D	< –7500	The company is characterized by a very low level of creditworthiness / financial reliability / financial stability. The company is in default. High probability that outstanding obligations at the Bank

Source: compiled by the authors.

Table 7

Calculation of the rating of Mail.ru Group

Indicator	Index	Coefficient	Means
1. Business risks			
Level of arrears to credit institutions, %	x_{17}	3320.25	0.02
Volume of the advertising market, bln rub.	x_{18}	29.42	73
Share of intangible assets in balance sheet, %	x_{19}	1081.99	0.59
Expenditure on R&D or capital investment, mln rub.	x_{20}	0.32	819
TOTAL			2336.8
2. Financial risk			
Absolute liquidity ratio, in shares	x_3	162.33	0.79
Autonomy ratio, in shares	x_4	12402.17	0.62
Equity to debt ratio, %	x_6	–1117.29	1.63
Turnover period of receivables, days	x_7	–170.42	48
Turnover period of payable, days	x_8	155.58	52
Financial cycle, days	x_9	162.09	–4
Return on assets, %	x_{12}	19604.19	–0.01
Debt/EBITDA, un.	x_{13}	499.42	2.18
TOTAL			2610.75

Source: compiled by the authors.

Table 8

Calculation of the integral score based on Mail.ru Group data

Group of risk of Integral rating	Rating range Means	Share, %
Business risk	2336.84	0.4
Financial risk	2610.75	0.6
TOTAL	**2501.18**	**1**

Source: compiled by the authors.

company by the level of creditworthiness risks, formed on the basis of a comprehensive risk assessment, are presented in *Table 6*.

The constructed regression equations are accepted as constituents of the rating model, allowing to carry out a quantitative assessment of risk groups taking into account the level of influence of each of the indicators on the final value of creditworthiness that negates the common problem of subjectivity in the conduct of credit analysis. The key advantage of the developed methodology is its industry-oriented risk-oriented approach, which takes into account the specifics of doing business and trends in its development in a quantifiable format.

RESULTS OF TESTING METHODOLOGY

To test the practical significance of the developed model, we will assess the creditworthiness of Mail.ru Group (from 12.10.2021 — VK).[7] Mail.ru Group — the largest IT-holding in Russia, aimed at the development of the leading Russian platform of communication and entertainment Internet services.

As the basis of calculations we use published reports for the last reporting date (Q1 2021) for assessment of financial risk, as well as relevant industry data for assessment of business risks. Results of calculations are shown in *Table 7*.

On the basis of the scores obtained, based on the results of the assessment of each risk group, it is necessary to calculate an integral assessment of the creditworthiness of the company, taking into account the set weight of each group (*Table 8*).

The final rating of Mail.ru Group, calculated on the basis of the developed author's methodology, amounted to 2 501 points, which corresponds to the rating of "B" with a moderately high level of creditworthiness. In general, the result is adequate to the conducted financial analysis of the company on the basis of its public data, which confirms the relevance of the rating received and the applicability of the methodology in practice.

CONCLUSION

Thus, in our research the algorithm of development and methodology of formation of complex rating of companies of IT-sector by the level of credit risk using mathematical and statistical tools is presented. The author's method is based on a system of identified risk factors, as well as a hypothesis about their impact on the activities of organizations of the analyzed industry. The regression analysis confirmed the relationship between the indicators included in the model and the market capitalization of companies IT-industry, serving as the result indicator, quantitatively reflecting the level of creditworthiness. The key factors influencing the creditworthiness of IT-companies are indicators of financial sustainability (autonomy ratio, equity and debt ratio), return on assets, liquidity ratio, volume of the online-advertising market, and the share of intangible assets (IA) in the

[7] 12.10.2021. Mail.ru Group announced the brand change to VK. URL: https://vk.company/ru/press/releases/11016/ (accessed on 20.10.2021).

structure of assets, the value of expenditures on R&D and capital investments.

According to the results of testing of the developed method of rating on the company Mail.ru Group the reliability of the rating assessment and practical significance of the author's methodology, which has a prospect of application by credit organizations when assessing the creditworthiness of borrowers, was confirmed, and can also be used as one of the rapid methods of diagnosis and control of risks of financial problems in IT-sector companies.

The developed credit rating model can be modified by adding to the sample historical data on defaults of borrowers, which will allow not only to predict the probability of debt repayment (probability of default) in the process of conducting credit analysis, but is also one of the ways to improve the competitiveness and efficiency of the lending organization within the IRB-approach.

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Direct Fuzzy Evaluation of Financial Risk "Chains" of an Organisation

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ABSTRACT

The **object of the research** is the diagnosis and evaluation of financial risks in order to create an effective risk management policy. The **subject of the research** is the methodology of direct fuzzy evaluation of financial risk "chains" of an organisation. The **relevance** of the problem is due, on the one hand, to the dynamic and chaotic macro-environment and the business environment of organisations, on the other hand, to the drawback of the analytical and expert methods used to assess financial risks. The former, moreover, imply statistical data processing and operate with quantitative measures. For the latter, the difficulty is the impossibility of their application in a short time interval. From the perspective of operational risk management, financial risks deserve special attention since the effective operation of the entire organisation depends on them. The **purpose of the research** is to form a methodology for direct fuzzy evaluation of financial risk "chains" of an organisation. The authors apply **the methods** of mathematical forecasting, fuzzy modelling, calculation of financial and economic indicators, and expert risk assessment. The proposed methodology consists of 12 stages, beginning with the analysis of business processes and the identification of financial risks of the organisation. The main stage is the construction of a fuzzy evaluation model and the calculation of indicators: the probability of occurrence and realization of risks and risky situations of the financial risk "chains", and the degree of confidence of the calculations conducted. The final stage of the methodology is an analysis of the results obtained to adjust the selected development strategy of the organisation, and the choice of methods for managing identified financial risks bearing the most significant financial and economic losses. The authors **conclude** the developed methodology allows to accurately assess the threat of a certain risk "chain" and losses from the implementation of specific risk situations for any organisation in the conditions of dynamic changes in internal and external elements of the business environment. The advantage of the methodology should be considered in the comparability of the accuracy of the evaluation and the low cost of modelling.
Keywords: financial risks; risk management; risk "chain"; fuzzy evaluation model; fuzzy direct evaluation; dynamic environment; financial and economic losses; organisation's business-processes

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INTRODUCTION

In the context of growing instability, uncertainty, complexity and ambiguity of the current economic and political situation, which is reflected in the VUCA world concept, which describes the business environment as chaotic and rapidly changing, the importance of risk management of business entities is increasing. In this respect, effective risk management should be based on a dynamic approach that involves many factors, including the time factor, in the process of improving the efficiency of management decisions based on forecasts. It is often extremely difficult even for highly experienced managers to give a quantitative assessment of risks for the purposes of subsequent economic and mathematical modeling. Such conditions hinder the adoption of high-quality decisions, which, in turn, must be supported by dynamic models and methods that take into account uncertainty.

Organizations most often use expert-analytical methods to analyze and assess risky situations. At the same time, analytical methods require a large amount of statistical data and are generally focused on quantitative indicators, while expert methods can be difficult in the rapid assessment of uncertainties and risks due to the lack of highly qualified analysts and significant time costs [1].

An economic entity cannot optimize the entire existing set of risks due to the objective nature of their occurrence, therefore, as part of operational risk management, it is necessary to evaluate only those that can be formally described and minimized by the organization. From this point of view, financial risks associated with the purchasing power of money, including inflation risks expectations, investment risks, risks related to the organizational structure of management, and the business model being implemented, deserve special attention.

Since the emergence and growth of risks are preceded by one or another reason, forecasting and preventive assessment of the likelihood of occurrence and development of a risk situation is relevant. This can be fully implemented on the basis of a systematic and integrated approach to analysis, which allows not only to identify the risk but also to determine the causes of its occurrence in the external and internal environment of the organization, and its relationship with other risks and the likelihood and severity of possible consequences.

Methods and models based on fuzzy logic and integrated into the organization's information system allow for high-precision risk assessment and low labor and time costs, taking into account the consistency and complexity of the analysis [2]. Such models make it possible to consider all the necessary elements of the organization's risk system, both quantitative and qualitative descriptions of them, in the mathematical formulations of fuzzy logic, sets, and linguistic variables, taking into account the uncertainty and relationships of their occurrence. Methods based on the use of fuzzy models are a management decision support tool that allows developing a strategy based on the diagnosis and optimization of risks, comprehensively exploring the financial and economic aspects of the functioning of the organization, and significantly reducing the labor, financial and time costs of the organization on risk assessment and insurance costs.

RISK "CHAINS" OF ORGANIZATIONS

Currently, most organizations have formed a financial and economic mechanism for strategic management, which allows the development and selection of an organization's strategy, taking into account the assessment of possible risks, as well as on the basis of modern analytical methods and technologies. An essential element of this mechanism is the risk management process, during which the mathematical apparatus of economic statistics (for example, mathematical expectation, variance, standard deviation, semi-dispersion) and expert methods (for example, the Delphi method, scenario method) are used [3]. These methods mainly assess a specific risk due to the current

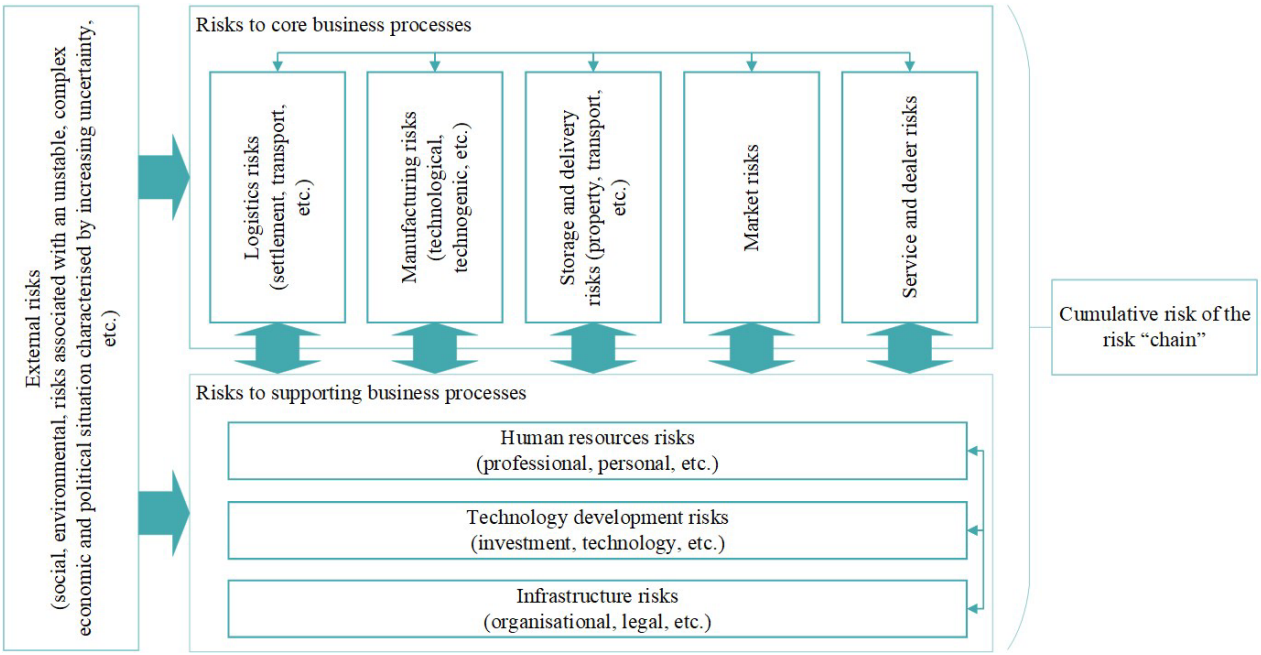

Fig. 1. **The risk "chain" of a manufacturing organisation**

Source: compiled by the authors.

situation but do not take into account its development trends, links with other risks, events, and factors that contribute to their occurrence.

A partial and unstructured analysis of these relationships is carried out in accordance with the standard risk management technology adopted in the organization after risk assessment during the decision-making procedure in risk situations, for example, when building an event tree or a decision tree [4]. Such a traditional approach in the face of increasing uncertainty, instability, and ambiguity of the current economic and political situation is gradually losing its effectiveness, since it often does not meet the objectives of increasing management flexibility, including in the field of operational and strategic risk management.

The noted shortcomings of the currently used risk assessment methods can be eliminated on the basis of an analysis of the main and auxiliary business processes. At the first stage, it is necessary to diagnose existing business processes, and in particular their state in terms of financial risks; identify critical areas of business processes in which there is a possibility of financial risk that can significantly affect the activities of the organization.

At the next stage, the relationships between risks are determined, on the basis of which it becomes possible to build their system, which we called the risk "chain". The structure of the risk "chain" (*Fig. 1*) is defined as an interconnected system of various risks arising from the environment of the organization. It should be noted that the risk "chain" includes both internal and external risks that characterize the current uncertain, unstable, difficult economic and political situation.

The "chain" in *Fig. 1* is generalized, therefore, for a specific production organization, it can only be used as a basis, followed by the specification of the types of risks, taking into account the specifics of business processes. Financial risks can arise in almost all links of the "chain" shown in *Fig. 1*, however, often affect other types of risks, due, for example, to the development of technologies, the state of infrastructure, the specifics of production, and marketing of finished products. Their identification and the establishment of relationships between them are important for the organization since the implementation of risky situations can be

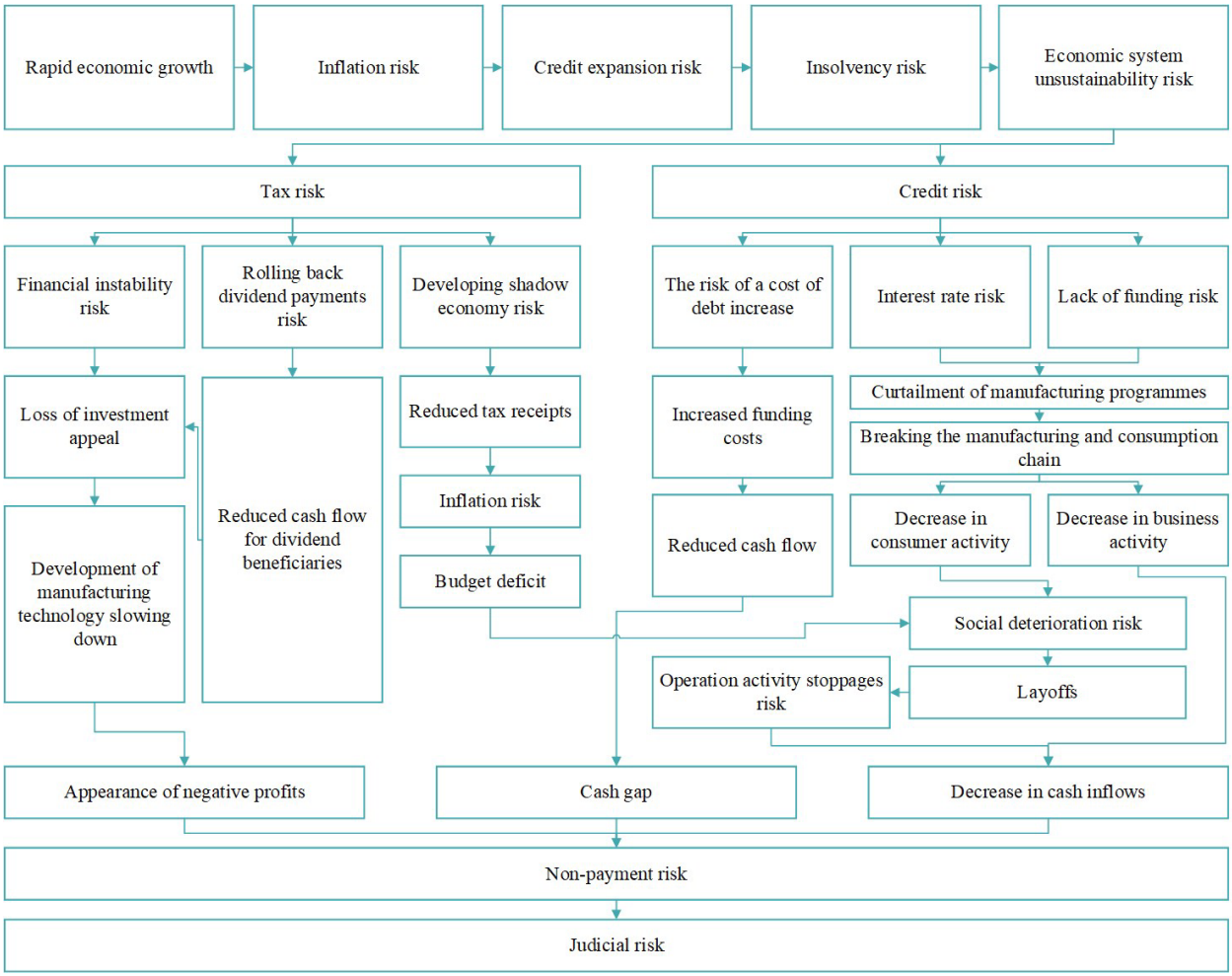

Fig. 2. **The financial risk "chain" of a manufacturing organisation**

Source: compiled by the authors.

accompanied by a cumulative effect, leading to serious losses. For example, underestimating the likelihood of the emergence of fundamentally new technologies that promote "disruptive" innovations can lead to an increased risk of not being in demand for finished products, liquidity risk, and also contribute to a drop in profits. At the same time, early identification of financial risks allows them to be described, evaluated, and optimized. The "chain" in *Fig. 2* illustrates one of the possible options for the relationship of various financial risks of a production organization.

When assessing various risks, analysts use traditional analysis methods, taking into account the characteristics of their types, which in some cases, in the absence of studies of risk factors, the magnitude of damage or the instability of the business environment, is inappropriate, unlike the use of expert methods or fuzzy modeling [1]. The latter are of particular relevance in modern conditions since they imply incomplete knowledge of all parameters, circumstances, and situations, and also take into account the multi-level structure of assessment, the different significance of indicators, as well as the presence of fuzzy compatibility relationship between them [4].

FUZZY EVALUATION MODEL FOR THE ANALYSIS OF THE FINANCIAL RISK "CHAIN"

The use of fuzzy logic in evaluating financial risk "chains" has a number of features. First of all, it is necessary to take into account the interpretation of this "chain" as a

mathematical set containing the results of assessing the values of risk indicators and risk situations. These "chains" have a multilevel structure, due to the different significance for the organization of the dimensions included in it and the form of fuzzy connections between them, especially at the top of the hierarchical chain. Accordingly, at each level of the hierarchy, the indicators form subsets, each of which corresponds to the indicator of the neighboring higher level of the hierarchy. At each level of the hierarchy, starting from the second, there may be indicators that do not form subsets at a lower level. At the first level of the hierarchy, there is a subset of one (generalized) indicator. Each indicator is assigned a weight. Indicators belonging to one subset form a fuzzy compatibility relation [2]. These features justify the need to apply the methodology of direct fuzzy estimation, as well as the use of fuzzy production models.

Note that the construction of a "chain" of financial risks and risk situations allows us to determine the full space of prerequisites that are sources of risks or risk situations presented in the "chain", as well as the space of conclusions resulting from specific risks.

Representation of the relationship between various financial risks and risk situations in the form of a "chain" allows going to its composition by grouping it into subsets that have the following form:

$$R^{(i)} = \left\{ R_1^{(i)}, R_2^{(i)}, \ldots, R_n^{(i)} \right\}, \quad (1)$$

where $i = 1,2,\ldots,I$; $n = 1,2,\ldots,N$; $R_n^{(i)}$ is a subset of risks and risk situations at the i-th level of decomposition of the financial risk "chain" (zero level of decomposition, or $R^{(0)}$, is a "chain" of financial risks with aggregated assessment indicators); I — the number of levels of decomposition of the fuzzy evaluation model; N — the number of risks and risk situations or subsets at the i-th level of model decomposition.

After grouping by subsets, it is necessary for each value of the risk indicator at the i-th level of decomposition of the fuzzy evaluation model ($r_{n,j}^{(i)}$) to determine the correspondence with the subset of risks and risk situations at the (i + 1)-th evel of decomposition of the financial risk "chain":

$$r_{n,j}^{(i)} \leftrightarrow R_m^{(i+1)} = \left\{ r_{m,1}^{(i+1)}, \ldots, r_{m,p}^{(i+1)}, \ldots, r_{m,p_s}^{(i+1)} \right\}, \quad (2)$$

where I is the number of decomposition levels of the fuzzy evaluation model ($i = 1,2,\ldots,I-1$); N — the number of risks and risk situations or subsets at the i- th level of model decomposition ($n = 1,2,\ldots,N$); M — the number of risks and risk situations or subsets at the (i + 1)-th level of model decomposition ($m = 1,2,\ldots,M$); p_s — the number of values of risk indicators from the subset $R_m^{(i+1)}$ of the (i + 1)-th level of model decomposition, correlated with the j-th indicator $r_{n,j}^{(i)}$ from the subset $R_m^{(i)}$ of the i-th level of model decomposition ($p = 1,2,\ldots,p_s$).

It should be noted that in order to build a fuzzy evaluation model, it is necessary to determine the significance or weights of all risks and risk situations in the constructed financial risk "chain" at each level of model decomposition:

$$r_{n,j}^{(i)} \leftrightarrow w_{n,j}^{(i)}, \quad (3)$$

where $n = 1,2,\ldots,N$; $i = 1,2,\ldots,I$; $j = 1,2,\ldots,p_s$; $w_{n,j}^{(i)}$ — the significance (weight) of the risk or risk situation $r_{n,j}^{(i)}$.

The main element of the fuzzy evaluation model is the fuzzy compatibility relationship between risks and risk situations (values of risk indicators), given in the following form:

$$\tilde{K}_n^{(i)} = \left\{ \left(\left(r_{n,q}^{(i)}, r_{n,l}^{(i)} \right) / c_{n,ql}^{(i)} \right) \right\}, \quad (4)$$

where $n = 1,2,\ldots,N$; $i = 1,2,\ldots,I$; $q,l \in \{1,2,\ldots,p_s\}$; $\tilde{K}_n^{(i)}$ — a fuzzy compatibility relation between risks and risk situations (values of risk indicators) of the subset $R_n^{(i)}$; $c_{n,ql}^{(i)}$ is the degree of compatibility of risks and risk situations (values of risk indicators) $r_{n,q}^{(i)}$ и $r_{n,l}^{(i)}$.

For the organization's financial risk "chain" compatibility is interpreted as the impact of one risk (risk situation) on another through the transfer of the "added effect of the total risk" (increase in danger or threat to the organization, as well as an increase in the

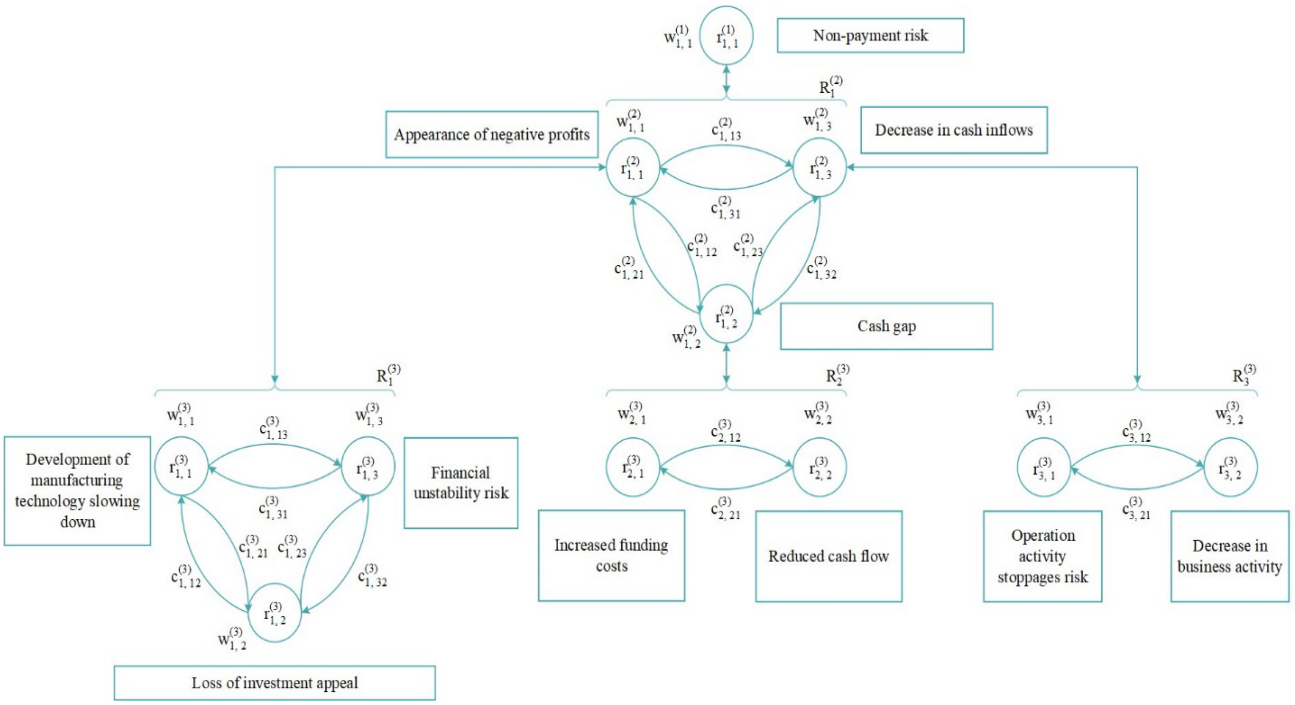

Fig. 3. **Fuzzy evaluation model of the financial risk "chain" of a manufacturing organisation (fragment)**

Source: compiled by the authors.

severity of consequences for the organization in case of passing the elements of the "chain"), a fuzzy compatibility factor is introduced to prevent double counting of risk.

Based on formulas (1)–(4), the proposed fuzzy evaluation model in a formalized form can be represented as formula (5).

$$\begin{cases} R^{(i)} = \left\{ R_1^{(i)}, R_2^{(i)}, \ldots, R_n^{(i)} \right\}, \\ R_n^{(i)} = \left\{ r_{n,1}^{(i)}, \ldots, r_{n,p}^{(i)}, \ldots, r_{n,p_s}^{(i)} \right\}, \\ r_{n,j}^{(i)} \leftrightarrow R_m^{(i+1)} = \left\{ r_{m,1}^{(i+1)}, \ldots, r_{m,p}^{(i+1)}, \ldots, r_{m,p_s}^{(i+1)} \right\}, i = 1,2,\ldots,I-1, \\ r_{n,p}^{(i)} \leftrightarrow w_{n,j}^{(i)}, \\ \tilde{K}_n^{(i)} = \left\{ \left(\left(r_{n,q}^{(i)}, r_{n,l}^{(i)} \right) / c_{n,ql}^{(i)} \right) \right\}, \end{cases} \quad (5)$$

where $i = 1,2,\ldots,I$; $n = 1,2,\ldots,N$; $p = 1,2,\ldots,p_s$; $m = 1,2,\ldots,M$; $j = 1,2,\ldots,p_s$; $q,l \in \{1,\ldots,p_s\}$.

Fig. 3 shows a fragment of the "chain" of financial risks and risk situations of a production organization, shown in *Fig. 2*. It should be noted that the relationship between the risk (risk situation) at the i-th level of decomposition of the fuzzy evaluation model and the set of risks (risk situations) at the $(i-1)$-th decomposition level has the form of a transition between decomposition levels with the accumulation of an additional effect of cumulative risk, increasing the threat of the risk "chain" for the organization, as well as the increase in the severity of the consequences for the organization.

The connection of the higher levels of decomposition of the fuzzy assessment model of the financial risk "chain" of the organization is established, in particular, the connection of decomposition levels with the elements: $R_1^{(2)}$ and $r_{1,1}^{(1)}$ (or $R_1^{(1)}$), s specified using the MISO structure (many inputs — one output) and is a cascade connection of several (for marked levels of decomposition of the fuzzy estimation model — three) bases of fuzzy production rules that implement the mapping of input variables to the output variable [4–6]. *Fig. 4* shows a cascade fuzzy model for assessing the impact of a combination of risks and risk situations, which is a space of risk prerequisites (risk situations), which is at a higher level of decomposition, on this risk (risk situation) for a financial risk "chain" and risk situations organization is shown in *Fig. 2*.

The fuzzy evaluation model of the "chain" of financial risks and risk situations of the

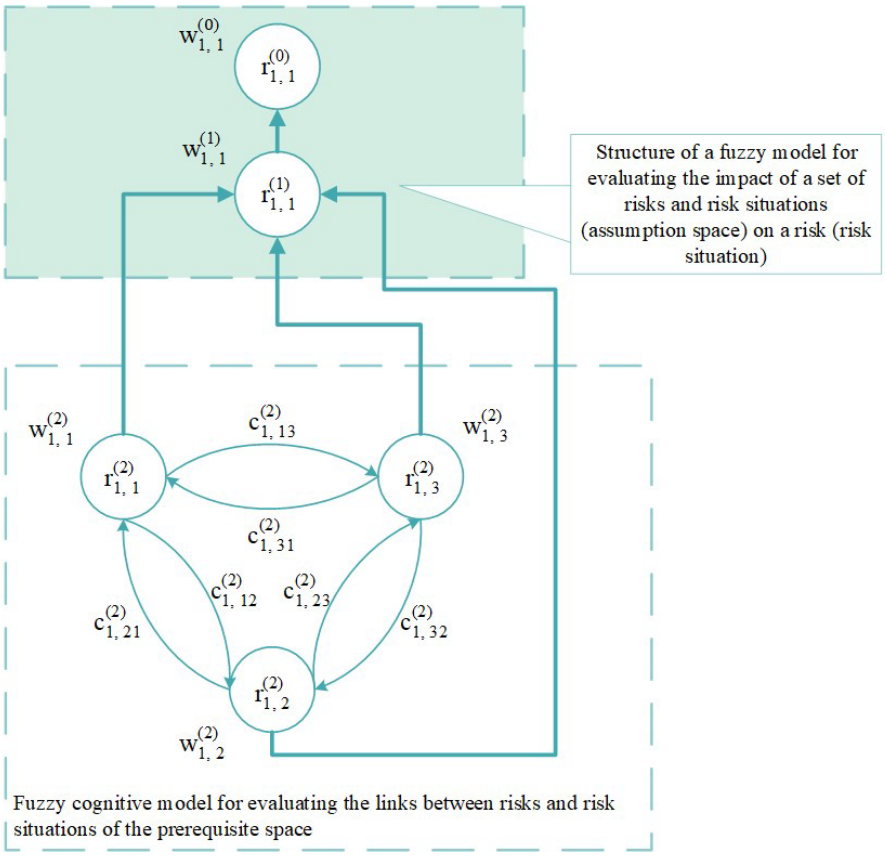

Fig. 4. **Example of a framework for evaluating the impact of risks and risk situations at the *i* decomposition level of a fuzzy evaluation model on a risk or risk situation at the (*i* + 1) decomposition level**

Source: compiled by the authors.

organization, described above, defines the direct fuzzy assessment algorithm. It should be noted that the evaluation process starts from the lower levels of decomposition of the fuzzy evaluation model, is carried out in "direct" order, i.e. from the lower levels of decomposition to the upper levels of decomposition, and ends with finding the totality of indicators for evaluating the "chain" of financial risks at the zero level of decomposition.

METHODOLOGY FOR DIRECT FUZZY EVALUATION OF THE "CHAIN" OF FINANCIAL RISKS OF AN ORGANIZATION

The proposed methodology for direct fuzzy evaluation of the "chain" of financial risks of an organization consists of the following main stages.

Stage 1. Analysis of the existing business processes of the organization, study of the current financial situation, and identification of financial risks.

To build an effective fuzzy evaluation model, it is necessary to involve experts (for example, leading specialists from consulting organizations) in the analysis of the current activities of the organization, in this case, it is necessary to present the information received in the form of *Table 1*, for the subsequent calculation of the confidence degree (reliability) of the assessment, as well as the interpretation of the relationship between risk, the prerequisite space and the conclusion space in the form of a "chain" of financial risks and the organization's risk situation.

Stage 2. Building the organization's financial risks "chain" clarifies the links between risks and risk situations.

Based on the information available and systematized in the form of *Table 1* on the identified financial risks, a risk "chain" of a production organization is formed, on

Table 1

Identified financial risks

Notation	Risk	Description of the prerequisite space	Description of the conclusion space	Risk value	Confidence degree
r_1					
r_2					
...					
r_n					

Source: compiled by the authors.

which the links are marked, in which the occurrence of financial risks is likely. On the basis of the marked links, the organization's financial risk "chain" is compiled. It should be noted that risk situations can be additionally included in this chain if they are significant in the prerequisite space or the conclusion space and are accompanied by a cumulative effect leading to serious losses with the impossibility of converting it into an emerging financial risk [7].

Stage 3. Building a fuzzy evaluation model of the financial risk "chain".

The financial risk "chain" obtained at the previous stage allows us to proceed to fuzzy modeling. At this stage, it is important to establish the relationship between the identified financial risks (risk situations), describe their nature, and identify the final risk (risk situation) that has the greatest additional effect on the total risk. After identifying this element of the financial risk "chain", it is necessary to decompose it based on the established links, thereby obtaining a hierarchical structure of assessment indicators, each of which correlates with the significance (weight) of the corresponding risk or risk situation [8]. After excluding minor financial risks by aggregating them with an adjacent risk or risk situation, a fuzzy model for evaluating the financial risk "chain" is built, which is shown in *Fig. 3*.

Stage 4. Identifying the degree of compatibility of aggregate indicators of financial risks and risk situations.

At this stage, according to formula (4), fuzzy compatibility relationships between risks and risk situations are specified. The emerging fuzzy relationships in the "chain" of the organization's financial risks are the determinants of subsequent fuzzy convolution operations. However, a direct method for determining the degree of compatibility described by formula (4) cannot always be used, since at present the business environment of an organization is often described as chaotic and rapidly changing, and how likely is the risk of a situation or risks that have not previously been described and are not amenable to "clear" evaluation [9]. In these cases, it is possible to use an indirect method based on comparing the levels of compatibility of risks and risk situations with the levels of the Harrington scale (LL — "Low level" LML — "Lower middle level", ML — "Middle level", HML — "Higher middle level", HL — "High level") [2]. Accordingly, formula (4) is supplemented by formula (6).

$$c_{n,ql}^{(i)} = c_z \in C = \{LL, LML, ML, HML, HL\}, z = 1,2,\ldots 5, \quad (6)$$

where $c_{n,ql}^{(i)}$ is the degree of compatibility of risks and risk situations (values of risk indicator) $r_{n,q}^{(i)}$ and $r_{n,l}^{(i)}$

($n=1,2,\ldots,N; i=1,2,\ldots,I; q,l\in\{1,2,\ldots,p_s\}$); z — is the index of the corresponding element of the set C, containing the levels of the Harrington scale.

At the same time, for risks (risk situations) that are at the same level of decomposition of the fuzzy evaluation model, but do not have logically established relationships, the degree of compatibility of these risks and risk situations (values of risk indicators) is considered to be the LL level according to the above Harrington scale for subsequent aggregation of the set of risks and establishing the cumulative added effect of the cumulative risk in the transition between levels of decomposition of the model.

Stage 5. Setting a strategy for assessing a subset of risk indicators or risk situations of the decomposition level of a fuzzy model for assessing a "chain" of financial risks.

The transition between the levels of decomposition of the fuzzy model for assessing the financial risk "chain" is accompanied by the cumulative effect of accumulating the additional effect of the total risk, which leads to serious losses for the organization. Therefore, the technique uses a parameterized family of convolution operations [10] described by formula (7).

$$med\left(r_k, r_l; \alpha\right), k,l \in \{1,2,\ldots,n\}, \qquad (7)$$

where $med\left(r_k, r_l; \alpha\right)$ is a parameterized operation of fuzzy convolution of the values of risk indicators and risk situations at the same level of decomposition of the fuzzy assessment model of the financial risk "chain" of a production organization; k,l — indices of risks or risk situations at the i-th level of decomposition; α — the fuzzy convolution parameter ($\alpha\in[0,1]$).

The value of the parameter α must correspond to the criterial levels of compatibility of aggregate risk indicators or risk situations at the (i + 1)-th level of decomposition of the fuzzy assessment model on the Harrington scale [11]. Since the proposed methodology provides for both the calculation of the aggregate indicator of the added effect of the total risk for the entire "chain" of financial risks, and the calculation of the aggregate indicator of the degree of confidence, when moving between decomposition levels, various strategies for evaluating subsets of risk indicators or risk situations are provided.

Strategy 1 — the fuzzy assessment from the least compatible risks (risk situations) to the most compatible ones with the summation of the accumulated added effect of the total risk during the transition between decomposition levels of the fuzzy assessment model of the financial risk chain. The choice of this strategy is determined by the simultaneous use of direct and indirect methods for determining the degrees of compatibility of risks and risk situations, setting the order for viewing these degrees of compatibility, the consistent nature of the fuzzy convolution at each level of decomposition of the evaluation model [12–14].

Strategy 2 — the fuzzy assessment from the most compatible risks (risk situations) to the least compatible when moving between decomposition levels of the fuzzy evaluation model of the financial risk "chain". The choice of this strategy is determined by the presence of indicators of the degree of confidence [15] for each financial risk identified at stage 1, the absence of the need to use summation to reflect the cumulative effect, since the value of the aggregate indicator of the confidence degree does not show the predicted severity of the consequences of the full "chain" of financial risks, but the confidence degree in the result. The confidence degree in the proposed methodology is measured on a scale from 0.00 to 1.00 with a step of 0.01. If necessary, it is possible to increase the accuracy of the values of the confidence degree indicator for a more correct measurement of the accuracy of the result obtained. The calculation of the aggregated degree of confidence is carried out according to the same methodology, taking into account the noted feature.

Stages 6–7. Splitting the fuzzy compatibility relationship between risks and

risk situations for the level of decomposition of the fuzzy evaluation model into compatibility classes. Selection and mapping of convolution operations to compatibility classes.

At this stage, in accordance with a certain strategy, the values of risk indicators and risk situations are aggregated, having the same degree of compatibility or close ones, belonging to the same level according to the Harrington scale used. At the same time, the order of the fuzzy convolution of these indicators within the corresponding subset of risks and risk situations is not important [16].

Stage 8. Modification of the fuzzy compatibility relationship between risks and risk situations for the decomposition level of the fuzzy evaluation model.

After a fuzzy convolution of risk indicators or risk situations, it is necessary to modify the fuzzy compatibility relationship between risks and risk situations and change the compatibility degree of other risks or risk situations that are in the same subset of risks, taking into account the new aggregate indicator of risks that are in the same compatibility class.

The implementation of steps 5–8 is cyclical or repetitive until the aggregation of all risk indicators and risk situations that are at the lower levels of the decomposition of the fuzzy assessment model of the organization's financial risk "chain" is achieved. After completion of all iterations, the analysis of the obtained structure of the fuzzy evaluation model for aggregated indicators takes place. In the methodology, two options for stage 9 are proposed.

Stage 9.1. It is used for a MISO structure, which is a cascading connection of a large number of input indicators of risks and risk situations and one resulting indicator. For this, in accordance with formula (5), the bases of fuzzy production rules are formed, as well as the structure of the fuzzy neural production network (ANFIS) [17, 18], which is shown in *Fig. 4*, in accordance with the number of input indicators of risks and risk situations.

Stage 9.2. It is used for other cases in which the fuzzy evaluation model from aggregated risk indicators (risk situations) does not have the form of a MISO structure. Within the framework of this stage, the structure of further fuzzy convolution of indicators is formed [19] [for example, in the form of formula (8)]:

$$R^{(0)} = h_u\left(h_y\left(\ldots\left(h_t\left(R_1^{(t)}, R_2^{(t)}\right),\ldots\right), R_n^{(y)}\right), R_n^{(u)}\right), \quad (8)$$

where $h(a, b)$ — fuzzy convolution operation; u, y, t are indices of these operations corresponding to different levels of decomposition of the consistency of indicators, subsets of risks and risk situations.

Stage 10. Setting the weighted values of indicators of risk subsets and risk situations.

As noted earlier, effective risk management in a chaotic and rapidly changing business environment should be based on a dynamic approach, the conditions of uncertainty in which are characterized not only by the fact that the probability distribution law for uncertain factors is unknown, but also by the fact that the time factor becomes the most meaningful. In this regard, the proposed method of the direct fuzzy evaluation of the financial risk "chain" of an organization provides for the assessment of alternatives. To calculate alternatives, each risk indicator or risk situation is assigned a weighted fuzzy value of the evaluated alternative to find the best solutions [20–22] that provide an acceptable value of the aggregated value of indicators for the considered financial risk "chain".

Stage 11. Obtaining aggregated values of indicators for the complete financial risks "chain" and checking the applicability of the obtained values based on the value of the aggregated indicator "confidence degree".

Stage 12. Correction of the selected strategies for the development of the organization, the choice of risk management methods.

Thus, the proposed method of direct fuzzy evaluation of the financial risk "chain" of an organization, based on the analysis of

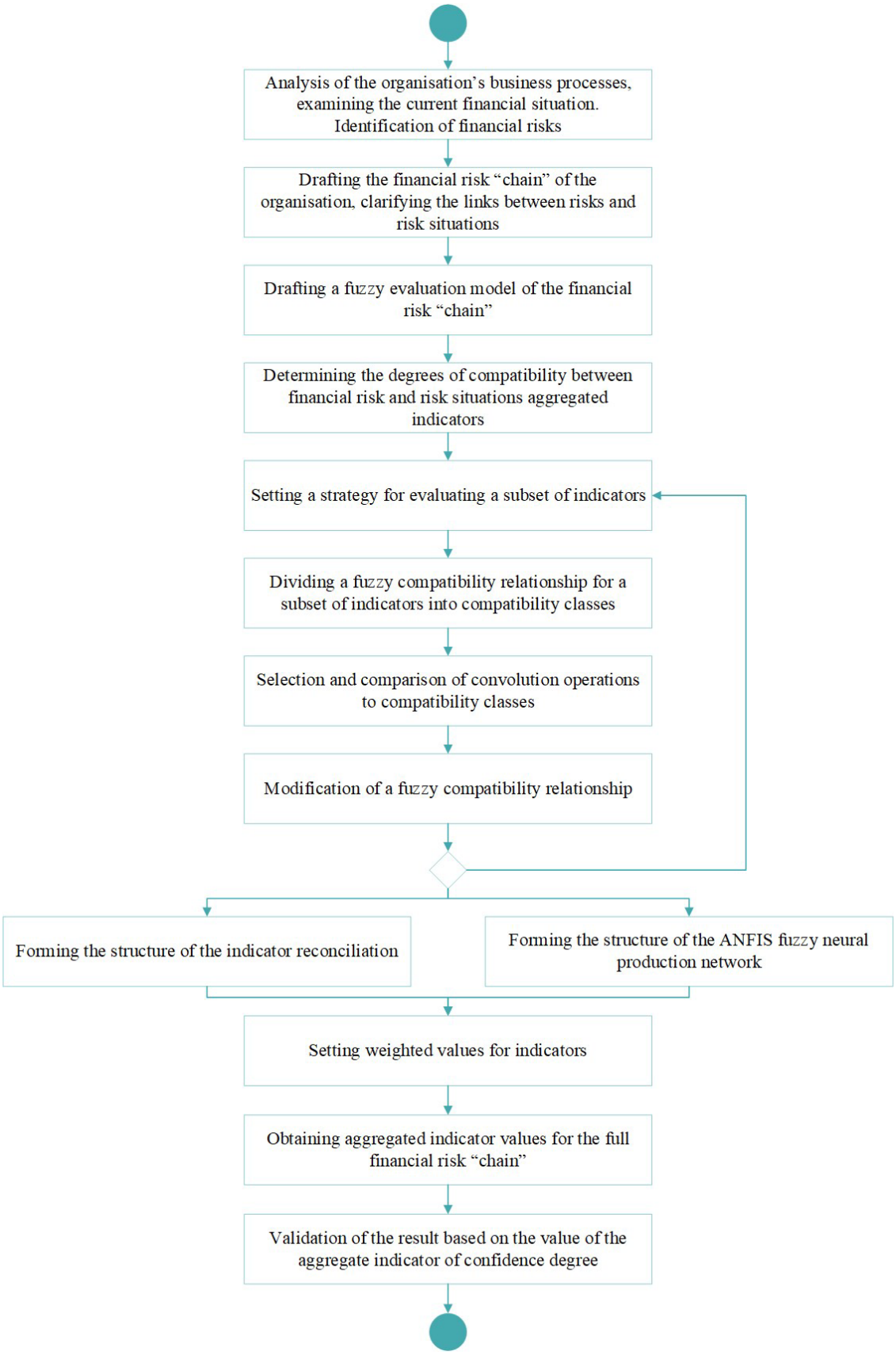

Fig. 5. **UML diagram of the generalised algorithm for a direct fuzzy evaluation methodology for an organisation's financial risk "chain"**

Source: compiled by the authors.

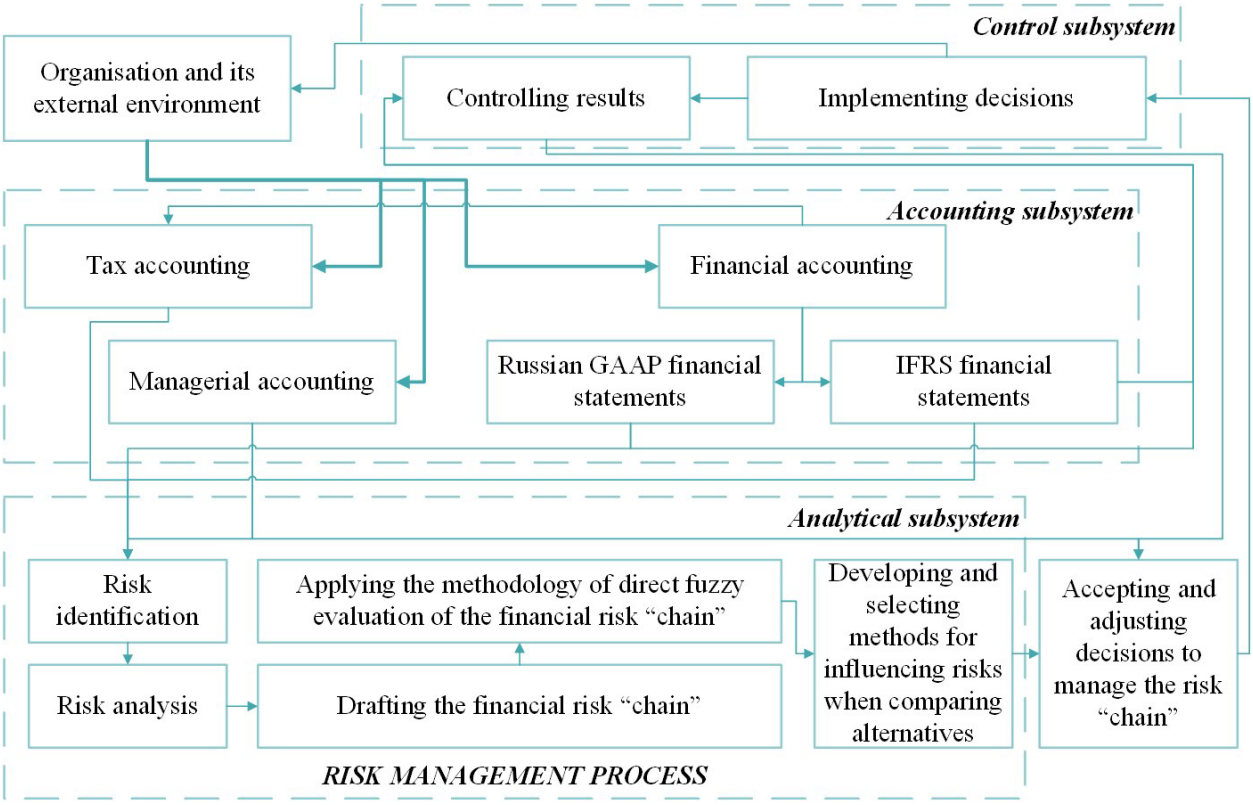

Fig. 6. **Formation of information flows in the process of evaluating an organisation's financial risk "chain" based on the proposed methodology of direct fuzzy evaluation**

Source: compiled by the authors.

business processes and a generalized "chain" of risks of an organization, allows taking into account the strategic aspects of the impact of financial risks on the activities of an organization and includes the stages shown in *Fig. 5*.

RESULTS AND DISCUSSIONS

The proposed method of direct fuzzy evaluation of the financial risk chain of an organization is focused on the conditions of increasing instability, uncertainty, complexity, and ambiguity of the current economic and political situation. For the timely identification of emerging or predicted financial risks, it is advisable to include it in the organization's information flow formation system in the process of risk management, in which risks are identified on the basis of the organization's tax, financial and management accounting (*Fig. 6*).

As confirmation of the practical significance of the proposed methodology, let us consider the evaluation of the financial risk "chain" of Macy's, Inc. Baseline data obtained from the Bloomberg based on the consensus forecast of the main economic indicators and historical observations for 2017–2021. To begin with, the cumulative average annual growth rate of each indicator was calculated using the formula (9):

$$CAGR_j = \sqrt[n]{\frac{V_t}{V_{t-n}}} - 1, \quad (9)$$

where $CAGR_j$ — the cumulative average annual growth rate of the j-th indicator; V_t, V_{t-n} — historical values of the j-th indicator in years t *and* $t - n$.

Next, the predicted growth (forward growth, FG) of each j-th indicator was calculated. These two indicators were the starting point in the expert determination of the degree of probability of a particular risk (risk situation).

Based on the data on the consensus forecast, the average value of the consensus

Table 2

Consensus forecast of Macy's economic indicators

Metrics	$CAGR_j$, %	FG_j, %	$\bar{x}_j$	$me(x_j)$	σ_j	RSD_j, %	CL, %
Shopping capacity	–3.4	–3.6	109 226.20 sq. foot	110 526.00 sq. foot	2755.63 sq. foot	2.5	96.30
Net sales	–9.4	36.2	$ 23 622.00 million	$ 23 758.50 million	$ 415.47 million	1.8	97.70
Tax expenses	–25.5	–139.6	$ 334.85 million	$ 344.21 million	$ 27.33 million	8.2	89.04
EBITDA	–55.0	2203.5	$ 2695.11 million	$ 2688.00 million	$ 56.70 million	2.1	97.60
Cash and cash equivalents	6.7	22.5	$ 2055.99 million	$ 1796.89 million	$ 1320.65 million	64.2	23.20
Intangible assets	–3.2	14.4	$ 500.08 million	$ 471.97 million	$ 82.09 million	16.4	78.00
Accounts payable	–0.2	13.0	$ 3308.32 million	$ 3509.51 million	$ 580.38 million	17.5	76.40
Cash flow from operating activities	–22.5	232.6	$ 2158.87 million	$ 1883.62 million	$ 1162.27 million	53.8	33.40
CAPEX	–15.5	44.6	–$ 673.67 million	–$ 650.00 million	$ 40.16 million	6.0	90.50
Dividends paid	–28.9	–18.3	–$ 95.58 million	–$ 95.49 million	$ 0.50 million	0.5	99.40
Net change in cash	52.7	–66.0	$ 347.49 million	–	–	21.4	78.60
Current liquidity ratio	–4.0	2.9	1.19	–	–	15.1	84.90
Quick liquidity ratio	8.8	4.5	0.33	–	–	39.2	60.80
Debt to equity ratio	13.4	–32.5	4.01	–	–	13.9	86.10

Source: Bloomberg, authors' calculations.

forecast, the median, and the standard deviation (standard deviation, SD), the level of confidence in the forecast was calculated, and adjusted for the tendency to a normal distribution of forecast valuesusing formula (10). The first part of the formula represents the accuracy of the forecast in terms of the coefficient of variation, the larger the coefficient of variation, the lower the reliability of the forecast, so the value (1 — *RSD*) is applied, and *RSD* is the coefficient of variation. The second part of the formula reflects the correction for the tendency to the normal distribution law, from the inequality of the median and the average consensus value we get the desired correction — correct due to the equality of these values in the case of a normal distribution.

$$CL = \left(1 - \left|\frac{\sigma_j}{\bar{x}_j}\right|\right) - \left|\frac{me(x_j)}{\bar{x}_j} - 1\right|, \qquad (10)$$

Table 3

Identified financial risks of Macy's

Notation	Risk	Description of the prerequisite space	Description of the conclusion space	Risk value	Confidence degree
r_1	Risk of curtailing outlets	–	r_2	0.036	0.963
r_2	Risk of decline in business and consumer activity	r_1	r_4, r_6, r_7, r_{13}	0.001	0.977
r_3	Tax risk	–	r_4, r_5, r_6, r_{13}	0.001	0.890
r_4	Risk of no economic profit	$r_1 - r_3, r_5 - r_{14}$	r_{15}	0.001	0.976
r_5	Funding risk	r_3, r_6, r_7, r_{13}	$r_4, r_9, r_{11}, r_{13}, r_{14}$	0.001	0.232
r_6	Cash flow risk	r_2, r_3, r_{13}	r_4, r_5, r_{12}	0.481	0.786
r_7	Risk of diversion of funds from operating activities	r_2	r_4, r_5	0.083	0.598
r_8	Risk of reduced business innovation	–	r_4, r_{13}	0.001	0.780
r_9	Financial stability risk	r_5	r_4, r_{10}	0.007	0.861
r_{10}	Risk of financial dependence	r_9	r_4, r_{15}	0.234	0.861
r_{11}	Default risk	r_5	r_4	0.001	0.608
r_{12}	Risk of decrease in current liquidity	r_6	r_4	0.012	0.849
r_{13}	Risk of decrease in return on core activities	$r_1, r_2, r_3, r_5, r_8, r_{14}$	r_4, r_5, r_6	0.001	0.334
r_{14}	Risk of obsolescence of fixed assets	r_5	r_4	0.001	0.905
r_{15}	Risk of reduced investment attractiveness	r_4, r_{10}	–	0.183	0.994

Source: compiled by the authors.

where CL — the level of confidence in the consensus forecast; $\bar{x}_j$ — the consensus means of the j-th indicator; σ_j — the standard deviation of the predicted values of the j-th indicator from $\bar{x}_j$; $me(x_j)$ — the consensus median of the j-th indicator.

Formula (11) was used to determine the level of confidence in the coefficients and the indicator "Net change in cash" (11).

$$CL = 1 - \left(\sqrt[i]{\prod_{i=1}^{N} \left(1 + RSD_j\right)_i} - 1 \right), \qquad (11)$$

where RSD_j — the coefficient of variation of the j-th indicator included in the model for calculating the indicator under study; i — the number of j-th indicators included in the model for calculating the indicator under study.

Table 2 presents the calculated indicators.

To calculate the value of the financial dependence risk indicator, we use formula (12).

$$r = \frac{V_{Fwd}}{\overline{V_i}} - 1, \qquad (12)$$

where r — the value of the financial dependence risk indicator; V_{Fwd} — the forecast value of the *D/E* indicator; $\overline{V_i}$ — the average value of the *D/E* indicator for the last i periods (years).

In accordance with the methodology, the calculated initial data are presented in *Table 3*.

The prerequisites and conclusion spaces given in *Table 3* form a financial risks "chain" of this organization. Based on the available data, it is possible to calculate the probability index for the occurrence of a complete "chain" of risks using formulas (5)–(8), for this "chain" it has a value of 0.042 (4.2%), as well as an aggregate confidence degree indicator — 0.749 (74.9%). It seems possible to calculate the additional effect of the total risk both for individual decomposition levels of the Macy's fuzzy evaluation model of the financial risk chain, and for the entire "chain" using formula (13). However, the implementation of these calculations requires an internal audit of the organization's business processes and a professional assessment of losses from possible risks, taking into account the risk management strategy chosen by the organization.

$$M_{i,j} = \sum_{i=1}^{N} \sum_{j=1}^{N} R_{i,j} \left(A_{i,j}^{init} A_{i,j}^{\text{end}} \right), \qquad (13)$$

where $M_{i,j}$ — the added effect of the total risk characterizing the costs associated with managing the j-th risk at the i-th decomposition level of the fuzzy evaluation model of the financial risk chain ($M_{0,1}$ — the added effect of the total risk of the full financial risk "chains"); $R_{i,j}$ — an aggregated fuzzy indicator that characterizes the significance of this risk in the financial risk "chain" obtained by formula (5); $\left(A_{i,j}^{\text{init}} - A_{i,j}^{\text{end}}\right)$ — a change in the structure of the financial risk "chain" when considering alternatives to each risk indicator or risk situation in order to find the best solutions that provide an acceptable value of the aggregate value of the indicator for the considered "chains" of financial risks in order to implement the risk management strategy.

Accordingly, the values obtained using the proposed method of direct fuzzy evaluation of the financial risk "chain" allow us to draw the following conclusion. Macy's in the current environment is threatened by the emergence and realization of risk situations of a financial risk "chain", accompanied by a cumulative effect leading to serious losses for Macy's, with a probability of 4.2% and a confidence degree of 74.9%. However, in order to conduct effective risk management, it is necessary to constantly monitor emerging risks based on a dynamic approach.

In the future, the development of the proposed methodology is the creation of an application software product that implements the main stages of the methodology based on the Python

programming language, and its integration into the information system of the organization. In addition, it is advisable to develop software for monitoring emerging risks and compiling economically justified prerequisites and conclusion spaces based on the identified risks.

CONCLUSION

In modern conditions, specialists involved in risk management in organizations, when building models and forecasts, and mathematical descriptions of risk situations, should also rely on a dynamic approach, among the many factors of which a significant place is given to the time factor. Moreover, it is often difficult for the top managers of organizations to provide the analyzed risks with an objective quantitative assessment for the purpose of subsequent economic and mathematical modeling and forecasting. These circumstances affect the quality of managerial decisions. Particular attention should be paid to assessing financial risks, including changes in the purchasing power of money, inflationary expectations, investment turbulence, variability in the organizational structure, and the business model being implemented.

The proposed method of direct fuzzy evaluation of the financial risk "chain" is aimed at solving the above problems with the proper level of expert assessments of emerging risks, constant monitoring of the current financial condition, competent compilation prerequisites and conclusion spaces, and the correct choice of risk management strategy allows accurately assessing the threat of a certain "chains" of risks and losses from the implementation of specific risk situations for any organization in the context of dynamic changes in the internal and external elements of the business environment. The advantage of the described technique is the comparability of high estimation accuracy with low labor and time costs for modeling in systematic and comprehensive analysis. The methodology will allow organizations to more effectively and adaptively plan the risk management process, which will significantly increase the organization's resilience in a turbulent environment and remain focused on creating economic added value. The described methodology is a management decision support tool that allows to comprehensively study the financial and economic aspects of the functioning of the organization, and develop a corporate strategy, taking into account the diagnosis and optimization of risks and risk situations.

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L.V. Fomchenkova — problem statement, development of the theoretical and conceptual framework of the paper.
P.S. Kharlamov — development of the methodology of the direct fuzzy evaluation of financial risk "chain" of an organisation, graphical presentation of the results.
K.S. Melikhov — drafting the financial risk "chain" of an organisation, tabular presentation and description of the results, formation of conclusions of the research and abstract of the paper.

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ORIGINAL PAPER

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Strategic Asset Allocation and Active Management: Evidence from Moroccan Pension Funds

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ABSTRACT

The **subject** of the study is to evaluate the contribution of strategic asset allocation to the variability of Moroccan pension funds performance. The **aim** of the paper is to identify the role of active management factors, namely tactical allocation and security selection, in generating a performance surplus compared to strategic allocation. The **relevance** of the study is justified by the need to identify the sources of performance creation in order to face the commitments of Moroccan pension funds and to compensate for the decline and volatility of asset returns. The article addresses, through the use of simple linear regression **methods**, the relative importance of strategic asset allocation in explaining the variability of the performance of Moroccan pension funds. It introduces a **scientific novelty** through the use of the "performance attribution" method. The **conclusions** of the paper confirm the main role of strategic asset allocation, which varies according to the size of the fund, the asset classes, and the risk aversion of the manager.

Keywords: strategic asset allocation; active management; linear regression; performance attribution; Moroccan pension funds

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INTRODUCTION

The pension fund investment decision-making process is based on three main steps: strategic asset allocation, tactical asset allocation, and security selection. The first one consists of allocating investments among different asset classes according to their level of return and risk [1]. It is similar to a buy-and-hold strategy, as opposed to tactical allocation, which aims to make short-term bets against strategic weightings. Both methods are based on modern portfolio theory, which emphasizes diversification to reduce risk and increase portfolio returns. The last step is the actual construction of the portfolio based on the selection of stocks according to the expectations of their price evolution.

Strategic asset allocation is downstream of the asset and liability management process and upstream of portfolio construction. It is guided by the liabilities and expectations of returns and risks of each asset class [2]. It is expressed as a benchmark that serves as a reference for managers. The question that arises is whether they will duplicate it or take bets on asset classes or securities by deviating from the strategic weights. Replicating the benchmark or passive management means achieving the same performance. It is opposed to active management which seeks to beat the benchmark by taking advantage of the opportunities offered by the different markets [3].

After setting the strategic asset allocation, managers build investment portfolios based on fundamental and technical analysis of markets and securities. They focus on the specificities of each company and its growth potential. It requires regular monitoring of events that may impact the profitability and solvency of companies.

The contribution of these three steps to performance is a subject of debate for pension funds and other institutional investors. It is raised by both theoretical and practical considerations. On the theoretical aspect, studies confirm the main role of strategic asset allocation in explaining the variation in the performance. On a practical aspect, asset management companies advertised their skills and innovative techniques to achieve better returns. Part of their revenues depends on the effort employed to outperform the benchmark.

According to the preceding debates on the contribution of strategic asset allocation and active

management in creating performance, we attempt to answer the following question: Does strategic asset allocation alone guarantee the achievement of management objectives or should active management be called for?

This article aims to answer this question through a two-level analysis: the first is the examination of the contribution of strategic asset allocation in explaining the variation in the performance of Moroccan pension funds. This contribution was analyzed in terms of three variables: fund size, asset classes, and the level of risk taken by the manager. The second level of analysis focused on the performance of one of the funds, which was analyzed using the "performance attribution" method in order to isolate the effects of active management and verify their correlation with the fund's performance.

LITERATURE REVIEW

The study published by Brinson et al. (1986) [4] provided an initial analytical framework for measuring and determining the contribution of strategic asset allocation and active management to the variation in the performances of American pension funds. A regression of the return series yielded an average coefficient of determination (R-square) of 93.6%, which led the authors to conclude that 93.6% of the variation in quarterly portfolio performance is explained by the regression model. The other factors, i.e. tactical allocation and security selection, contribute little to improving the returns of managed funds [5].

These findings have been observed in other countries and markets beyond the United States. German and Swiss balanced mutual funds [6, 7], Canadian, British and Australian funds [8], or Spanish pension funds invested in Eurozone or global equities have displayed the same findings [9].

The explanation of the variation in performances over time and between funds has been addressed by Ibbotson and Kaplan (2000) [10]. Their study concluded that asset allocation accounted for 90% of the variation in fund's performance over time and only 40% of the variation in performances between funds. The remaining 60% is explained by other factors, such as market timing, security selection, and fees.

Drobetz and Köhler (2002) [6] proposed a method based on the calculation of an average allocation return ratio by relating the benchmark return to the fund's total return.[1] The authors arrived at an average ratio of 134% and a median ratio of 131%. Compared to the results obtained by Brinson et al (1986, 1991) [4, 5]and Ibboston and Kaplan (2000) [10], the authors concluded that active management significantly destroyed performance and that the quality of active management in the Swiss and German sample is lower than in the American sample. These two findings confirm that active management has a significant influence on overall fund performance and is an important factor that should not be neglected alongside strategic asset allocation. Similarly, Tokat (2006) [11] argues that while active management would negatively impact returns and volatility, it offers managers the opportunity to outperform the benchmark. He recommends building a strategic portfolio tailored to the specific constraints of each investor and unearthing excess performance by diversifying asset portfolios and minimizing implementation costs.

Strategic asset allocations, while important, face the problem of market dynamics and opportunities [12]. It also depends on the chosen benchmark and subsequently on the investor's risk aversion and time horizon [13]. According to Hoernemann et al. (2005) [14], market movements should be considered as an explanatory element of the variation in the performance. The authors concluded that strategic asset allocation accounts for an average of 77.5% of the variation in portfolio performance.

In the same vein, Aglietta et al. (2012) [15] discussed the need to consider strategic asset allocation in the asset/liability management process. They outlined the contribution of strategic asset allocation based on a sample of 143 US defined benefit pension funds from 1990 to 2008. Using a very detailed database, the authors conclude that 80% of the variation in fund's performances is explained by market movements, in contrast to the work of Brinson et al. (1986, 1991) [4, 5] and Ibbotson and Kaplan (2000) [10]. The authors used two methods to estimate the market return. For sample A, they used the average return of all pension funds

[1] According to the authors, if the ratio (benchmark return / fund return) is equal to 100%, then the manager practices passive management by duplicating the same benchmark weightings. In this case, his R-square will be equal to 100%.

in the sample. While for another sample B, the return was estimated from the market indices.[2]

Strategic asset allocation allows to orient investments and defines the levels of return and risk. It should not be static and fixed, creating rigidity in its implementation. On the contrary, it should be dynamic and [2, 16].

These findings mostly concerned developed markets with high volatility and liquidity, what about other less dynamic markets? The study conducted by Baş and Sarioğlu (2018) [17] covered the Turkish market which is fundamentally different from developed markets. The authors claimed, based on 62 Turkish pension funds and over two different time periods (5 and 10 years), that price changes dominate other effects with 98% for funds invested in equities and 89% for balanced funds.

Funds with particular themes were also discussed. Peillex et al. (2018) [18] worked on a sample of 281 Islamic equity funds. These funds are characterized by restrictions on investment products in accordance with religious beliefs. They have a very narrow investment universe, less balanced and less speculative. The authors conclude that market movements explain 74 to 93% of the variation in fund performance, asset allocation policy accounts for 18% to 20%, while active management accounts for 10% to 26%.

DATA AND METHODOLOGY

We Studied 29 Moroccan[3] mutual funds, presented in detail in *Appendix* (*Table 1*). The assets managed by these funds represent 70% of the total investments[4] of Moroccan pension funds. The funds are distributed as follows: 5 stock funds, 22 bond funds, and 2 balanced funds. For the stock funds, the allocation consists in dividing the investments between the economic sectors, while for the bond funds, the allocation is built according to the residual[5] maturity strata. Finally, balanced funds use two levels of diversification: asset classes and economic sectors or maturity strata.

To analyze the performance and effects of the bets at the time of their implementation, we used weekly observations over the period from January 3, 2014 to December 25, 2020, i.e. 363 weekly net asset values (NAV) provided by "Six Financial Information".[6] For the strategic asset allocations, we used the elementary indices of both stock and bond markets to calculate the benchmark performances. For the stock market, we used the Moroccan All Stocks Index (MASI) and the Moroccan All Stocks Index Return (MASIR). For the bond market, we used the Moroccan Bond Index (MBI) and its sub-indices: MBI Short Term (MBICT), MBI Medium Term (MBIMT) MBI Medium and Long Term (MBIMLT) and MBI Long Term (MBILT).

We have calculated, in the same period, weekly performances, for the fund and its benchmark. The performance is determined by the structure of the portfolio, which integrates market fluctuations, strategic allocation, and active management decisions. The performance of the benchmark considers the structure of the allocation and asset prices [1].

For a fund ***P*** and its benchmark ***B,*** we used the following ratings:

- The time series of fund performance:

$$r_t^P = \ln \frac{NAV(t)}{NAV(t-1)} \text{ for } t\text{: } 2\ldots n \text{ where } NAV(t) \text{ is the}$$

net asset value of the fund ***P*** at date *t* and *n* is the number of *NAV.*

- The time series of benchmark performance:

Each fund's published prospectus provides information on its benchmark.[7] For Moroccan mutual funds, the benchmark corresponds to an elementary index or a composite of two indices. We have calculated the performance of the benchmarks by weighting the performance of the elementary indices by the strategic weights. As an illustration, for a composite benchmark of two indices (index$_1$ and

[2] MSCI World for equities and JP Morgan Global Aggregate Bond Index US for bonds and a composite of 65% equities and 35% bonds for diversified portfolios).

[3] Pension funds in Morocco are not required to publish detailed financial information. For this purpose, we used the mutual funds created for pension plans which, on the other hand, are obliged to publish their net asset values on a weekly basis, at least.

[4] The total investments of pension funds reached 259.3 billion MAD at the end of 2019. Source: Activity Report 2019, Supervisory Authority of Insurance and Social Welfare (ACAPS). URL: https://www.acaps.ma/en/publication/rapports-et-publications

[5] Short term (< 1 year), medium term (2–5 years), medium and long term (5–10 years) and long term (> = 10 years).

[6] URL: http://www.six-financial-information.com/

[7] From the web site of Moroccan Capital Market Authority. www.ammc.ma

index$_2$) with respective weights w and (1-w), we have calculated an index that captures, at each date, w of the first index and (1-w) of the second index. This is how we calculated the series of performances of the strategic allocations according to the following formula:

$$r_t^B = w \ \ln\frac{Index_1(t)}{Index_1(t-1)} + (1-w)\ln\frac{Index_2(t)}{Index_2(t-1)}.$$

$t = 2,3,\ldots, n.$

- The coefficient of determination for each fund is calculated according to the following formula:

$$\text{R-square} = \sum_{t=1}^{n}\left(\widehat{r_t^P} - \overline{r^P}\right) / \sum_{t=1}^{n}\left(r_t^P - \overline{r^P}\right).$$

Where $\widehat{r_t^P}$: predicted fund return predicted by regression model of fund performances against the benchmark.

And $\overline{r^P} = \frac{1}{n}\sum_{t=1}^{n}\left(r_t^P\right)$: The average observed return of the fund.

The R-square measures the proportion of variability explained by the regression model. If the R-square is high (close to 100%), then the regression curve fits the data well. However, if it is low, we can understand that other explanatory variables can be added to the model [19, p. 133–134]. In our case, tactical allocation and security selection are potential explanatory variables.

- Tracking error (TE) is a measure of relative risk taken by a fund compared to its benchmark. In general, the promoter of a fund sets a risk budget measured by the tracking error to give the manager margin of freedom and at the same time to frame his exposure to risk [20]. It is calculated as the standard deviation of performance differences between a fund and its benchmark:

$$TE = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(\Delta r_t - \overline{\Delta r}\right)^2}$$ Where: $\Delta r_t = r_t^P - r_t^B$ and

$$\overline{\Delta r} = \frac{1}{n}\sum_{t=1}^{n}\left(\Delta r_t\right).$$

To explain the variability in performance by strategic asset allocation, we performed a simple regression of the fund's performance against the benchmarks [15], calculated and analyzed coefficients of determination R-square.[8] The calculations were also redone taking into consideration three differentiating variables, namely: the category of the funds (stock, bond or balanced), the fund size [21], and the level of the tracking error [22, 23].

The second question, which concerns the contribution of active management, has been approached on two levels. First, is to assess the performance surplus between the fund and its benchmark by calculating and analyzing the ratio "*performance gap between fund and benchmark / fund performance*" called $Contrib_{AM}$.

$$Contrib_{AM} = \left(\frac{r_t^P - r_t^B}{r_t^P}\right) \times 100.$$

The second level consists in using the "performance attribution" method of Brinson and Fachler (1985) [24], which consists of isolating the effects of active management decisions, namely: tactical allocation, selection, and interaction.

The tactical allocation measures the difference in the performance of the asset class compared to the overall performance of the benchmark. It reflects the impact of the decision to overweight or underweight an asset class compared to its weight in the benchmark. Security selection measures the performance gap linked to the choice of securities within an asset class. Finally, Interaction is explained by the intersection of the two effects.

Performance attribution requires the availability of actual data on asset class weights and performance [4]. That's why the analysis was restricted to one of the mutual funds (F29) for which we were able to obtain all the necessary information. The correlation was calculated between each asset management factors and fund's performance.

Consider, for a portfolio ***P*** and its benchmark ***B***, the following ratings:

r_i^P : Return of class i in the portfolio ***P***

w_i^P : Weight of class i in the portfolio ***P***

[8] Hoernemann et al (2005) proposed using the standard deviation of fund returns to track return variability instead of the R-square. The standard deviation thus makes it possible to construct a confidence interval around the mean to track the variability of returns.

r^P: Portfolio ***P*** return = $\sum_{i=1}^{n} w_i^P r_i^P$

r_i^B : Return of class *i* in the benchmark ***B***

w_i^B : Weight of class *i* dans le benchmark ***B***

r^B: Benchmark ***B*** return = $\sum_{i=1}^{n} w_i^B r_i^B$

N: The number of asset classes

The performance gap: $\Delta r = r^P - r^B$ (1) can be broken down as follows:

$$\Delta r = \sum_{i=1}^{N} (r_i^P w_i^P - r_i^B w_i^B).$$

We can finally write:

$$\Delta r = \sum_{i=1}^{N} (w_i^P - w_i^B)\left(r_i^P - r^B\right) + \sum_{i=1}^{N} w_i^B \left(r_i^P - r_i^B\right) + \sum_{i=1}^{N} (w_i^P - w_i^B)\left(r_i^P - r_i^B\right)$$

$$\text{or } \Delta r = \sum_{i=1}^{N} (A_i + S_i + I_i) \quad (2)$$

With:

$A_i = \left(w_i^P - w_i^B\right)\left(r_i^P - r^B\right)$: Tactical allocation effect

$S_i = w_i^B \left(r_i^P - r_i^B\right)$: Security selection effect

$I_i = (w_i^P - w_i^B)\left(r_i^P - r_i^B\right)$: Interaction effect

Thus, from equality (1) and (2), we deduce the breakdown of the portfolio's profitability according to the different effects: $r^P = r^B + A + S + I$ with

$A = \sum_{i=1}^{N} \left(A_i\right)$: Performance linked to tactical allocation bets.

$S = \sum_{i=1}^{N} \left(S_i\right)$: Performance linked to the choice of securities.

$I = \sum_{i=1}^{N} \left(I_i\right)$: The part of the performance explained by the interaction between the two effects tactical allocation and security selection

For simplification purposes, interaction effect and selection effect were grouped (*S*+*I*) and noted as (S'). The regression of the fund performance will be done, this time, with each of the three explanatory variables: strategic asset allocation (r^B), tactical allocation (A) and selection (S').

RESULTS AND DISCUSSION OF PERFORMANCE VARIABILITY

The first results of the calculation of absolute and relative performance, detailed in *Appendix* (*Table 1*), show that the average annualized performance of the funds is 5.4% compared to 4.9% for their benchmarks. 72.4% of the funds recorded an outperformance between 30 and 440 basis points (bps), while 27.6% of the funds underperformed between –220 and –20 bps. The contribution of strategic allocation to performance represents on average 92.2%. The contribution of active management, as measured by the $Contrib_{AM}$ ratio, was 24.7% for funds that outperformed their benchmark and –16.6% for those that underperformed.

Regarding the impact of strategic asset allocation on the variability of fund performance over time, the average R-squared is 81.7% (*Table 1*). This is lower than those obtained by Brinson et al. (1986, 1991) [4, 5].[9] The calculation of the coefficient of determination R-square gives disparate results between funds. This result is explained by the heterogeneity of the funds in terms of strategic allocation, size, and asset class.

The concentration of R-square (*Fig. 1*) shows that 75.9% of the funds have a coefficient greater than 80%, attesting to the importance of strategic asset allocation for the majority of the funds. It is important to note that one fund has an R-square equal to 27.4%. This fund will be analyzed to answer the second question of the study.

Another finding from the results in *Appendix* (*Table 1*) is that funds with the same benchmark do not necessarily have the same R-square. This confirms that managers implement their portfolios differently and use active management techniques in order to beat their benchmark. *Table 2* presents data for two funds with the same benchmark but mandated to different managers in the stock category.

We note that the two stock funds show slightly different R-square with a return advantage for the

[9] See Appendix (*Table 2*).

(F3) fund against a higher tracking error of 0.7%. Both funds have outperformed the benchmark, demonstrating the additional value creation which, represents 21.2% and 13% respectively for the (F3) and (F1) in fund performance.

Similarly, for the bond funds, *Table 3* presents data for three funds with the same benchmark.

The three funds are managed under the same strategic asset allocation constraints. They have the same benchmark but the management style and results are not the same. The (F16) and (F21) funds show the same performance while their R-squares are different. The two other funds (F21) and (F22) showed close R-square but significant differences in performance. While the former outperformed the MBI by 56 pbs, the latter underperformed by 16 bps.

After this overview, we will present results highlighting three differentiating factors that we consider important in explaining the variability in the performance, namely: fund category, asset size, and the level of ex-post risk measured by the tracking error.

For three categories of funds, we present the coefficients of determination in *Table 4*.

The results show an average R-square of 94.5% for equity funds and 54.9% for balanced funds. For bond funds, this coefficient varies between 32% and 97% with an average of 81.2%. We can deduce that the asset class of a fund has an influence on the variability of its performance.

Regarding the impact of the fund size on the R-square. We expect small funds to show a relatively low R-square. Indeed, these funds could deviate significantly from their benchmark index in order to take full advantage of the opportunities offered and readjust their allocation in the event of a market trend reversal. However, the results obtained (*Table 5*), show that the R-square of some large funds (+5 billion dirhams) is lower than those of small assets. These funds are invested in treasury bills and private debt with a risk premium not included in the Moroccan Bond Index.[10]

Finally, the third factor that influences the divergence of R-square is the degree of weighting mismatch between the fund and its benchmark. This mismatch, measured by the tracking error, is a deliberate decision taken by the manager according to his risk aversion and the leeway granted to him

Table 1

Min, Max and average of the R-square

Measure	R-square, %
Min	23.5
Max	97.0
Average	**81.7**

Source: authors' calculations.

[10] The Moroccan Bond Index (MBI) is calculated solely on the basis of Treasury bills. It does not include corporate bonds.

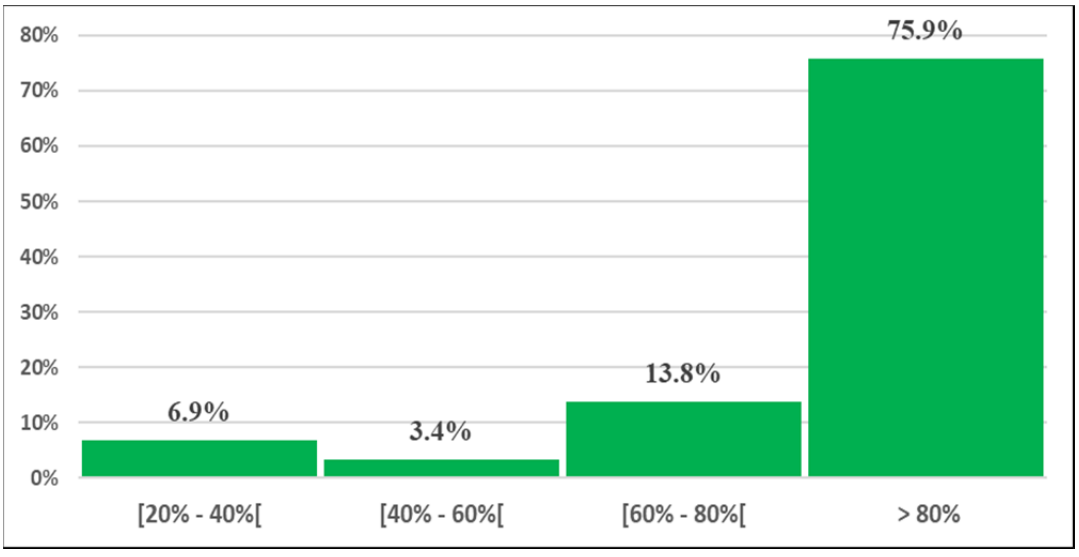

Fig. 1. **R-square concentration range**

Source: compiled by the authors.

Table 2

Performance and risk indicators for two stock funds with the same benchmark

Stock funds	F1	F3
Benchmark	MASI R	MASI R
Average size in Million MAD	705.3	836.3
R-square	96.4%	93.5%
Tracking error	2.0%	2.7%
Average annualized fund performance	7.7%	8.5%
Performance average annualized benchmark	6.7%	6.7%
Performance gap in basis points (bps)	102	176

Source: authors' calculations.

Table 3

Return and risk indicators for tree bond funds with the same benchmark

Bond funds	F16	F21	F22
Benchmark	MBI	MBI	MBI
Average size in million MAD	5 945.1	4 463.8	529.1
R-square	96.5%	84.3%	85.1%
Tracking error	0.7%	0.9%	0.8%
Average annualized fund performance	5.9%	5.9%	5.2%
Average annualized benchmark performance	5.3%	5.3%	5.3%
Performance gap in basis points (bps)	56	56	–16

Source: authors' calculations.

Table 4

Min, max and average R-square by fund category, %

Category	R-square Min	R-square Max	R-square Average
Stock	91.2	96.9	94.5
Bond	32.0	97.0	81.2
Balanced	23.5	86.4	54.9

Source: authors' calculations.

Table 5

Min, Max and mean of R-square according to fund size, %

Fund size	R-square Min	R-square Max	R-square Average
< 500 million MAD	23.5	95.7	71.5
[500 million – 1 billion MAD[	32.0	96.9	84.0
[1–5 billion MAD[	47.2	97.0	83.4
> 5 billion MAD[	61.6	86.4	74.0

Source: authors' calculations.

Table 6

Min, max and average R-square according to category and tracking error level

Category	Tracking Error	R-square min %	R-square Max, %	R-square Average, %
Stock and Balanced fund	Less than 2%	86.4	96.9	92.9
	More than 2%.	23.5	95.7	76.0
Bond fund	Less than 1%.	86.2	97.0	91.9
	More than 1% of the total	32.0	93.7	76.6

Source: authors' calculations.

by the fund promoter.[11] *Table 6* shows the results obtained for the two categories "equity and balanced funds" and "bond funds".

The greater the tracking error, the lower the coefficients of determination. For both categories, the R-square show significant differences depending on the risk budget consumed by each manager.

Overall, the analysis of the performance and risk of the funds studied shows that strategic asset allocation accounts for most of the performance. Also, for some funds, active management has been beneficial, creating a performance surplus but with a higher level of risk relative to the benchmarks. On the other hand, we note that for other funds, active management had a negative impact on performance.

RESULT AND DISCUSSION OF ACTIVE MANAGEMENT CONTRIBUTION

Contrib$_{AM}$ Ratios

The results of the calculation of the "*Contrib*$_{AM}$" ratio, summarized in *Table 7*, show that all the funds recorded performance gaps with their benchmarks.[12] Some managers (22 out of 29) took advantage of their bet against the strategic allocation and generated an average surplus equivalent to 17.7% of the fund's performance. Note that this surplus exceeded 48% for one of the studied funds (F29). On the other hand, some funds suffered losses relative to their benchmark, representing an average of –23.6% of the overall performance.

The contribution of active management in explaining the performance of the studied funds

[11] In general, the promoter of an investment fund sets a risk budget measured by the value-at-risk or tracking error to give the manager room for manoeuvre and at the same time to frame his exposure to risk.

[12] In practical terms, benchmarks are generally difficult to reproduce due to the lack of liquidity of certain assets on the one hand, and on the other hand due to the existence of a cash pocket in the fund to cover redemptions and the payment of management fees.

Table 7

Contribution of active management, %

	ContribAM		
	Min	Max	Average
Funds that outperformed their benchmark	3.3	48.5	17.7
Funds that underperformed their benchmark	−58.6	−3.1	−23.6

Source: authors' calculations.

Note: For more details, see *Appendix* (*Table 1*).

Table 8

Fund (F29) performance and risk Indicators, %

	Average Annualized Return	Standard deviation	Tracking error
Fund (F29)	7.9	6.2	6.3
Benchmark	4.8	2.8	

Source: authors' calculations.

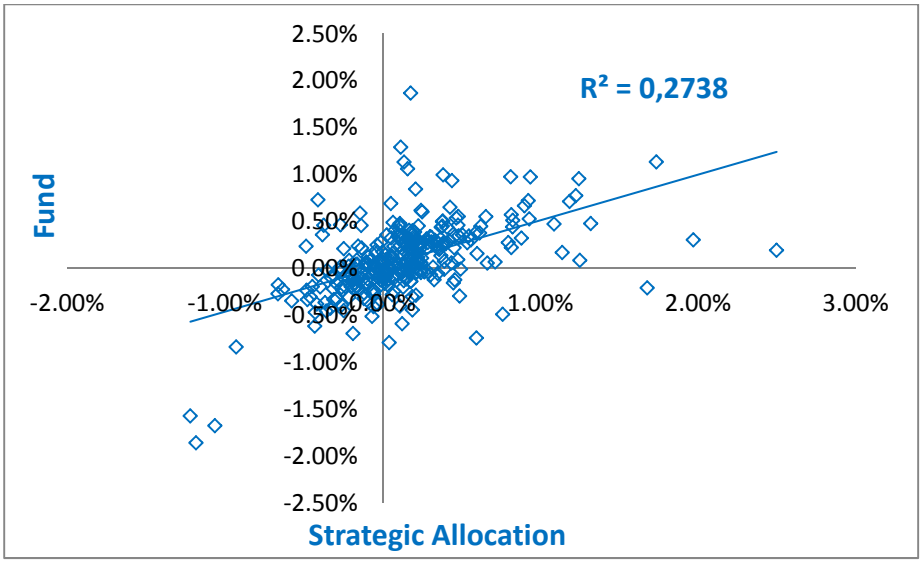

Fig. 2. **Scatter plot of fund returns (F29) versus benchmark**

Source: compiled by the authors.

has just been confirmed. The dispersion of results between funds is explained by the ability of managers to anticipate market behavior. It is also linked to the possibility of arbitrage between the markets.

Performance Attribution Results

The performance attribution analysis was applied to the fund (F29) for which we calculated the contribution of the active management factors to the performance. The calculation of the return and risk indicators of this fund is presented in *Table 8*.

We note that the fund has outperformed its benchmark by more than 3% on average per year with a much higher level of risk. The tracking error is considered high for a pension fund that is supposed to be backed by its liabilities.

Willing to outperform the benchmark by active management factors is increasing the risk-taking level. The risk cannot be ignored in explaining performance and performance its gap to the benchmark.

Table 9

Fund Performance Attribution (F29)

Source of performance		Performance, %
Strategic asset allocation		4.84
Effects of active management	Tactical Allocation	–0.50
	Security Selection	3.08
	Interaction	0.49

Source: authors' calculations.

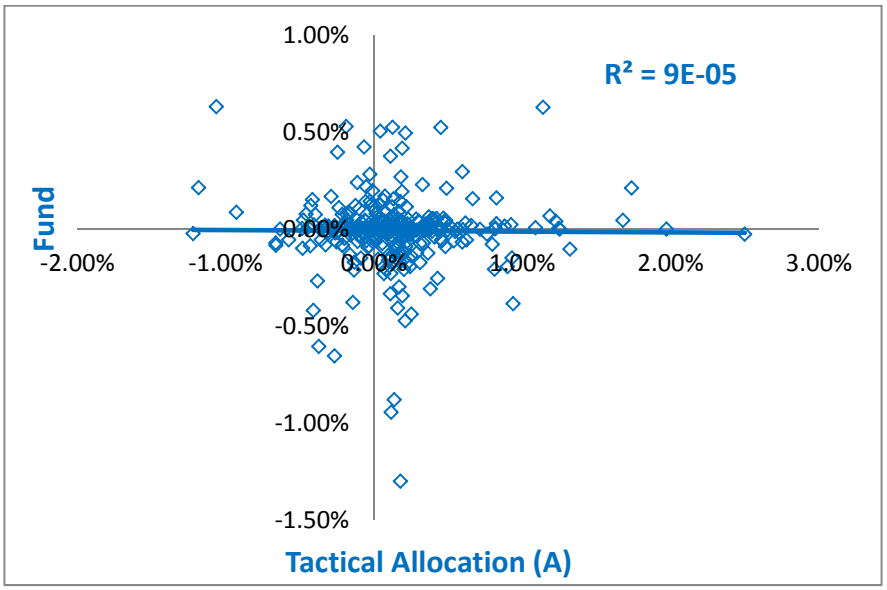

Fig. 3. **Scatter plot of fund returns (F29) versus tactical allocation returns**

Source: compiled by the authors.

Another factor, not the least, is the size of the funds compared to the transactional volume and the abundance of opportunities in a given market. The fund (F29), because of its relatively small size compared to the daily volumes on both the stock and bond markets, has been able to beat its benchmark over several years, sometimes, with a very high spread.

As regards the analysis of the variability of the fund's performance, we have plotted, in *Fig. 2*. the scatter plot between the performance of the benchmark and that of the fund. The regression gave an R-square of 27.4%. This result led us to conclude that the performance of the strategic allocation only weakly explains the variability of the fund's performance (F29).

The results of the application of the attribution performance method [23] allowed us to divide the performance gap in three effects: tactical allocation, selection, and interaction. The results summarized in *Table 9* indicate that security selection generated an average performance of 3.08% compared to 4.84% for the strategic allocation.

The performance surplus was generated due to a good selection of securities. In fact, security selection generated 39% of the fund's performance. Adding the interaction effect, the overall effect (S') is 3.57% which represents 45% of the overall performance.

The scatterplot in *Fig. 3* was created between the performance series generated by the tactical allocation and the fund's performance. We can clearly see that the tactical (A) allocation does not explain the variability of the fund's performance. (R-squared ≈ 0).

Fig. 4 below shows the regression between the fund's performance and that of the selection (S'). We note that the R-square is 58.5%, which is higher than R-squared obtained in *Fig. 2*. The variability of the performances of our fund is explained by the selection of securities.

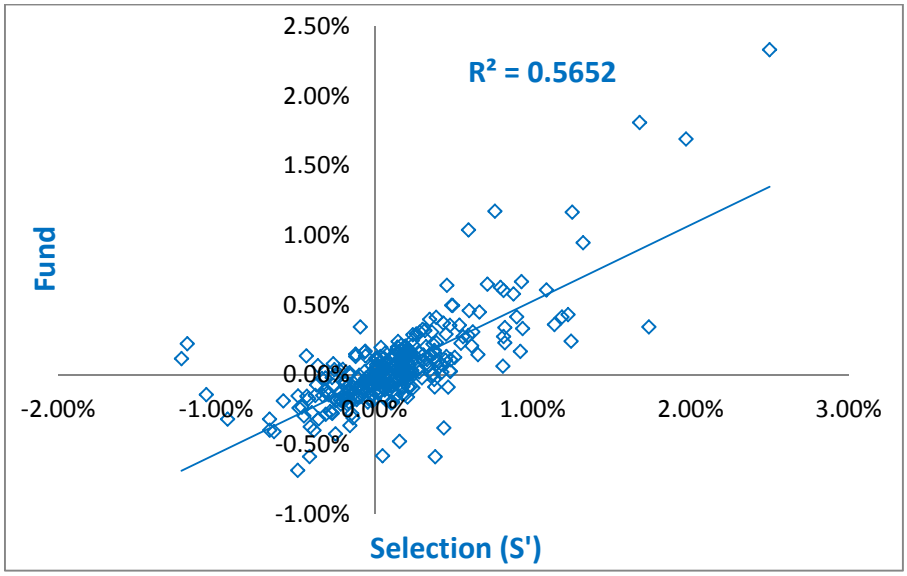

Fig. 4. **Scatter plot of fund performances (F29) versus selection performance**

Source: compiled by the authors.

We note the importance of strategic allocation in explaining the variability of fund performance. However, an investment process should not be limited only to this step. The active management techniques can potentially create additional value. This conclusion is reinforced by the value creation of our dynamic fund which created almost as much performance as the strategic allocation. The performance gap (+308 basis points on average per year) is very significant and requires the implementation of an adequate risk hedging policy. Finally, we note that our findings were observed over the 5-year period without being observed for each year of the study period. This confirms two principles: the first is that pension funds should balance a long-term strategy focused on financing their liabilities with active management. The second is that active management could be a source of value creation if the risk is well covered and the managers have the necessary skills to do so.

CONCLUSION

Strategic asset allocation for pension funds is an important step in the investment process. Given its strategic implications, it must be validated under the responsibility of the board direction. It must also be regularly monitored in order to successfully manage the objectives considering regulatory constraints and market developments.

The results of our study confirm the importance of strategic asset allocation in explaining the variability of Moroccan mutual funds. The level of variability obtained differs according to the three parameters that we have analyzed. However, other parameters such as the evolution of the economic and financial environment, the size and liquidity of markets could be the subject of further research.

Static allocation does not always suit to market fluctuations; fund managers take bets to create more performance. Active management makes it possible to take advantage of short-term market movements and security characteristics in investment decisions. But, moving away from strategic weightings generates a risk that should not be ignored. Managers must consider this when developing their investment strategy.

The studied pension fund recorded an average annual performance above its benchmark and that is due to a securities selection effect based on price expectations. The analysis of the performance gap was possible thanks to the performance attribution method. However, this analysis must be complemented by risk attribution to quantify the relative contribution of each asset to the overall risk.

Finally, the strategic allocation should not be static in order to take advantage of short-term market fluctuations; it is recommended to be dynamic based on an objective and rigorous mathematical approach.

APPENDIX

Table 1

Performance and risk indicators for the studied funds, %

Category	Fund	Average annualized perfromance		Gap ($r^P - r^B$)	Standard deviation		TE	R-square	$Contrib_{AM}$
		Fund r^P	Benchmark r^B		Fund	Benchmark			
Stock	F1	7.7	6.7	1.0	10.9	10.3	2.00	96.9	13.2
	F2	2.4	3.5	–1.0	17.4	18.9	2.20	95.3	–43.2
	F3	8.5	6.7	1.8	10.4	10.3	2.70	93.5	20.8
	F4	5.1	7.3	–2.2	8.6	11.3	3.30	95.7	–43.2
	F5	9.0	7.4	1.6	11.0	11.3	2.70	91.2	17.8
Bond	F6	4.4	3.4	1.0	1.3	0.9	0.70	73.7	22.0
	F7	4.8	3.5	1.2	1.0	1.0	1.00	62.4	26.1
	F8	4.0	3.4	0.6	1.9	0.9	1.50	32.0	14.6
	F9	3.9	3.8	0.1	1.1	0.80	0.80	61.6	3.3
	F10	6.0	6.3	–0.3	2.2	2.6	0.80	90.2	–4.9
	F11	6.3	6.8	–0.5	1.9	2.2	1.20	70.6	–7.1
	F12	6.6	6.3	0.3	2.4	2.6	0.90	87.9	4.8
	F13	6.0	6.3	–0.3	2.4	2.6	1.10	80.7	–4.8
	F14	2.4	3.8	–1.4	0.1	0.8	0.70	47.2	–58.6
	F15	5.7	5.3	0.4	2.2	1.9	0.60	93.7	6.3
	F16	5.9	5.3	0.6	2.1	1.9	0.40	96.5	9.6
	F17	6.1	5.3	0.7	2.1	1.9	0.60	93.3	12.0
	F18	6.0	5.3	0.6	2.2	1.9	0.60	93.7	10.7
	F19	5.9	5.3	0.6	2.1	1.9	0.40	97.0	9.8
	F20	6.0	5.3	0.6	2.1	1.9	0.60	92.5	10.7
	F21	5.9	5.3	0.6	2.2	1.9	0.90	84.3	9.6
	F22	5.2	5.3	–0.2	1.9	1.9	0.80	85.1	–3.1
	F23	5.7	5.3	0.4	2.2	1.9	0.50	95.9	7.1
	F24	3.7	2.3	1.4	1.0	1.2	0.40	86.2	36.9
	F25	3.5	2.3	1.2	1.3	1.2	0.50	82.5	33.8
	F26	3.3	2.3	0.9	1.2	1.2	0.40	88.8	28.0
	F27	3.7	2.4	1.3	1.2	1.3	0.40	91.2	34.8
Balanced	F28	6.1	5.4	0.6	2.4	2.2	0.90	86.4	10.4
	F29	9.0	4.7	4.4	6.7	2.7	6.90	27.4	48.5

Source: authors' calculations.

Table 2

Comparative results of the average R-square

Authors	Nature of the Funds	Country	R-square average, %
Brinson et al (1986)	Pension funds	United States	93.60
Brinson et al (1991)	Pension funds	United States	91.50
Ibboston and Kaplan (2000)	Pension funds	United States	88.00
	Mutual Funds		81.40
Drobetz and Köhler (2002)	Mutual Funds	Switzerland and Germany	82.90
Andreu et al (2010)	Funds invested in euro zone equities	Spain	92.99
	Funds invested in global equities		96.22

Source: [4–6, 9, 10].

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A Comparative Financial Performance of the GCC's Largest Banks During the Pandemic

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ABSTRACT

This paper investigates the financial performance of the largest Gulf Cooperation Council (GCC) banks by total assets before and during the recent COVID-19 pandemic. The **purpose** of the study was to identify the impact of the COVID-19 pandemic on banks' financial performance. Financial ratios analysis during the period 2017–2020 is employed to measure the financial performance of the largest GCC banks mainly based in Saudi Arabia, Qatar, United Arab Emirates, Kuwait, Oman, and Bahrain. The ratios cover key performance areas such as profitability, efficiency, liquidity, asset quality, asset risk, and expense management. Two significant developments in 2020 are the COVID-19 pandemic and severe drop in oil prices, both of which led to a sharp drop in the region's GDP growth rate from an average of –0.09% in year 2019 to –5.9% in 2020, which in turn is expected to negatively impact bank performance. Using paired samples t-test the research study found statistically significant **results** that the financial performance of all banks suffered on almost all the key parameters in 2020 compared to the earlier period which can explained by the decline in economic activity due to COVID-19. The focus of this study and its conclusions are novel to the extent that there are no country specific studies related to impact of COVID 19 on the biggest banks in a country. Further as far as the authors know there are no studies on the topic of impact of COVID-19 on big banks operating in the Gulf cooperation council countries. The conclusions of the study would of importance to the regulators who would not like the big banks to fail.

***Keywords*:** GCC; pandemic; financial performance; COVID-19; banks

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INTRODUCTION

The current ongoing COVID-19 pandemic is one of the biggest crises of our time, beginning in December 2019 in Wuhan, central China. The availability of credit, risky mortgages, artificially low interest rates, transparency and adequate supervision of the company's balance sheets, and the risk of large financial institutions creating and selling financial derivatives have contributed to the global financial crisis in 2008 [1]. Hence the COVID-19, a virus, created an almost similar effect on the world economy to the global financial crisis. The World Health Organization (WHO) shows that the number of cases across Gulf Cooperation Council (GCC) countries reaching more than 2 million by the end of July 2021. The COVID-19 pandemic is a global crisis, directly affecting almost every country and the banking and financial system in the world. A stable and financially sustainable banking system is essential for the general growth and economic and social well-being of the people of any country [2]. It is expected that because of the scale and extent of the COVID-19 crisis, it can still be compared with the global financial crisis of 2007–2009, and no bank will remain unaffected. The overall financial market's first reaction was a tsunami, which struck many local and international banks indiscriminately [3]. The governments of the GCC region and most countries in the world have decided to close public places, schools, and lockdown people at home, which has effectively wintered and harmed most of the economy. The cross-border movement of people and goods is strictly minimal. Furthermore, the current pandemic may have accelerated changes in consumer behavior. Banks in many countries continue to operate, but people (especially non-millennials) are forced to use more digital banking solutions and bypass branches and ATMs. In addition, the government started to increase support for digital finance to build a more digital and sustainable economy [4].

The Gulf Cooperation Council (GCC) is home to some of the largest banks in the entire Middle East and North Africa (MENA) region. The Gulf Cooperation

Council is where Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE) is located. It is a regional and intergovernmental political and economic organization with six members. It was established in May 1981 in UAE, and its headquarter is in Riyadh in Saudi Arabia. The region as a whole has a strong and very active banking industry. The non-oil GDP ratio of all Gulf countries today is higher than 10 or 20 years ago. Many countries still rely heavily on oil and gas exports, which account for more than 70% of total exports for Kuwait, Qatar, Saudi Arabia, and Oman. In addition, the oil revenue exceeds 70% of the total government revenue of Kuwait, Qatar, Oman, and Bahrain [5]. The six biggest banks included in this study; Ahli United Bank (Bahrain), National Bank of Kuwait (Kuwait), Bank Muscat (Oman), Qatar National Bank (Qatar), Saudi National Bank (Saudi Arabia), and First Abu Dhabi Bank (UAE).

When large banks become unstable and vulnerable, they usually stop lending, and the credit crunch can cause the economy to fall into recession or slow growth [6]. Inspired by the above facts and arguments, the objective of this paper is to provide a comparative commentary on the actual impact of the COVID 19 pandemic on the significant Gulf Cooperation Council banks before and during this global pandemic crisis. This research study is an important contribution to the literature. As far as we know, this is the first study to examine major GCC banks before and during the pandemic and helps to understand how these banks are affected by COVID-19.

Two significant developments in 2020 are the COVID-19 pandemic and severe drop in oil prices, both of which led to a sharp drop in the region's GDP growth rate from an average of –0.09% in year 2019 to –5.9% in 2020. The slowdown in economic activity in the region is in turn expected to negatively impact big bank performance.

The structure of the research paper is organized as follows: Section 2 discusses the existing literature. Section 3 presents the data, defines our variables and the methodology, and results and implications in section 4. Section 5 concludes the research paper.

LITERATURE REVIEW

The COVID-19 pandemic has harmed the domestic and foreign economies, leading to a decline in the financial performance and profitability of many companies. The bank loans are the weakest for the countries hardest hit by the health crisis [7]. The COVID-19 pandemic is considered an unprecedented crisis in world history, and its severity varies from country to country. The pandemic caused many companies to close down, severely disrupted world trade, and caused losses to almost every industrial sector in the world. Most companies in the GCC take measures to cut costs, save money, avoid expansion and try to cut costs to maintain their safe funds. These problems are even more severe for start-ups or small and medium enterprises because they freeze hiring or even downsize and fire their staff. A study by Rababah et al. [8] used conventional least squares (OLS) regression to analyze the impact of the COVID-19 pandemic on the financial performance of listed companies on the China Stock Exchange. It is found that small and medium-sized companies are the most severely affected by the pandemic, and the financial performance of the industries most affected by COVID-19 has fallen sharply compared with other sectors. Comparing with the global financial crisis that started in the United States in 2007, when the mortgage crisis hit the stock market and spread globally in 2008, a study by Flögel and Gärtner [9] concluded that banks seem to be better prepared for the COVID-19 crisis. However, as we are still in this crisis, it is difficult to measure the long-term impact of the pandemic on the banking sector in GCC. As there are limited studies currently available, this study aims to examine the effect of the COVID 19 pandemic on the financial performance of major banks in the GCC before and after the crisis.

Elnahass et al. [10] examined 1,090 banks from 116 countries in the world using quarterly data during 2019–2020. The results provide strong empirical evidence that the COVID-19 outbreak in the global banking industry has adversely affected the financial performance of various indicators, including risk indicators, default, liquidity, and assets. In addition, based on the trend analysis, the average performance and financial stability of banks in each quarter indicate that bank stability has recovered in the second quarter of 2020. A study by Devi et al. [11] investigated the financial performance of 214 companies on the Indonesian Stock Exchange, divided into nine or 49 sub-sectors in proportion. The results show that during the COVID-19 pandemic, the company's leverage ratio and short-term activity rate have increased, but the company's liquidity ratio

and profitability have declined; in addition, before and during the COVID-19 pandemic, the profitability index of listed companies and the short-term activity index fluctuates wildly. Another study by Demirgüç-Kunt et al. [12] studied banks' stock prices around the world to measure the impact of the COVID-19 pandemic on the banking industry. The results show that the crisis and the anticyclical role of banks are expected to have put pressure on the banking system under stress. However, banks' stocks are worse than the stocks of domestic markets and other non-bank financial companies. In addition, they suggested that as the pandemic continues to affect the global economy, the volatility of the banking industry needs to be closely monitored.

Furthermore, Fakhri and Darmawan [13] compared the financial performance of Islamic and conventional banks during the COVID-19 crisis using six financial performance variables. The study used lending on deposit ratio, net operating margin, operating expenses to operating income, capital adequacy ratio, return on assets, and short-term mismatch. The study found using the Artificial Neural Network method that Islamic banking is more susceptible to the impact of financial crises than traditional banking, which is in line with the previous literature. In addition, a study by Akkas and Al Samman [14] analyzed the GCC Islamic financial institutions and Islamic windows at two different stages during the COVID-19. The first phase (January 1, 2020, to October 30, 2020) shows that compared with the traditional and Islamic financial institutions in Oman, Bahrain, Qatar, Saudi Arabia, and the United Arab Emirates, Islamic financial institutions are less affected by the COVID 19 epidemic.

Moreover, Islamic financial institutions in Saudi Arabia and Oman have not been affected by the COVID-19 outbreak. The analysis of the second phase of the COVID 19 outbreak (from November 1, 2020, to March 17, 2021) confirmed that the negative impact of COVID 19 on Islamic financial institutions in Bahrain and Oman has disappeared. Another study by Barua and Barua [15] in the Bangladesh banking sector and the implications of the COVID 19 using the stress testing model show that the largest banks are relatively more vulnerable. The study used three dimensions; capital adequacy ratio, assets value, and interest income. In contrast, and based on 426 banks from 48 countries, Mirzaei et al. [16] evaluated the performance of Islamic bank stocks compared to their traditional peers in the early stage of the COVID 19 crisis (December 31, 2019, to March 31, 2020). The study found that the profitability of Islamic banks is 10–13% higher than that of traditional banks.

By investigating how Canadian banks responded to the COVID 19 pandemic, a study by Talbot and Ordonez-Ponce [17] had applied a strategic positioning analysis. The study attempted to understand how the Banks in Canada serve their customers and communities during the current health crisis. A content analysis was conducted to analyze the actions taken by the top ten Canadian banks supporting efforts toward the pandemic. One hundred twenty-five documents and 19 different measures were examined in the study. The data was performed through a combination of hierarchical clustering and multi-dimensional scaling. Following the corporate social responsibility approach, three banks stand out: aggressive action, cautious action, and waiting. The study finally highlighted that although most banks have done little to help their stakeholders, three of them have shown active participation and strong support for customers and the community during the pandemic period.

DATA AND METHODOLOGIES

Balance sheet and income statement data for years 2019 and 2020 of the biggest bank in each of the six GCC countries is used to examine the impact of COVID 19 on the top banks in the regions. The banks were selected based on total assets, which is the best indicator of size. Data for the years 2017 and 2018 was used to look at the trends in key ratios. The banks selected are as follows: Ahli United Bank (Bahrain), National Bank of Kuwait (Kuwait), Bank Muscat (Oman), Qatar National Bank (Qatar), Al-Rajhi Bank (Saudi Arabia), and First Abu Dhabi Bank (UAE).

Figure presented oil price trends in the last three years are shown in the chart given below. Oil prices in 2019 averaged around 60 USD per barrel. COVID-19 severely impacted oil prices. Prices dropped sharply in 2020, as can be seen in the Brent crude price chart given below. The Gulf economies suffered due to the twin impact of low oil prices and lockdowns due to COVID-19. GCC markets tend to be inefficient during global crisis with few exception [18]. The paper, therefore, tries to examine the effect of the severe economic slowdown and low oil prices on the

Fig. **Crude Oil Prices (Brent)**

Source: URL: https://www.macrotrends.net/2480/brent-crude-oil-prices-10-year-daily-chart (accessed on 12.08.2021).

performance of the top banks by comparing how key performance ratios behaved over the period 2019 to 2020.

Key performance ratios, which have been identified by many of the studies reviewed in the earlier section, were used to examine if COVID-19 impacted the performance of GCC big banks. The key performance ratios and their definitions are reported in *Table 1*.

Past studies have identified that profitability, efficiency, liquidity, asset quality, and cost management are critical issues impacting a bank's performance. Return on equity, defined as net income after taxes divided by total equity, is an indicator of profitability. Return on assets, net income after taxes divided by total assets, is an indicator of efficiency and profitability. Net interest margin, which is net interest income (interest income minus interest expense) divided by total assets, indicates competitive pressures. Liquidity is measured using the ratio of liquid assets to customer deposits and short-term funds. Liquid assets are defined as cash and cash equivalents. Asset quality and asset risk is an essential performance parameter for a bank. Asset quality is measured using the ratio of loan loss provisions to net loans. Cost management is calculated using the cost to income ratio, a very standard and well-accepted measure. Cost to income ratio is defined as non-interest expenses divided by net-interest income plus other income.

In this paper, we start the analysis by first looking at the trends in key performance ratios from 2017 to 2020. Since a worsening or a decline in a particular ratio from 2019 to 2020 may or may not be statistically significant, we use the t-test to compare means.

Table 1

Key Ratios and definitions

Symbol	Ratio
ROE	Return on Equity
ROA	Return on Assets
NIM	Net Interest Margin
LCST	Liquid Assets to Customer Deposits and Short Term Funds
LLP	Loan Loss Provisions to Net Loans
CostInc	Cost to Income ratio: Non-Interest Expenses divided by Net Interest Income plus Other income

Source: compiled by the author.

Two-tailed paired samples t-test (dependent) for means is used to examine whether the average for each ratio for the year 2019 is statistically significant from the average for the year 2020. The dependent t-test compares two means when those means have come from the same entities [19] if the t-value is statistically significant, i.e., if the 2-tailed probability associated with the t-value is < 0.05, we conclude the behavior of the ratio in 2020 is different from 2019.

Table 2

Trends in key ratios of GCC Big Banks, %

	AVG 2020	AVG2019	AVG 2018	AVG 2017
ROE	11.00	13.91	12.21	12.94
ROA	1.33	1.77	1.55	1.76
NIM	2.28	2.54	2.60	2.50
LCST	11.81	11.37	13.62	12.15
LLP	0.93	0.54	0.62	0.59
CostInc	–34.63	–34.53	–33.93	–36.34

Source: compiled by the author.

RESULTS AND DISCUSSION

Table 2 reported below shows the behavior of average (mean) values of various ratios from 2017 to 2020. Compared to 2019, the average performance of the big banks was worse in 2020 in the following key areas: profitability, efficiency, margins, asset quality, and cost or expense management. Return on equity dropped from 13.91% to 11%, and return on assets was also much lower in 2020, indicating that both profitability and efficiency fell due to COVID-19 and low oil prices.

Average net interest margins were much lower in 2020 compared to 2019, primarily due to reduced interest income due to lower earnings on the banks' loan portfolios. Loan loss provisions were much higher in 2020, indicating a worsening in the banks' asset quality and higher asset risk.

Costs increased but only by a small percentage. Top banks reported slightly higher liquidity levels in 2020. We conclude that on the whole, trends in key ratios indicate that top banks did severely on almost all performance parameters in the year 2020, and the apparent reason cutting across the region (and the world) is the advent of the COVID-19 pandemic, resultant lockdowns, and lower oil demand.

While the decline in average ROE from 13.9% to 11% indicates a decrease in profitability of the top GCC banks, we are not sure if the change is statistically significant. Similarly, in ROA and NIM, we have to examine if the reduction in these ratios is statistically significant. In LLP, CostInc, and LCST, we have to statistically determine if the increase is substantial. In this paper, we use the Paired-Samples t-test to check if the two means are statistically different from each other. If the t-value of the paired samples test is significant at a 5% level (that is, if two-tailed $p < .05$), we conclude the decline (or increase) is noteworthy.

Tables 3 and *4* report the results of the t-test for return on equity and return on assets. In both cases, the t-values are statistically significant at the 5% level. The results imply that top banks in the Gulf region suffered in 2020 in terms of profitability and efficiency. This result has to be contrasted with the trend from 2018 to 2019. While banks improved their profit performance from 2018 to 2019, the exact opposite happened from 2019 to 2020. However, it is noteworthy that none of the top GCC banks reported losses despite the COVID-19 and low oil prices.

T-test results for net interest margins (NIM) are reported in *Table 5*. The average net interest margin of banks declined from 2.53% in 2019 to 2.27% in 2020. The t-value at 2.67 is statistically significant at the five percent level, which concludes that the decline in net interest margins is noteworthy (significant). Although a drop from 2.53% to 2.27% appears small, it is imperative and has a compelling impact on the performance and profitability. It is a known fact that due to the extreme competitive pressures in the banking market, banks generally operate on fragile margins of around 2% in most banking needs across the world. At the best of times, generating a net interest margin of even 3% is very difficult for a bank. A typical GCC bank pays 2% on deposits on an average and lends at 4.5%, resulting in a standard 2.5% interest margin. Any decline in this margin can push the bank into a severe financial crisis because it has to take care of the administrative and staff costs and losses due to non-performing loans with the wafer-thin interest margin. The biggest bank in each country manages to defend its margins because of its competitive strength

Table 3

t-Test: Paired Two Sample for Means Return on Equity

	ROE 2020	ROE 2019
Mean	0.110029806	0.139125785
Variance	0.001651484	0.001555874
t Stat	–4.245707488	
P(T < = t) one-tail	0.004062548	
t Critical one-tail	2.015048373	
P(T < = t) two-tail	0.008125096	
t Critical two-tail	2.570581836	

Source: compiled by the author.

Table 4

t-Test: Paired Two Sample for Means Return on Assets

	ROA2020	ROA2019
Mean	0.013305223	0.017718321
Variance	2.29177E-05	2.16298E-05
t Stat	–5.602181893	
P(T < = t) one-tail	0.001251952	
t Critical one-tail	2.015048373	
P(T < = t) two-tail	0.002503905	
t Critical two-tail	2.570581836	

Source: compiled by the author.

and market share. The results in *Table 5* indicate that even top banks suffered due to COVID 19 despite their muscle power.

T-test results for the liquidity ratio (LCST) are reported in *Table 6*. LCST is the ratio of liquid assets to customer deposits and short-term funds. Cash and cash equivalents, including short-term money market funds from banks, are added to arrive at liquid assets. Liquidity is a key performance indicator and has acquired added significance due to BASEL III recommendations. A bank may be able to survive continuous losses over several years because of its capital strength but can become bankrupt very quickly due to a lack of liquidity. This is probably one reason why the BASEL committee is emphasizing liquidity coverage. Liquidity is significant, especially during periods of economic slowdown or a financial crisis. The average liquidity of top Gulf banks increased from 11.3% to 11.8% from 2019 to 2020. Still, the change is not statistically significant as the t-value at 0.368 is lower than the critical value, and the associated two-tail p is more than 0.05. We conclude that the liquidity levels of top banks remained steady during the COVID-19 pandemic. From a managerial perspective, one may say that these banks did an excellent job in managing liquidity in a crisis period, which of course, would not have been possible without the support of the respective central banks.

Table 7 reported below shows the paired sample means t-test for the cost to income ratio. T-value at 0.11 is not statistically significant, indicating no noteworthy change in the cost to income ratios of the top GCC banks during the period 2019 to 2020. The average cost to income ratios remained more or less the same at 34%. One has to view this result in light of the decline

Table 5

t-Test: Paired Two Sample for Means Net Interest Margin

	NIM2020	NIM2019
Mean	0.022791777	0.025392081
Variance	5.78594E-05	8.43417E-05
t Stat	–2.67225209	
P(T < = t) one-tail	0.022114452	
t Critical one-tail	2.015048373	
P(T < = t) two-tail	0.044228904	
t Critical two-tail	2.570581836	

Source: compiled by the author.

Table 6

t-Test: Paired Two Sample for Means Liquid Assets to Deposits and Short Term Funds

	LCST 2020	LCST2019
Mean	0.118116013	0.113660448
Variance	0.011529106	0.009575299
t Stat	0.368317199	
P(T < = t) one-tail	0.3638581	
t Critical one-tail	2.015048373	
P(T < = t) two-tail	0.727716199	
t Critical two-tail	2.570581836	

Source: compiled by the author.

in banks' net interest income during this challenging period. When net interest income declines, the cost to income ratio will increase if the operating expenses remain unchanged. The fact that the ratio remained at 34% implies that banks reduced costs to offset the decline in net interest income during this period. Top GCC banks managed cost ratios quite well despite the economic slowdown due to the COVID-19 pandemic.

T-test results for loan loss provisions to net loans ratio are reported in *Table 8* given above. The t-stat for the two-tailed test for paired means at 3.02 is statistically significant at the 5% level, implying that the change in loss provisions ratio for 2019 to 2020 is noteworthy.

There is a considerable jump in the average loan loss provisions of the top GCC banks from 2019 to 2020. The mean value of the loss provision ratio almost doubled from 0.5% to 0.9%. In a typical year, a bank may offset the higher loan provision expenses by increasing interest margins to minimize impact profitability. In any given year, top banks improve margins by changing their portfolio mix or using innovative marketing strategies such as zero-interest lottery deposits, etc.

Lower net interest margins combined with higher loan loss provisions are a potent combination that can be debilitating for a bank. Lower interest margins indicate that the bank cannot convert its inputs that are deposited into output that is lending at profitable levels. When a country's economy is suffering due to a slowdown in business activity due to COVID-19, it is difficult for a bank to find core borrowers willing to pay a reasonable rate on loans. Naturally, banks try to continue lending by lowering loan rates or lending to marginal customers whom a top bank would generally avoid. In the process, a bank will experience lower interest

Table 7

t-Test: Paired Two Sample for Means Cost to Income Ratio

	CostInc2020	CostInc2019
Mean	–0.3462623	–0.345284976
Variance	0.002167449	0.002139527
t Stat	–0.114646241	
P(T < = t) one-tail	0.456593565	
t Critical one-tail	2.015048373	
P(T < = t) two-tail	0.913187129	
t Critical two-tail	2.570581836	

Source: compiled by the author.

Table 8

t-Test: Paired Two Sample for Means Loan Loss Provisions to Net Loans

	LLP 2020	LLP 2019
Mean	0.009289594	0.005359497
Variance	8.75791E-06	3.91181E-06
t Stat	3.020292794	
P(T<=t) one-tail	0.014703245	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.029406489	
t Critical two-tail	2.570581836	

Source: compiled by the author.

margins and higher asset risk both simultaneously. A decline in asset quality has a multi-year impact, and it would not be surprising if these banks report more and more loan losses in the coming years as well.

Table 9 shows the GDP annual growth rate in the six GCC countries in the years 2019 and 2020. The data clearly shows that there has been a sharp drop in economic activity during the year 2020 due to COVID-19 combined with low oil prices. Unemployment data in the six GCC countries also indicates that GCC economies suffered a lot due to the COVID 19 pandemic. We conclude that the slowdown in economic activity has led to a decline in the performance of big GCC banks during the COVID-19 pandemic.

CONCLUSION

This paper investigates the impact of COVID-19 on the performance of top Gulf Cooperation Council banks. The

Table 9

GDP Annual Growth Rate

	2019	2020
Bahrain	–1.14	–4.09
UAE	3.4	–6.1
Oman	–0.8	–6.3
Kuwait	–1.1	–11.2
Qatar	–0.6	–3.9
Saudi Arabia	–0.3	–3.9

Source: URL: https://tradingeconomics.com/country-list/gdp-annual-growth-rate?continent=asia (accessed on 21.10.2021).

effects of COVID-19 on the economies in the Gulf region can be termed a double whammy because it resulted in a slowdown in business activity and a decline in oil prices. Oil price is a critical factor in the well-being of the GCC economies because a significant part of the gross domestic product of these countries can be attributed to the oil and gas sector. The biggest bank in each of the six GCC countries was picked up for analysis. Balance sheet and income statement data for 2017 to 2020 were used to analyze trends in key performance ratios. The ratios selected are returned on equity, return on assets, net interest margin, liquid assets to customer deposits and short-term funds, loan loss provisions to net loans, and cost to income ratio. The ratios cover key performance areas such as profitability, efficiency, liquidity, asset quality, asset risk, and expense management.

Trends in the key ratios over the period 2017 to 2020 indicate that the performance of banks suffered on almost all the key parameters in 2020 compared to the earlier period. Results of dependent t-test for paired sample means revealed that compared to 2019 in 2020, there was a statistically significant decline in return on equity, return on asset, and net interest margins. The profitability and efficiency of big GCC banks suffered due to COVID-19 and low oil prices. Cost to income ratios and liquidity ratios did not change significantly during this period indicating that banks could control costs and maintain a steady level of liquidity despite the economic crisis resulting from the COVID-19 pandemic. The ratio of loan loss provisions to net loans increased sharply and is statistically significant, indicating a decline in asset quality and an increase in asset risk during 2020. The decline in interest margins combined with declining asset quality is a dangerous and potent combination that may unfavorably impact the solvency of the big banks in the coming years.

The focus of this study and its conclusions are novel to the extent that there are no country specific studies related to impact of COVID-19 on the biggest banks in a country. Further as far as the authors are knowing there are no studies on the topic of impact of COVID-19 on big banks operating in the Gulf cooperation council countries. Another important contribution of this study is that COVID-19 has negatively impacted the top banks in each of the Gulf Cooperation Council countries. From the central bank and monetary regulators point of view this is a very important finding. Big banks in any country are too important to be allowed to fail. Failure of big banks can have a domino effect and can bring down not only the whole banking and financial system, but also the economy itself, as has been seen during previous financial crises such as the global financial crisis of 2008. There is need for further research on the impact of COVID-19 on the banking system in the GCC, as the financial performance of the countries' largest bank does not characterize the general condition of the banking system, given the "too big to fail" hypothesis.

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Effect of Foreign Banking Capital on the Financial Innovativeness of the Country: Evidence from Former Soviet Union and Young EU Members Countries

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ABSTRACT

The **main hypothesis** of the paper was the assumption that the increase in the level of innovation of the financial sector in the post-Soviet states and young European Union (EU) members with an imperfect banking sector and a protracted financial crisis is accompanied by difficulties accessing financing sources and significantly depends on the volume foreign banking capital. The **aim** of the study is to identify the correlation between the growth of financial innovativeness of the country and the level of foreign banking capital, using Panel data analysis from 2009 to 2019. Unlike previous studies, it was taken into account that the level of financial innovation of the republics of the former Soviet Union is increasingly dependent on external credit resources, while the innovative development of the EU countries becomes financially independent, and this constitutes the **scientific novelty** of the research. The **results** confirm the relationship between foreign banking capital and the growth of financial innovativeness of the country, especially with its low and medium levels. To test his hypothesis, the author presented empirical **models** with the conditions of interaction with the Financial Innovativeness Index. Based on a comparison of indicators of the financial innovation of the country and foreign banking capital, clusters of countries are distinguished according to the nature and direction of the relationship of the analyzed indicators. The author **concludes** that the increase in the level of innovation in the financial sector of the countries of the former Soviet Union and young EU members depends on the amount of foreign banking capital and the need to consistently expand the tools for the country's economic growth by attracting it.

Keywords: financial sector; foreign banking capital; financial innovations; financial innovativeness; financial services market; innovative development; investments; competitiveness; national economy; post-Soviet states; young EU members; Indexed parameters; Vector AutoRegression (VAR) model

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INTRODUCTION

The innovation of the financial sector has a positive impact on the business environment efficiency, contributes to the country's economic growth, its economic and financial development stability. Today, the innovations in the country's financial system plays a multifaceted role, manifested both in economic (diversification of financial services, efficient allocation of resources, acceleration of the production cycle, the reduction of financing and transaction costs) and social (facilitating access to financial services, financial information) points of view.

Recently, theoretical and practical issues pertinent to financial innovativeness get immense attention among researchers, state regulators, financial intermediaries, central banks, and financial institutions by admitting its critical role in fostering the financial sector. Innovations in the financial sector, according to the World Bank and IMF, are one of the key aspects of doing the financial system more efficient and competitive.

At the same time, the previous studies focus mainly on a more general analysis of the countries' innovativeness indicators in the context of their financial development, defining the main determinants of its achievement. Scientists proved the significant dependence of the financial innovation level of the country on indicators of economic development, political, demographic situation in the country [1–3]. These constituents are those which have a positive impact on the financial innovativeness of the developing countries since it is often the basic source of funding for innovation development and, therefore, has a stimulating effect on economic growth.

Despite the fact that the problem of increasing the level of financial innovativeness is investigated by researchers, existing studies have largely failed to offer a unified theoretical basis for determining the main mechanisms for innovative activity growth in the country's financial sector. One of the tools to achieve these goals is to attract foreign capital. Unfortunately, these aspects of innovative development of the financial sector in the economy are poorly studied and have not been actively reflected in the scientists' works.

Our research aims to address these unresolved issues in two ways. Based on the analysis of 12 international indexes characterizing the level of the country's economic development and its digital technology development, we define the financial innovativeness level of the country; using Panel data analysis, we will evaluate the correlation between the level of the country's financial innovativeness and the foreign banking capital level.

Previous studies combine both EU and non-EU countries. In the present paper, we focus on former republics of the USSR[1] and young EU members.[2] This article aims to investigate the relationship between the foreign banking capital and financial innovativeness based on the hypothesis that an increase in the innovativeness level of the financial sector of the former Soviet Union countries and young EU members with an imperfect banking sector and a protracted financial crisis is accompanied by difficulties accessing funding sources, and significantly depends on the volume of foreign banking capital; to develop and approve an approach to assessing the level of financial innovativeness of the country.

THEORETICAL BACKGROUND

Financial innovativeness and economic development

Innovative development is an important component in the functioning of any economy, increasing its competitiveness, ensuring sustainable economic growth. In the constant transformations of forms and types of economic activity, mutual relations with contractors, innovations are the driving force to form steady competitive advantages of the economic subject. The innovation is also a way of ensuring the competitiveness and efficiency for financial sector players. According to J. Schumpeter [4], innovation is crucial for the country's growth, is a stimulus to its economic development.

Today, there are many scientific papers exploring the role of financial innovation in the country's economic development [1, 2, 5–9], increasing business competitiveness [3, 10, 11], the formation of demand in the money market [12, 13], the functioning and digitalization of the financial market [14–25], banking sector [26–37] and international banking [38–42], etc. Valuable information on these

[1] Russian Federation, Ukraine, Belarus, Moldova, Kazakhstan, Uzbekistan, Tajikistan, Turkmenistan, Kyrgyzstan, Azerbaijan, Georgia, Armenia, Lithuania, Latvia, Estonia.

[2] Since 2004 — Croatia, Bulgaria, Romania, Slovenia, Czech Republic, Slovakia, Poland, Malta, Hungary, Cyprus.

issues is also contained in the reports of the OECD[3] and Pricewaterhouse Coopers.[4]

According to the results of the study, it is possible to conclude that the financial innovation diffusion in the economic sphere has several manifestations. According to M. Miller [43], financial innovations form a critical and persistent ingredient for economic progress. Author claims that the financial markets that actively implement financial innovation can produce financial instruments aimed at managing assets by transferring and minimizing financial risks.

The active introduction of innovations in the financial services market leads to changes in the technology of conducting financial transactions, a significant increase in the share of non-cash payments, and the online banking and mobile banking development [44, 45]. The financial innovation development contributes to the diversification of financial services, replacing traditional financial intermediaries and providers of individual financial services to the consumer's needs [46].

According to the results of empirical research [47–49], concluded that higher innovation activity is typical of countries with higher levels of economic development.

At the same time, B. Ślusarczyk, A. Haque [50] emphasized a more comprehensive study of the financial innovation role in the country's development. In their opinion, it is important to consider the interdependence of financial sector innovation with certain components of their business environment, including the social, demographic, political, ecological and other dimensions. L. Kozubikova, A. Kotaskova [51] argued about the multi-channel diffusion of financial innovations in certain areas of the country's development, emphasizing their significant impact on the efficiency of public administration and the development of social spheres in the country.

Based on empirical calculations, V. Bhatt [52] confirmed a direct link between financial innovation and the development of the financial sector in the economy. In particular, the authors proved their role in accelerating the development of the country's financial sector, diversifying investments, and minimizing risks, by accumulating capital in the financial system, encouraging people to save etc.

In general, according to the analysis of the financial innovation relationship with the country's development indicators, we can identify 4 vectors of their impact. First, financial innovation increases the quality of financial services [53], the speed of their provision, accessibility for all segments of the population (internet banking and mobile banking services). Second, financial innovation is the tool for improving the institutional environment in a country [54]. Third, financial innovations contribute to the development of the corporate sector of the economy (trade efficiency and efficiency in financial institutions of dealing with a customer capital accumulation, financial reporting, customer interaction techniques) [55].

At the same time, today it is difficult to understand the nature of the relationship between financial innovation and the country's development indicators. According to the first hypothesis, financial innovation promotes economic growth by allowing financing expansion [56; 57]. Second hypothesis, financial innovations are not imperative to ensure economic progression [58]. Some authors deny the usefulness of most financial innovation because it leads to financial malpractice and instability [59–62]. The authors believe that not all financial innovation will be welfare-enhancing or successful. In this context, M. Kapidani, E. Luci [63] prove that financial innovation relates to more volatile economic growth and with greater bank fragility. Third, the feedback hypothesis states a two-way relationship between indicators [64]. A. Bara, C. Mudzingiri, using data from the banking, sectoral and national levels for 32 countries, mostly high-income, for the period 1996–2006, assessed the relationship between financial innovation in the banking sector and real sector growth and bank fragility. The authors argue that higher levels of financial innovation are due to the country's growth potential, capital growth and GDP per capita, as well as higher growth rates in industries that rely more on external financing and are more dependent on innovation. On the other

[3] OECD. Financial Markets, Insurance and Private Pensions: Digitalisation and Finance. 2018. 108 p. URL: http://www.oecd.org/finance/Financial-markets-insurance-pensions-digitalisation-and-finance.pdf (accessed on 29.03.2022).

[4] Pricewatherhouse Coopers. Implications of Fintech Developments for Banks and Bank Supervisors. Redrawing the Lines: FinTech's Growing Influence on Financial Services. Global FinTech Report 2017; 2017. 18 p. URL: (accessed on 24.02.2022).

hand, financial innovations relate to higher volatility of growth rates of industries dependent on external financing and innovation, and with higher fragility of banks, higher instability of bank profits and higher losses of banks during the crisis.

S. Lyeonov et al. [65], based on OLS and GMM estimators,[5] conclude a positive and significant relationship between global growth opportunities of a country and a higher level of financial innovation and GDP growth. Their calculations are based on expenditure data for the financial intermediation industry as a Financial Innovation proxy for bank, industry, and country-level data in 32 countries.

Buriak A. et al. [66], based on an investigation of the financial innovation impact on savings and domestic savings for twenty countries during 2005–2014, conclude that level of financial innovation and financial access are important parameters affecting both indicators.

Measurement of financial innovativeness of the country

M. Qamruzzaman, W. Jianguo [2] developed a financial innovation index as an integrated indicator that combines three indicators: the ratio of aggregate money supply to narrow money, the ratio of broad to narrow money, the percentage change in domestic credit to the private sector.

H. Shaughnessy [54] proposes to assess the level of innovation in the financial sector using the Elastic Innovation Index, as an indicator that measures innovation inputs (or capabilities), as opposed to innovation outputs (new products or new services). This index measures capability and readiness to change rather than measuring what has been achieved in the business execution process.

S. Lyeonov et al. [65] propose to use the Technological Financial Services Index as an integral indicator of the level of financial service technologization. It includes the financial component (share of population with an account in a financial institution or mobile money provider) and the technological component (share of the population using the Internet at least once a week; the share of population who use internet banking; the share of population conducting other financial transactions via the Internet; the share of population who use electronic payments; the share of population who use mobile phones to pay bills; the share of traditional loans substitution by alternative on-line financing).

The role of foreign banking capital in financial innovativeness of the country

Most scientific papers observe foreign capital as a major blessing to an economy. Foreign capital affects the national economy by attracting the necessary amount of financial resources for the introduction of new technologies, management skills.

Thus, S. Andros et al. [26] examines the relationship between the amount of borrowed capital and the innovation activity on the example of developed and emerging countries. The empirical calculations showed that larger amounts of borrowed capital coincide with stronger innovation activity. According to the study, the authors concluded that foreign banking capital is an important component of financial innovation and may therefore favorably determine national innovative capacity.

Schumpeter J. [4] emphasized the important role of bank capital in promoting innovation. The author highlighted the role of banks in promoting innovation and, accordingly, the development of the financial sector. The active attraction of foreign banking capital was associated not only with the fact that it is accompanied by attracting new investment and contributes to increasing national income and employment but also with the formation of additional benefits for the national economy, increasing exports.

Based on a panel model for 54 developing countries for the period 1980–2009, R. Crescenzi et al. [69] proved the existence of non-linear effects in the relationship between foreign investment and innovation. The paper identifies the threshold value of innovative development, below which the attraction of foreign capital has a negative impact on innovation.

S. Sandu, B. Ciocanel [68] studied the relationship between foreign capital and the country's innovative development. Based on the calculations, the authors concluded that foreign capital increases the innovative potential of businesses. At the same time, the authors emphasized the short-term effect of financing innovations with foreign capital because they are targeting immediate profit.

R. Crescenzi et al. [69] stress on positive impacts of foreign capital on the innovative performance of domes-

[5] OLS — Ordinary Least Squares, GMM — Generalized Method of Moments.

tic firms. He points out that investments generate positive spillovers through virtuous cycles of cooperation and competition. In developed countries, domestic firms with greater foreign investment have stronger innovative performance than in less developed countries [70].

The nexus between financial innovation and foreign banking capital is yet to be unleashed through empirical investigation. Empirical literature produced evidence proving the correlation between financial innovation and banking capital variables, such as banking credits, assets, profit. Therefore, with the available nexus between financial innovation and banking capital, it can be presumed that there is a relationship between foreign banking capital and financial innovations in the financial system.

MATERIALS AND METHODS

Our proposed integral Index of Financial Innovativeness is based on a linear model of calculating the service innovation in the financial sector of the economy using the weighted sum method [65]. Twelve indicators characterizing the level of national economic development and the development of its innovative technologies (Financial Development Index, Digital Economy and Society Index, Global Innovation Index, Index of Economic Freedom, Ease of Doing Business and so on), weighted by the appropriate weighting factor, are included in the index calculation [2, 22]. The international indexes, which are calculated by international experts and organizations, will be used as sub-indices that characterize the level of innovation in the financial sector. The annual values of the above indicators were used for calculations. The characteristics of the indicators selected for analysis are presented in *Table 1*.

The evaluation of the integrated Index of Financial Innovativeness will be carried out according to the following formula:

$$FII = w_{SDI} \cdot SDI + w_{HDI} \cdot HDI + w_{GCI} \cdot GCI + w_{IEF} \cdot \\ \cdot IEF + w_{GI} \cdot GI + w_{EPI} \cdot EPI + w_{DB} \cdot DB + w_{DI} \cdot DI + \\ + w_{DRS} \cdot DRS + w_{DESI} \cdot DESI + w_{FDI} \cdot FDI + w_{GII} \cdot GII, \quad (1)$$

where w_i — a weighting coefficient of indicator *i*.

Sources of information for generating input data to calculate the foreign banking capital are the official World Bank Database. Foreign banking assets among total bank assets (%) were used as an indicator of the foreign banking capital. Malta, Romania, Tajikistan, and Turkmenistan were excluded from the sample since there is no information on foreign banking assets for these countries. The data of international organizations defined in *Table 1* are used to calculate the Financial Innovativeness Index.

Determining the rank of sub-indices used as components of the Financial Innovativeness Index will be done using the Fishburn formula (*formula 2*). The priority of indices will be determined using the expert assessments [65].

$$w_i = \frac{2 \cdot (n - i + 1)}{n \cdot (n + 1)}, \quad (2)$$

where *n* is the total number of sub-indices to assess the Financial Innovativeness Index;

i — the rank of the sub-index to assess the Financial Innovativeness Index.

The use of the expert assessment method is due to the lack of complete information on the importance of the impact of each of the analyzed indicators on the level of development of the country and its ability to eliminate these shortcomings.

Based on this formula, the priority and weights for all 12 sub-indices were determined, the values of which are given in *Table 2*.

The obtained values of Financial Innovativeness Indexes will form the basis to test the hypothesis of the foreign banking capital impact on the level of innovation of the financial sector in the economy. The hypothesis will be tested using the VAR / VEC model, describing the relationship between the indicators. The choice of model depends on the characteristics of the indicators (stationary, cointegrated):

1) Vector error correction model will be used for non-stationary spatial panel data which are cointegrated (VEC model):

$$\Delta y_t = a_0 + A y_{t-1} + \sum_{m=1}^{p} A_m \Delta y_{t-m} + \sum_{n=0}^{q} B_n \Delta x_{t-n} + \varepsilon_t, \quad (3)$$

where $\Delta y_t = y_t - y_{t-1}$ is the differencing operator, A is the coefficient matrix for the first lag and are A_m, B_n the matrices for each differenced lag.

2) The VAR model will be used for stationary indicators:

$$y_t = a_0 + \sum_{m=1}^{p} A_m y_{t-m} + \sum_{n=0}^{q} B_n x_{t-n} + \varepsilon_t, \quad (4)$$

where a_0 is the vector-valued mean of the series A_m, are the coefficient matrices for each lag and ε_t is a multivariate Gaussian noise term with mean zero.

Table 1

Indexed parameters of innovation in the financial sector of the economy

Index	Methodology	Source / developers
Social Progress Index (SPI)	It includes 12 indicators organized into three categories: – Basic human needs (nutrition and basic medical care, water and sanitation, shelter, personal safety); – Foundations of wellbeing (access to basic knowledge, access to information and communications, health and wellness, environmental quality); – Opportunity (personal rights, personal freedom and choice, tolerance and inclusion, access to advanced education)	Social Progress Imperative
Human Development Index (HDI)	It is a summarized measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living	United Nations Development Program
Global Competitiveness Index (GCI)	It includes 103 indicators organized into 12 pillars: Institutions, Infrastructure, ICT adoption, Macroeconomic stability, Health, Skills, Product market, Labor market, Financial system, Market size, Business dynamism, Innovation capability	World Economic Forum
Index of Economic Freedom (IEF)	The Index is based on 12 quantitative and qualitative factors, grouped into four broad categories, or pillars, of economic freedom: Rule of Law (property rights, government integrity, judicial effectiveness); Government Size (government spending, tax burden, fiscal health); Regulatory Efficiency (business freedom, labor freedom, monetary freedom); Open Markets (trade freedom, investment freedom, financial freedom)	The Wall Street Journal and the Heritage Foundation
Gini Index (GI)	It is a measure of statistical dispersion intended to represent the income inequality or wealth inequality within a nation or any other group of people	Eurostat
Environmental Performance Index (EPI)	It includes 20 indicators in 9 categories: health impacts; air quality; water and sanitation; water resources; agriculture; forests; fisheries; biodiversity and habitat; climate and energy	Yale Center for Environmental Law and Policy; Center for International Earth Science Information Network; World Economic Forum
Doing business (DB)	It covers 10 areas of business regulation: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts and resolving insolvency	World Bank Group
Democracy Index (DI)	It includes 60 indicators within the five categories: electoral process and pluralism; civil liberties; the functioning of government; political participation and political culture	Economist Intelligence Unit
Digital Readiness Score (DRS)	It includes seven components: basic needs, human capital, ease of doing business, business and government investment, start-up environment, technology infrastructure, technology adoption	Cisco Corporate Affairs
Digital Economy and Society Index (DESI)	DESI is a composite index that summarizes relevant indicators on digital performance and tracks the evolution of countries in digital competitiveness. Includes 6 index groups: Connectivity, Human Capital/Digital Skills, Use of Internet, Integration of Digital Technology, Digital Public Services, Research and Development ICT	European Commission
Financial Development Index (FDI)	FDI is aggregate of the Financial Institutions index (Financial Institutions Depth index, Financial Institutions Access index, Financial Institutions Efficiency index) and the Financial Markets index (Financial Markets Depth index, Financial Markets Access index, Financial Markets Efficiency index)	International Monetary Fund
Global Innovation Index (GII)	The Global Innovation Index is based on 80 indicators within these categories: political environment, education, infrastructure, and business sophistication	Cornell University, INSEAD, the World Intellectual Property Organization

Source: generalized by the author.

3) VAR model will be used in a difference for nonstationary spatial panel data which are not cointegrated.

RESULTS

The initial step in analyzing the relationship between indicators is to study their stability. For this purpose, we will calculate the standard deviation, coefficient of variation, maximum, and minimum values, Financial Innovativeness Index depending on the level of foreign banking capital of the country.

The data presented in *Table 3* show significant variability in the volume of foreign banking assets in the analyzed countries. For most countries (Azerbaijan, Croatia, Cyprus, the Czech Republic, Georgia, Lithuania, Slovenia, Uzbekistan), the share of foreign banking capital for the period 2009–2019 has hardly changed. However, if for Croatia, Lithuania and other countries with high indicator it is an index of confidence from foreign investors and the banking system stability, for countries with low values (Uzbekistan, Azerbaijan, etc.) this situation may indicate the absence of positive changes in the banking service market and the need to implement measures aimed at increasing confidence from foreign partners. In most former Soviet Union countries, the share of the foreign banking assets among total bank assets is low and on average does not exceed 10%.

One of the tools to increase the country's investment attractiveness is to increase the level of financial inclusion and transparency of financial transactions, facilitating access to financial services, which can be achieved by increasing the level of innovation in the financial sector.

The interdependence between the level of financial sector technologicalization and the amount of foreign banking capital shown in *Fig. 1* demonstrates the existence of a straightforward relationship between them. With the increase in the share of foreign banking capital, the level of innovation is also increasing in the country's financial sector.

We will analyze the relationship between certain indicators in terms of groups of countries depending on the Financial Innovativenes Index (0–20; 20–40; 40–60; 60–80; 80–100%) using economic mathematical tools to verify the validity of the established dependencies.

At the first stage, we analyze the stability of the Financial Innovativeness Index of the country using the statistical analysis. The results in *Table 4* indicate a significant deviation of the indicators over the years. The standard deviation of the analyzed countries is characterized by a significant scale. If for countries with a foreign banking capital 20–40% the variation scope of the Financial Innovativeness Index is 0.5033, for other countries its value is more than 7. The greatest variability has indicators for countries with a foreign banking capital of more than 60%. For most of these countries, there has been a significant increase in the Financial Innovativeness Index over the past 11 years. One of the reasons for this situation may be the availability of better financial opportunities to finance innovative development, including through access to foreign banking capital.

Table 2

Weighting coefficients to assess the Index of Financial Innovativeness

Sub-index	The rank of the sub-index, *i*	Weighting coefficient, w_i
SPI	3	0.128205
HDI	4	0.115385
GCI	5.5	0.096154
IEF	5.5	0.096154
GI	2	0.141026
EPI	1	0.153846
DB	7	0.076923
DI	8	0.064103
DRS	10.5	0.032051
DESI	10.5	0.032051
FDI	9	0.051282
GII	12	0.012821

Source: compiled by the author.

The correlation analysis carried out using the Multiple regressions method indicate the influence of the foreign banking capital on the Financial Innovativeness Index in terms of all groups of countries. Most results are statistically significant at 0.1% and 0.05%. The results of the calculations are shown in *Table 5*.

The multiple regression method is given by:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + u_i, i = 1, \cdots, n. \quad (5)$$

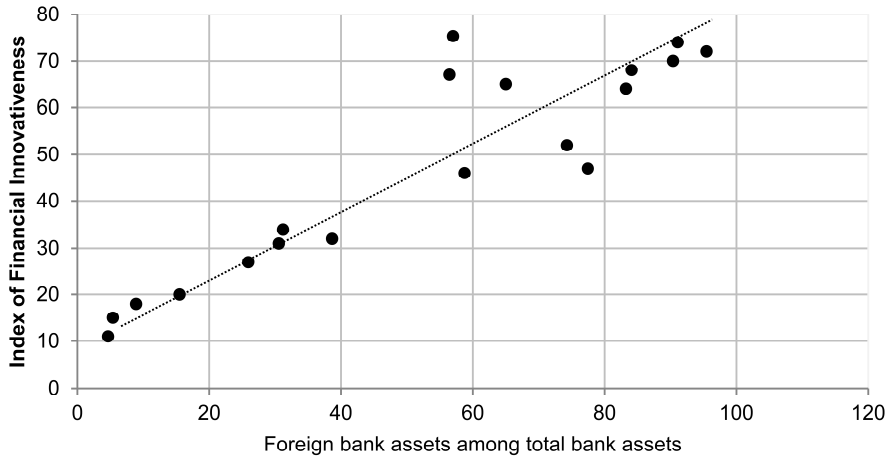

Fig. 1. **Correlation zone of foreign banking capital and the Financial Innovation Index**

Source: compiled by the author.

Table 3

Foreign banking assets among total bank assets (%) from 2009 to 2019**

Country	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Armenia	71	84	84	83	85	86	88	88	86	86	84
Azerbaijan	5	5	4	4	4	4	4	5	5	6	5
Belarus	24	27	31	33	31	31	32	32	31	33	31
Bulgaria	82	79	73	70	62	60	60	57	57	56	55
Croatia	90	90	90	90	90	90	90	91	91	91	91
Cyprus	19	12	*	*	*	16	15	15	15	16	16
Czech Republic	83	83	82	81	85	83	83	82	87	*	*
Estonia	99	99	97	97	97	95	95	93	93	93	92
Georgia	67	65	62	64	64	66	66	65	65	65	66
Hungary	64	63	63	59	56	53	53	52	52	53	53
Kazakhstan	18	16	18	17	13	12	13	13	11	11	12
Kyrgyzstan Latvia	* 68	* 66	71 60	76 60	79 58	* 57	* 57	* 55	* 56	* 56	* 53
Lithuania	92	90	89	94	91	90	89	92	92	93	90
Moldova	41	41	46	39	27	24	24	26	26	25	24
Poland	73	73	72	76	76	77	73	*	*	*	*
Russian Federation	12	10	10	10	8	8	7	8	8	9	8
SlovakRepublic	86	86	87	78	75	75	73	73	74	73	72
Slovenia	25	24	24	26	25	25	27	27	27	29	26
Ukraine	57	54	55	36	28	31	36	34	32	31	31
Uzbekistan	5	5	6	6	5	6	6	5	5	5	5

* no data. **banks where more than 50 percent of shares are owned by foreigners.

Source: based on the World Bank (for 2009–2013), Bank Focus database (for the countries of the former Soviet Union), the official website of Statista (for the Czech Republic and Poland for 2014–2019); the official website of Deutsche Beratergruppe Ukraine (for Ukraine for the period of 2014–2019); European Investment Bank (for Belarus after 2013) data; calculated by the author based on European Banking Federation; Trading Economics (for other countries) data and official statistics of relevant countries' central banks.

Table 4

Descriptive statistics of Index of Financial Innovativeness for the period from 2009 to 2019

Group	Mean	Std. Dev.	Max	Min
Countries with the level of foreign banking capital 0–20%	11.84444	7.572666	18	4
Countries with the level of foreign banking capital 20–40%	21.46667	.5033223	57	24
Countries with the level of foreign banking capital 40–60%	29.5	7.778175	74	53
Countries with the level of foreign banking capital 60–80%	27.96	9.612648	86	62
Countries with the level of foreign banking capital 80–100%	33.2	9.613532	91	71

Source: compiled by the author.

Table 5

Multiple regressions (OLS) for foreign banking capital and the Financial Innovativeness Index in the post-Soviet states and young EU countries

Group	OLS	cons
Countries with the level of foreign banking capital 0–20%	1.49403**	1.33247**
	(0.28549)	(0.11563)
Countries with the level of foreign banking capital 20–40%	2.78212*	2.6477***
	(0.63758)	(0.1435)
Countries with the level of foreign banking capital 40–60%	2.82884**	2.31124*
	(0.67351)	(0.19626)
Countries with the level of foreign banking capital 60–80%	4.09876**	3.29025**
	(4.38755)	(0.83115)
Countries with the level of foreign banking capital 80–100%	1.42545**	1.3125**
	(0.2758)	(0.10256)
*p<.05 ** p<.01 ***p<.001. Standard errors within parentheses		

Source: compiled by the author.

According to the obtained results, the greatest influence on the Financial Innovativeness Index is made in the countries with the level of the foreign banking capital from 60 to 80%. Countries with the level of foreign banking capital in the range of 0–20 and 80–100% have the lowest correlation coefficient.

The group of countries with high Financial Innovativeness Index includes economically developed countries — young EU members, which have a high potential for self-financing of innovation and investment development measures. The insignificant values of the regression coefficient for the former can be explained by the low share of foreign banking capital in the country, the volume of which during the analyzed period was almost at the same level, and hence its insignificant impact on the result.

We check the all-time series for stationarity using the Dickey-Fuller test (ADF test) to build a model of the Financial Innovativeness Index dependence on the foreign banking capital (*Table 6*).

We use Augmented Dicky-Fuller test (1981) to testify variables stationery and integration order. It is conducted by the consideration of n_{th} order difference of the seven variables.

$$x_t = D_t\gamma_1 + \gamma_2 x_{t-1} + \sum_{i=1}^{n}\pi_i \Delta x_{t-1} + \varepsilon_t, \qquad (6)$$

where D_t is a vector of deterministic term (constant, trend etc.), n for lagged difference term, Δx_{t-i} term for

Table 6

The testing results of the data group for stationarity by the Dickey-Fuller and Philips-Perron tests

Groups	ADF Test Statistics			Philips Perron Test Statistics		
	Prob.	lag	Test statistic	Prob.	lag	Test statistic
Countries with the level of foreign banking capital 0–20%	0.9785	1	0.1163**	0.9785	1	0.1163**
Countries with the level of foreign banking capital 20–40%	0.0750	1	–3.7338**	0.7222	1	–3.1178*
Countries with the level of foreign banking capital 40–60%	0.0105	0	–3.4587**	0.0105	0	–3.4587**
Countries with the level of foreign banking capital 60–80%	0.0001	0	–4.6919***	0.0001	1	–4.6919***
Countries with the level of foreign banking capital 80–100%	0.4268	2	–3.7405**	0.5007	1	–3.5977**
*p < .05 ** p < .01 ***p < .001						

Source: compiled by the author.

ARMA structure of the error and ε_t is for white nose (error term).

According to the results, most indicators are non-stationary. The absolute calculated value is less than the critical value at 1%, 5%, and 10% significance levels. Thus, the ADF test statistic for countries with the foreign banking capital less than 20% is 0.1163, is less than the critical value (–2.66) and indicates the non-stationarity of the analyzed data. For other countries, the obtained values are more than critical. The results of the Philips-Perron Test Statistics allow us to reject the unit root null hypothesis for stationary of all indicators within all groups of countries at the 10% level of significance.

For most indicators, p-value[6] does not allow to reject the null hypothesis about a single root in the time series. The first difference of the series (*Table 7*) is fixed for all groups of countries, allowing to conclude about first-order integration (I (1)).

The absolute value of t-statistics in the first differences exceeds the critical values for the significance level of 1%, 5%, and 10% and the p-value for all indicators is less than 10%. It allows us to reject the null hypothesis about the nonstationarity of the first differences in the data series with a minimum error probability (almost 0% of cases with 100%). Thus, the series in the first difference is stationary and has the order of integration — 1.

At the next stage of forming a relationship model between the Financial Innovativeness Index and the volume of foreign banking capital we will test the hypothesis of the indicator cointegration from rank 0 to rank k — 1 by Johansen tests (the alternative hypothesis is the cointegration of the data). If the hypothesis is not rejected for rank 0, then the rank is considered to be null (no co-integration) and so on to k — 1. If the trace statistic is more than 5% critical value it allows us to accept the alternative hypothesis of data co-integration.

According to the results shown in *Table 8*, for all countries the values obtained for 0 rank are critical values. It enables to accept the hypothesis of analyzed data series co-integration. For example, for countries with the foreign banking capital level from 0 to 20%, the trace statistic is 31.253 and exceeds 5% (15.41) and 1% critical value (20.04), for 20–40%, it is 27.841, for 40–60% — 17,841. At the same time, rank 1 is lower than the 5% critical value for countries with the foreign banking capital level more than 40%.

Confirmation of the hypothesis about the stationary and the data cointegration indicate the expediency of formalizing the relationship between the Financial Innovativeness Index and the volume of foreign banking capital by the VAR model.

For the construction of the VAR model, we will determine the time lag through which this effect is max-

[6] p-value — a value used in testing statistical hypotheses. In fact, this is the probability of error when rejecting the null hypothesis (error of the first kind).

Table 7

The first differences of the data series for stationarity by the Dickey-Fuller test

Groups	ADF Test Statistics		
	Prob.	lag	Test statistic
Countries with the level of foreign banking capital 0–20%	0.0125	0	–3.3562**
Countries with the level of foreign banking capital 20–40%	0.0178	0	–3.9585**
Countries with the level of foreign banking capital 40–60%	0.0014	0	–3.6454***
Countries with the level of foreign banking capital 60–80%	0,0058	0	–4,6919***
Countries with the level of foreign banking capital 80–100%	0.0405	0	–4.125***
*p <.05 ** p <.01 ***p <.001			

Source: compiled by the author.

Table 8

Johansen tests for cointegration

Groups	Rank	5% critical value	1% critical value	Trace statistic
Countries with the level of foreign banking capital 0–20%	0	15.41	20.04	31.253
	1	3.76	6.65	9.039
Countries with the level of foreign banking capital 20–40%	0	15.41	20.04	27.841
	1	3.76	6.65	8.790
Countries with the level of foreign banking capital 40–60%	0	15.41	20.04	17.841
	1	3.76	6.65	1.792
Countries with the level of foreign banking capital 60–80%	0	15.41	20.04	19.746
	1	3.76	6.65	1.589
Countries with the level of foreign banking capital 80–100%	0	15.41	20.04	17.842
	1	3.76	6.65	1.965

Source: compiled by the author.

imum and their optimal structure. These calculations are based on tests for maximum lag and exclusion.

The results indicate that for countries with a foreign banking capital from 0 to 40%, from 80 to 100% the maximum lag is 5 years, 40 to 80% — 6 years (*Table 9*). The VAR model with these lags has the best values for the Akaike, Hannan-Quinn, Schwar'z Bayesian criteria among other considered model specifications.

These dependences indicate a certain gap in time between the growth of the foreign banking capital share and the increase in the level of the country's financial innovation. However, given the fact that the implementation of any innovation is a long-term process that involves the development and design of innovation, its testing and implementation, the presence of time lag is a natural and only confirms our hypothesis about the relationship between these indicators.

In doing so, the obtained data correspond to the results of the study by [68], regarding the impact of foreign banking capital on the level of the country's financial innovation with a certain time lag. At the same time, empirical calculations confirmed the

Table 9

The maximum lag of the impact of the foreign banking capital on Financial Innovativeness Index*

lag	LL	LR	df	p	FPE	AIC	HQOC	SBIC
Countries with the level of foreign banking capital 0–20%								
0	125.185	.	27		1.63E-18	–33.9721	–34.5721	–34.0207
1	1104.778	.	27		–2.01E-91			
2	1667.18	–15.879	27		–2.30E-84*	–463.92	–468.12	–464.259
3	1659.761	10.129	27			–461.651	–465.851	–461.991
4	1664.825	33.728	27	1.258		–463.098	–467.299	–463.439
5	1681.687	22.547	27	0.457		–467.917*	–472.117*	–468.256*
6	1692.958	28.965	27			–471.137	–475.338	–471.478
Countries with the level of foreign banking capital 20–40%								
0	130.5956		27		4.65E-19	–35.5181	–36.1181	–35.5666
1	842.8112	1424.36	27		1.88E-84*	.	.	.
2	1676.824	1668.0*	27			–466.528	–470.729	–466.868
3	1684.552	15.444	27	1.236		–468.735	–472.935	–469.074
4	1674.236	–20.635	27	1.123		–465.787	–469.988	–466.126
5	1685.909	23.3533	27	1.026		–469.123*	–473.322*	–469.462*
6	1683.383	–5.0422	27			–468.402	–472.602	–468.742
Countries with the level of foreign banking capital 40–60%								
0	148.1919	.	27		3.28E-19	–40.3038	–40.9846	–40.3588
1	956.371	.	27		1.18E-79*	–261.028	–265.113	–261.358
2	1902.759	.	27			–529.388	–534.155	–529.773
3	1911.527	17.5259	27			–531.892	–536.658	–532.277
4	1899.821	–23.415	27	1.402		–528.547	–533.313	–528.932
5	1913.067	26.4999	27	1.164		–469.123	–473.322	–469.462
6	1910.201	–5.7215	27			–531.514*	–536.28*	–531.9*
Countries with the level of foreign banking capital 60–80%								
0	111.9442		27		1.46E-18	–30.3789	–30.9154	–30.4224
1	987.9253		27	0.000	–2.01E-91*			
2	1491.309		27	0.000		–173.921	–176.643	–174.141
3	1484.208	–14.200	27	0.984		–352.727	–355.903	–352.984
4	1488.736	9.05846	27	1.1224		–354.396	–357.571	–354.652
5	1503.815	30.1607	27	0.4089		–352.167	–355.343	–352.423
6	1513.894	20.163	27	0.9494		–347.222*	–350.33*	–347.473*
Countries with the level of foreign banking capital 80–100%								
0	158.3119		27		2.07E-18	–42.962	–43.7207	–43.0234
1	1397.128	1254.68	27		–2.54E-91*	–258.965	–239.854	–398.58
2	2109.016	1258.9*	27			–402.076	–405.717	–402.37
3	2098.974	–20.081	27	0.8658		–400.109	–403.75	–400.405
4	2105.377	12.8105	27	1.5874		–401.364	–405.005	–401.659
5	2126.702	42.6535	27	0.5783		–405.54*	–409.181*	–405.834*
6	2140.955	28.5146	27	1.3427		–408.331	–411.972	–408.627
*p < .05								

Source: compiled by the author.

* LL – log-likelihood function; LR – the likelihood ratio test; df – calculate degrees of freedom for fixed effects; p – p-value; FPE – final prediction error; AIC – Akaike information criteria; HQOC – Hannan-Quinn information criteria; SBIC – Schwar'z Bayesian information criteria.

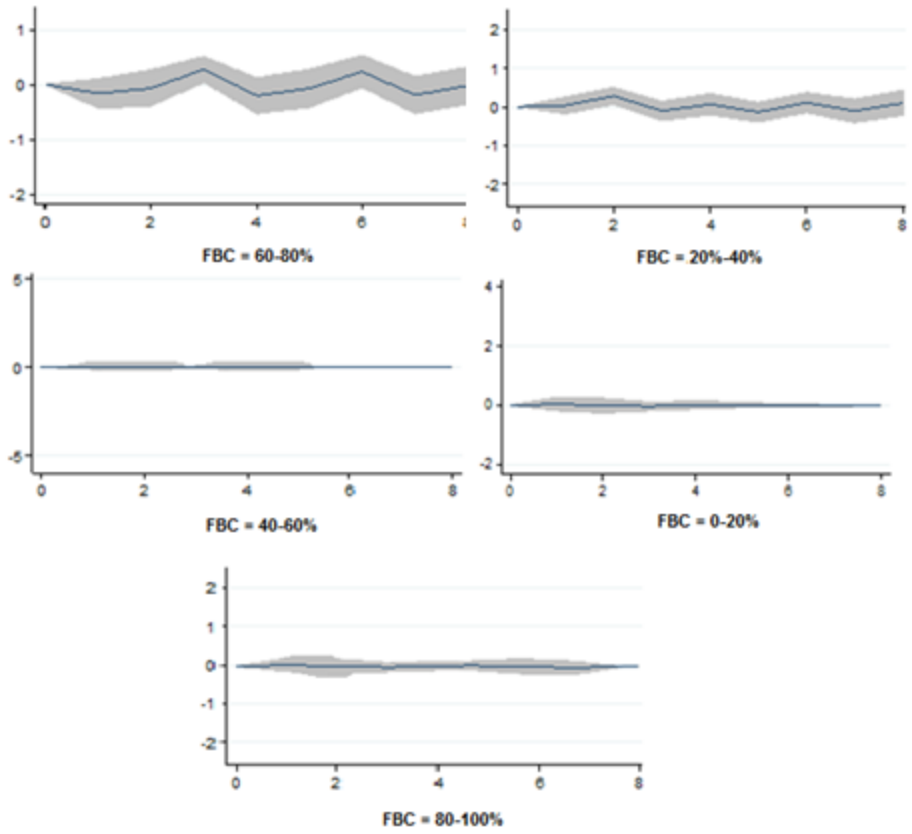

Fig. 2. **Impulse function of the Index of Financial Innovativeness response to the shocks of the foreign banking capital**

Source: author's calculations using Stata 14 software.

long-term effect of foreign capital due to financing innovations. Simultaneously, the authors insisted on a small time lag (not more than 3 years) between them.

The determination of the number of lags and cointegration relations form a VAR model, describing and confirming the relationship between the foreign banking capital and Financial Innovativeness Index of the national economy.

This model reflects the dependence of the differences in the values of the Financial Innovativeness Index on the lag differences in the values of both the same indicator and other parameters. The model can be written as follows:

$$D(FI) = f(D(FI(L)), D(FBC(L)), \quad (7)$$

where $D(FI)$ — the differences in the series of Financial Innovativeness Index; $D(FI\,(L))$ — lag differences of the Financial Innovativeness Index of series; $D(FBC(L))$ — lag differences of the foreign banking capital series.

All model variables are endogenous. Exogenous variables were not included. Graphs of responses of the model parameters to single and accumulated shocks of the foreign banking capital were constructed to visualize the simulation results. The model assumes that other parameters are not changed. Graphs of single shocks are demonstrated in *Fig. 2*.

The established interdependencies correlate with the regression coefficients given in *Table 5*, obtained using the OLS method. Thus, according to the results of the analysis, we can conclude that the growth of the foreign banking capital share is an important component of increasing the financial innovation level for those countries where this value is in the range of 20–40% and 60–80%. At the same time, for countries with the foreign banking capital of 0–20% and 40–60%, a change in its level has an insignificant effect on the Financial Innovativeness Index.

Testing the model for normality, autocorrelation, stability, using the Lagrange-multiplier test, Jarque-Bera test and eigenvalue stability condition confirmed the reliability of the results. According to the stability test of the underlying VAR model,

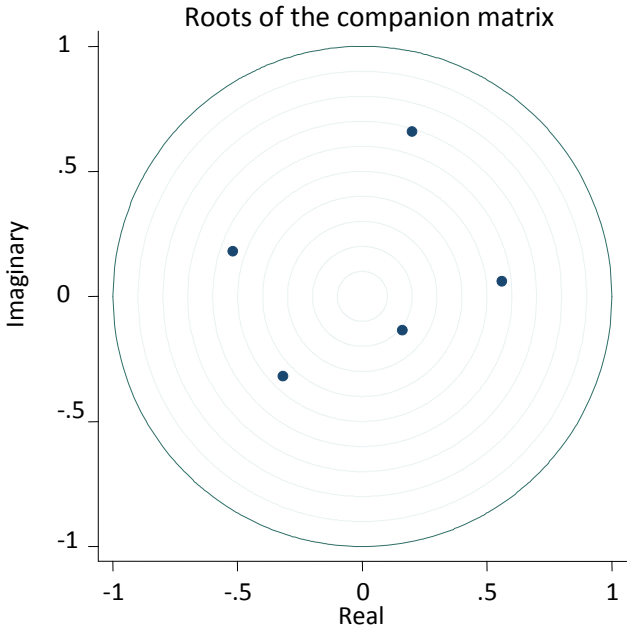

Fig. 3. **Results of VAR model validation using Eigenvalue stability condition test**

Source: compiled by the author.

all the eigenvalues lie inside the unit circle (*Fig. 3*). It implies that the estimated model is dynamically stable.

Since the estimated VAR passed all the diagnostic tests, we can conclude about bidirectional causality between foreign banking capital and Financial Innovativeness Index. It means that foreign banking capital increases the level of the country's financial innovativeness, and high level of financial innovativeness causes foreign banking capital attraction.

CONCLUSIONS

Assessment of the innovative development level in the financial sector involves the analysis of its level dependence on the structure of funding sources for activities. One of the indicators is the amount of bank capital. Meanwhile, a lack of understanding of the relationship between the level of the country's financial innovativeness and the foreign banking capital volume can affect the stability of the financial sector and reduce its economic growth.

Considering the lack of research on the impact of foreign banking capital on the level of financial innovativeness of the former Soviet Union and young EU members countries, our study sheds light on the nature of this connection. According to the analysis results, the increasing level of innovation in the financial sector in post-Soviet countries and young EU members depends significantly on the amount of foreign banking capital. Thus, our results are consistent with the research of previous scientists [19, 26, 68] regarding the importance of foreign banking capital in the growth of national innovation potential.

The scientific value of the research is the expansion of tools to increase the financial innovation of the country. The study complements the results of the previous scientists' analysis and along with traditional tools (stimulating business to finance innovation, GDP growth) justifies the feasibility of attracting foreign banking capital as one of the key tools to increase the innovation level in the financial sector.

The conducted research has certain practical implications. Unlike previous studies, this research suggests a significant dependence of the financial innovativeness level of the former Soviet Union countries on external credit resources, while the EU is financially independent. Namely, public authorities must consider the established interdependencies in the implementation of their investment and monetary policy. At the same time, they should continuously implement measures aimed at increasing the innovation of the financial sector, update their investment and innovation policies.

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Verification of Okun's Law on Russian Data

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ABSTRACT

The **purpose** of the study is to assess the empirical relationship between economic growth and unemployment in the Russian economy. The research **methodology** is based on an econometric analysis of time series representing data on unemployment and economic growth to identify an empirical relationship between these variables. In the article author continued the work on identifying the relationship between the unemployment rate and GDP in Russia based on empirical data. Based on the results of the optimal length model, the long-term Okun coefficient describing the relationship between GDP and unemployment is calculated. As a result of the empirical assessment, the Okun coefficient was obtained equal to 0.87, which is consistent with the previous studies based on the data of the Russian economy. The discrepancies can be explained by the pandemic factor in 2020. It is **concluded** that the value of the long-term Okun coefficient confirms the stable relationship between the GDP and the unemployment rate. However, its value for Russia is somewhat inferior to estimates for most developed countries and is comparable to indicators for emerging market countries. The results of the study can be used in the construction of short-term forecasts of the response of unemployment changes to fluctations in GDP, as well as in the development of macroeconomic policy measures in Russia as a whole.

Keywords: unemployment rate; employment; economic growth; Oaken's law; coronavirus pandemic; time series; empirical estimation; Russian Federation

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INTRODUCTION

The problem of unemployment and its impact on key macroeconomic indicators, including gross domestic product (GDP), was the subject of research by many post-Keynesian scientists in the XX century [1, 2]. Arthur Okun is one of the economists who contributed to the empirical relationship between unemployment and GDP. He presented his research on the relationship between unemployment and economic growth in 1962. According to the author, the increase of the unemployment rate by 1% reduces the country's GDP by about 2% [3].

Over the last 50 years, many other empirical works have appeared in which the authors have tried to identify the relationship between unemployment and GDP and to prove previously established empirical relationship [4]. Theoretical aspects of the Okun's law have been researched to determine its practical implications for different countries of the world.

Overall, the Russian labour market was characterized by positive development trends in the pre-pandemic period. In particular, in Russia the employment rate was above the average, and the unemployment rate was below the average for the OECD countries [72.1 and 5.9% respectively (as of 2018)]. Flexible labour market legislation, weak unemployment insurance and continued economic recovery were factors reducing unemployment.[1]

The main purpose of this article is to reveal the relationship between the unemployment rate and GDP in Russia. The main question of the research: if high unemployment has a negative impact on GDP?

The novelty of this article is primarily related to the attempt to test Okun's law in relation to Russian data. As will be shown in the literature review, there are a number of works devoted to proving the applicability of the Okun's law to Russia. However, the research takes into account recent events and recent data on the Russian economy. Unemployment rates for both men and women are taken into account when analysing data for greater accuracy. This article will therefore also focus on the gender dimension.

In order to achieve this goal, such tasks as the review of the literature, data analysis (with a special focus on the single root test, cointegration test), empirical analysis (with an emphasis on finding the optimal lag length, performing diagnostic tests). Diagnostic tests will be related to autocorrelation tests, hetero-sufficiency tests, normality tests. All of them will help to check the correctness and quality of assessments. In conclusion, the main results of the research will be determined. Thus, the structure of the article reflects the main tasks that are set to achieve the goal and answer the research question of the article.

REVIEW OF LITERATURE

The main theoretical assumptions for this research are based primarily on the Okun's law. The main idea of the law is to establish an empirical link between the GDP growth rate and the unemployment rate [5]. The law is defined by the following equation:

$$\frac{Y - Y^*}{Y^*} = -\beta(U - U^*),$$

where Y^* — potential GDP; U — actual unemployment; U^* — natural unemployment; β — empirical ratio of GDP sensitivity to cyclical unemployment (Okun coefficient). The coefficient is dimensionless and shows the relationship between the degree of deviation of actual unemployment from its natural level and actual GDP from its potential level.

The Okun's law connects fluctuations in unemployment to fluctuations in GDP. According to this law, annual real GDP growth of about 2.7% holds unemployment rate at a stable natural level. Every subsequent 2.5% increase in GDP decrease the unemployment rate by 1%. Every additional 2.5% decrease in GDP increases the unemployment rate by

[1] The new OECD Jobs Strategy How does Russia compare? OECD. 2018. URL: https://www.oecd.org/russia/jobs-strategy-RUSSIA-EN.pdf (accessed on 25.07.2022).

Table 1

Key data on the volume of GDP and the unemployment rate in the Russian economy during the period of 1992–2020

Variable	1994		2009		2015		2020	
	Value	Change to previous period,%	Value	Change to previous period, %	Value	Change to previous period, %	Value	Change to previous period, %
GDP at current prices, bln USD	395	–12.57	1223	–7.8	1363	–1.97	1483	–2.95
Unemployment rate, %	7.2	+1.9	8.2	+2	5.6	+0.4	5.9	+1.3

Source: compiled by the author.

1% [3]. In fact, it is not a law, but a trend with many constraints across countries, regions, the world as a whole and time periods [6].

Theoretically, unemployment exceeds natural levels with negative socio-economic consequences. The higher the unemployment rate, the more real GDP will lag behind the nominal and the economy will produce less. In addition, the exceedance of the unemployment rate at the natural level leads to a decrease in tax revenues to the State budget, an increase in the cost of unemployment benefits in the economy [7].

Economists J. Villaverde and A. Maza try to analyze the Okun's law for Spain and its seventeen regions during the period 1980–2004. They found that the impact of GDP on unemployment in the Spanish regions varied. The Okun coefficient varies from a minimum of 0.3 for Asturias to a maximum of 1.55 in Castile-La Mancha [8].

The Okun coefficient of 2.5 mainly characterizes the US and some European economies (e.g., the United Kingdom and France) [9]. Empirical researches show that this coefficient is lower in emerging market economies, including Russia. For example, according to the calculations of Russian economists [10], the value of the Okun coefficient for Russia is 1. Other researches on the Russian economy produced different results. Dobrozhinskaya has set that the Okun coefficient was 3 in 2018 in own research. Due to the high unemployment rate, Russia lost about 3.1 bln rub [11]. However, according to the calculations of M. Kazakova, the Okun coefficient was almost insignificant. According to her estimates, the change in unemployment. According to Kazakova, the Okun coefficient was –0.2 [12].

This article will continue an attempt to identify the relationship between the unemployment rate and GDP in Russia based on empirical data.

ANALYSIS OF DATA

The inverse relationship between unemployment and GDP can be determined on the basis of stylized facts. For example, along with the fall in GDP, there was a rise in unemployment, during periods of economic shock in 1994, 2008, 2015, 2020 years. The highest unemployment rates for this period are presented in *Table 1*.

Table 2

Discription of veriables

Variable	Variable description	Comment / Source of information
GDP	Volume index	Based on seasonal variations Source: IMF International Financial Statistics
Unemployment rate	Unemployment rate, ILO methodology, %	Based on seasonal variations. The difference in unemployment is used for modelling purposes

Source: compiled by the author.

Nevertheless, despite the established link between unemployment and GDP at the level of stylized facts, there is a need for a more in-depth analysis of the time data on unemployment and GDP and their relationship through econometric methods.

The International Monetary Fund (IMF) and Federal State Statistics Service (Rosstat) databases will serve as data sources for analysis. GDP data are taken from IMF International Finance Statistics.[2] The research uses seasonally adjusted index of volume of GDP for modelling purposes. Rosstat is the source of unemployment (total, male and female) data.[3] The unemployment rate is calculated by Rosstat on the basis of International Labor Organization (ILO) methodology.[4] The data for both variables cover the period from 1995 [the beginning of the modern consecutive collection of statistics for Russia (after the break-up of the USSR) to the end of 2020]. Data description is presented in *Table 2*. Time series were adjusted for seasonality. The GDP indicator was taken as a logarithm and the unemployment rate was considered without a logarithm.

For econometric modelling and statistical correlation between unemployment and GDP growth, time series analysis of modelling data is needed.

In particular, a visual analysis of GDP, overall unemployment, and gender data showed that series have a deterministic trend (*Appendix 1, Fig. 1–3*). The same can be said about data for a series of LGDP variables where visual analysis does not reveal certain trends.

The ADF-test helped confirm the validity of the visual analysis. With a value level of 1% the time series for LGDP, d(UR_total) have a single root. Other time series such as UR (total), UR (male) and UR (female) are stationary (*Appendix 2, Table 1*).

The autocorrelation process was analyzed on the basis of the autocorrelation of residuals (form of autocorrelation) (*Appendix 1, Fig. 2*). A partial autocorrelation was found which indicates that the autocorrelation function is decreasing for the variable that characterizes the overall unemployment rate. This is also confirmed by the form the residuals are distributed (*Appendix 1, Fig. 3*). Moreover, autocorrelations of 1st, 3rd and 5th orders are of high importance. This assumption is further tested in regression equation with autoregressive variables $X(-1)$, $X(-3)$ and $X(-5)$ (*Appendix 2, Table. 2*). The evaluation confirmed the visual analysis assumption.

The residuals distribution graph also shows that the autocorrelation function is decreasing (*Appendix 1, Fig. 3*).

The Engle-Granger cointegration test correctly identified, whether the time

[2] IMF International Financial Statistics. URL: https://data.imf.org/?sk=4C 514D 48-B 6BA-49ED-8AB 9–52B 0C 1A0179B (accessed on 31.08.2021).

[3] Official website of the Federal State Statistics Service. Rosstat. URL: http://www.gks.ru/ (accessed on 31.08.2021).

[4] ILO Indicator description: Unemployment rate. URL: https://ilostat.ilo.org/resources/concepts-and-definitions/description-unemployment-rate/ (accessed on 31.08.2021).

Table 3

Variables for Estimating the Optimal Length

Dependent Variable: D(UR)				
Method: Least Squares				
Date: 06/27/21 Time: 20:28				
Sample (adjusted): 1996Q4 2020Q4				
Included observations: 97 after adjustments				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.018828	0.076807	0.245131	0.8070
D(UR(−1))	−0.142883	0.108135	−1.321345	0.1901
D(UR(−2))	−0.226868	0.108799	−2.085200	0.0402
D(UR(−3))	−0.005176	0.112342	−0.046075	0.9634
D(UR(−4))	0.321385	0.107997	2.975880	0.0038
D(UR(−5))	0.155949	0.112982	1.380303	0.1712
D(UR(−6))	−0.004297	0.107615	−0.039933	0.9682
D(UR(−7))	−0.116678	0.099798	−1.169136	0.2457
DLOG(GDP)	−32.23280	11.36062	−2.837240	0.0057
DLOG(GDP(−1))	−25.53007	11.37397	−2.244604	0.0275
DLOG(GDP(−2))	−3.316407	12.23670	−0.271021	0.7871
DLOG(GDP(−3))	−11.24537	12.22278	−0.920034	0.3603
DLOG(GDP(−4))	7.091200	12.11674	0.585240	0.5600
DLOG(GDP(−5))	8.505420	11.35478	0.749061	0.4560
DLOG(GDP(−6))	10.98067	11.96251	0.917923	0.3614
R-squared	0.433752	Mean dependent var		−0.038351
Adjusted R-squared	0.337075	S.D. dependent var		0.746959
S.E. of regression	0.608175	Akaike info criterion		1.984579
Sum squared resid	30.32992	Schwarz criterion		2.382730
Log likelihood	−81.25209	Hannan-Quinn criter.		2.145572
F-statistic	4.486629	Durbin-Watson stat		1.967222
Prob(F-statistic)	0.000007			

Source: compiled by author.

series are following the same stochastic trend for LGDP and UR variables, and whether the coefficients are evaluated in a consistent way, and whether the problem of false regression does not appear. The results of the pairing tests show that at 10% the variables LGDP and UR indicate no cointegration. This helped to conclude that all variables UR (general, female and male) and LGDP are not cointegrated at a level of significance of 10%. Moreover, GDP is a more exogenous variable than unemployment. This suggests that GDP has an impact on employment.

Overall, the analysis showed the adequacy of the time series under consideration for subsequent econometric evaluation.

EMPIRICAL RESULTS

For econometric modeling of interrelationship between time series the optimal log length is determined. To do this, a set of variables was generated. Estimation of optimal length identified six variables, four of which are statistically significant (*Table 3*).

On the basis of the results of the optimum length model, the long-term Okun coefficient was calculated using the formula:

$$c(DLOG(GDP)) + c(DLOG(GDP(-1))) + c(DLOG(GDP(-2))) + c(DLOG(GDP(-3))) + c(DLOG(GDP(-4))) + c(DLOG(GDP(-5))) + c(DLOG(GDP(-6)))) / (1 - (c(D(UR(-1))) + c(D(UR(-2))) + c(D(UR(-3))) + c(D(UR(-4))) + c(D(UR(-5))) + c(D(UR(-6))) + c(D(UR(-7)))).$$

Its value is 0.86. This estimate is close to the estimate received by economists Gurvich and Vakulenko in 2015 [10]. Differences may be due to the different time periods considered by the authors, as well as to the different factors affecting the labour market. In particular, the weaker impact of GDP on the labour market identified in this article may be related to government support for the labour market during the coronavirus pandemic crisis. Moreover, unemployment in Russia was lower than in some OECD countries. For example, the US unemployment rate exceeded 8.3% in 2020 [13].

To assess the significance of linear regression, an F-test was performed. According to the F-test, the null hypothesis (H0) assumes that the regression equation is statistically insignificant and the estimate is unreliable. For the F-test we compare the F-statistics from the best equation, which is 4.49, and the value from the F-distribution table with (m; $nK - 1$) degrees of freedom, which is 3.94 at a 5% significance level. This means that the actual t-criterion value of the Student's is greater than the table value. H0 irrelevance regression rejected.

CONCLUSION

For Russia, the Okun's law applies in both the short and long term. The study showed that the long-term Okun coefficient is negative and different from zero, and the variables LGDP and UR-total are considered cointegrated, meaning that the relationship between the variables is stable.

Country factors related to the Russian labour market may influence the evaluation results. These include: hidden unemployment not recorded in official data (reduced working hours, unpaid leave, no unemployment benefits and no union institution), and a large informal employment sector. Along with these factors, the Russian labour market is not responding to the crisis by increasing unemployment, but rather by reducing wages in real terms.

As in other countries, the relationship between GDP and unemployment increases during periods of crisis and declines (to such an extent that it may become insignificant) during periods of economic growth [14]. Overall, the Okun coefficient for Russia is slightly lower than the estimates for most developed countries and comparable to that for emerging market countries [15, 16].

Further direction of the analysis may be connected with the comparison of the obtained results for Russia with other countries. Of course, there are estimates of the Okun coefficient for other countries such as Switzerland (–0.24), Japan and Austria (–0.16 and –0.14 respectively), the US (–0.4), Spain (–0.85) [12]. In many countries, the relationship between GDP and unemployment increases during periods of crisis and decreases (as it may become insignificant) during periods of economic growth [10]. However, these results are not fully comparable with those calculated in this research for Russia. However, the Okun coefficient for Russia is slightly lower than the available estimates for most developed countries and more comparable with that for emerging market countries [17].

The observed differences in Okun's law coefficients between countries (and

apparently between periods) are determined by the institutional characteristics of the labour market (such as the strength of union institution in the negotiation, the level of employee protection, etc.), as well as the nature of the economic shocks that have occurred in the Russian economy. The Russian economy is characterized by more shocks (due to both national and international factors) that prevailed in Russia during the period under review. In comparison with Russia, the number of shocks in developed countries is relatively balanced. Therefore, estimates of Okun coefficients may be more related to the conditions under which Russia's economy developed during the period under review. This issue is often highlighted by researchers who consider that the evaluation of the Okun's law should also take into account external factors (including economic shocks) that could explain the relationship between unemployment and production [10].

Moreover, the formulation of meaningful conclusions from the comparative analysis of the Okun coefficient in Russia and other countries does not seem appropriate without a proper examination of the characteristics of the labour markets in these countries, which could be the subject of further research. For example, the problem may be related to the comparability of time periods during which studies have been conducted for Russia and other countries. Also important are the structural characteristics of the Russian labour market, which differs significantly from those of the OECD countries in terms of income levels, low labour productivity (due to the low level of capital stock in the economy), low labor market security, etc. [18]. Sanctions and other import barriers make it difficult to transfer of technology from abroad [19]. Weak investment climate, in particular weak property rights, they hinder innovation. In this regard, a further possible area of research could be to test the hypothesis of whether the Okun's law has common features for other economies under consideration.

However, the results of the Okun's law assessment for Russia may be of practical importance in the construction of forecasts of the reaction of unemployment to GDP change, as well as in the development of macroeconomic policy measures in Russia as a whole. In particular, estimates can be useful in determining costs to support employment and in the fight against inflation.

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Appendix 1

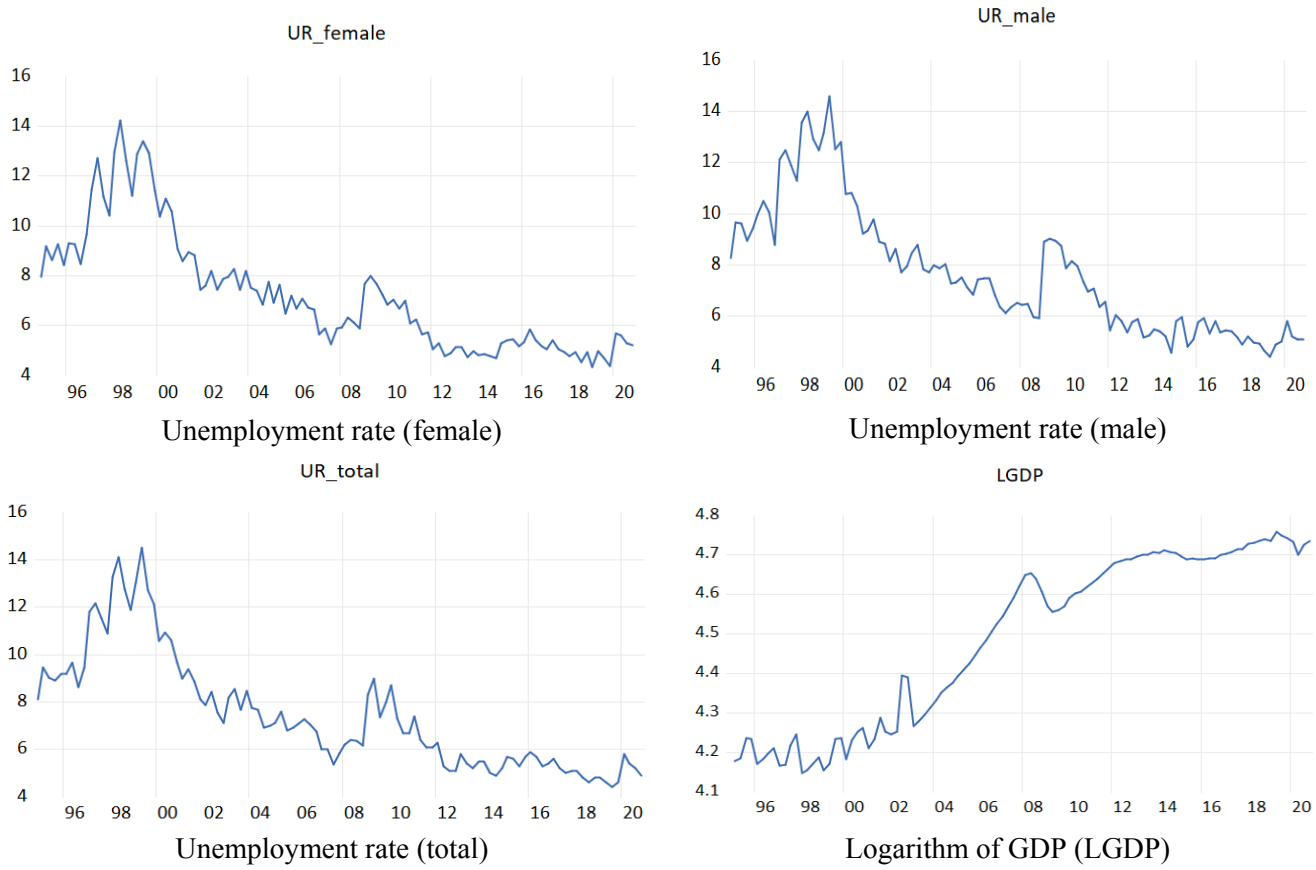
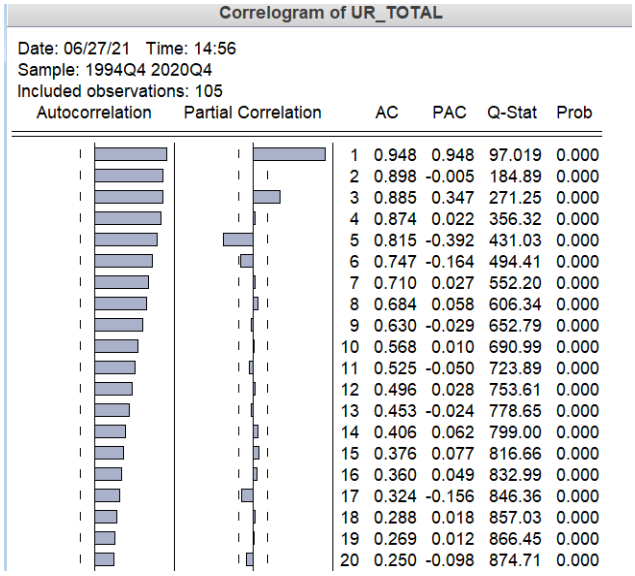


Fig. 1. **Data distribution for variables considered in the study**

Source: compiled by the author.

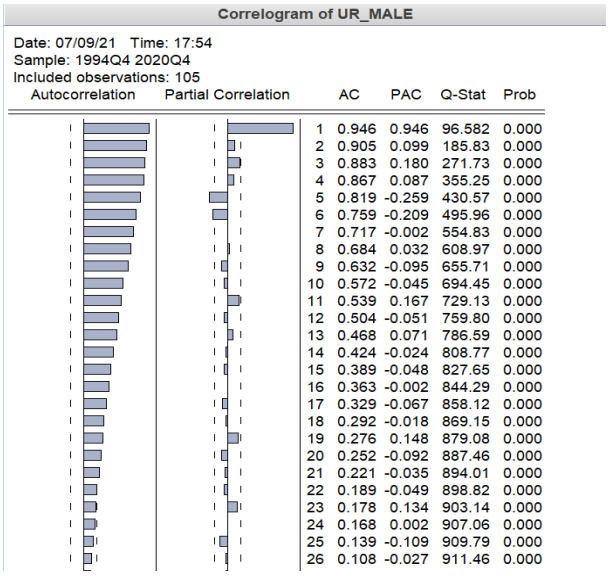


Correlogram of UR_TOTAL

Date: 06/27/21 Time: 14:56
Sample: 1994Q4 2020Q4
Included observations: 105

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.948	0.948	97.019	0.000
		2	0.898	-0.005	184.89	0.000
		3	0.885	0.347	271.25	0.000
		4	0.874	0.022	356.32	0.000
		5	0.815	-0.392	431.03	0.000
		6	0.747	-0.164	494.41	0.000
		7	0.710	0.027	552.20	0.000
		8	0.684	0.058	606.34	0.000
		9	0.630	-0.029	652.79	0.000
		10	0.568	0.010	690.99	0.000
		11	0.525	-0.050	723.89	0.000
		12	0.496	0.028	753.61	0.000
		13	0.453	-0.024	778.65	0.000
		14	0.406	0.062	799.00	0.000
		15	0.376	0.077	816.66	0.000
		16	0.360	0.049	832.99	0.000
		17	0.324	-0.156	846.36	0.000
		18	0.288	0.018	857.03	0.000
		19	0.269	0.012	866.45	0.000
		20	0.250	-0.098	874.71	0.000

Autocorrelogram for data on unemployment rate (total)

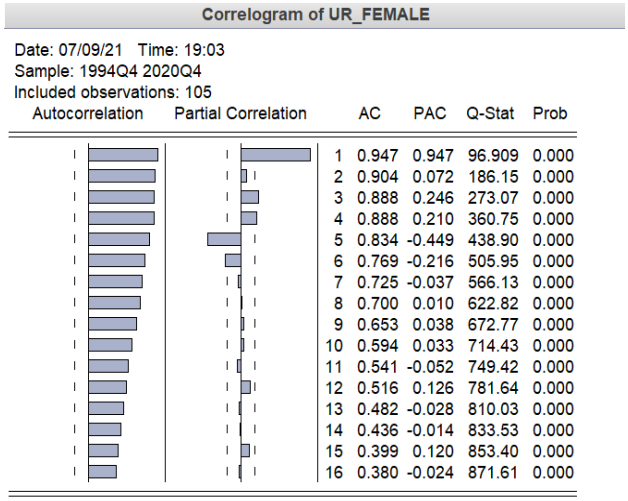


Correlogram of UR_MALE

Date: 07/09/21 Time: 17:54
Sample: 1994Q4 2020Q4
Included observations: 105

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.946	0.946	96.582	0.000
		2	0.905	0.099	185.83	0.000
		3	0.883	0.180	271.73	0.000
		4	0.867	0.087	355.25	0.000
		5	0.819	-0.259	430.57	0.000
		6	0.759	-0.209	495.96	0.000
		7	0.717	-0.002	554.83	0.000
		8	0.684	0.032	608.97	0.000
		9	0.632	-0.095	655.71	0.000
		10	0.572	-0.045	694.45	0.000
		11	0.539	0.167	729.13	0.000
		12	0.504	-0.051	759.80	0.000
		13	0.468	0.071	786.59	0.000
		14	0.424	-0.024	808.77	0.000
		15	0.389	-0.048	827.65	0.000
		16	0.363	-0.002	844.29	0.000
		17	0.329	-0.067	858.12	0.000
		18	0.292	-0.018	869.15	0.000
		19	0.276	0.148	879.08	0.000
		20	0.252	-0.092	887.46	0.000
		21	0.221	-0.035	894.01	0.000
		22	0.189	-0.049	898.82	0.000
		23	0.178	0.134	903.14	0.000
		24	0.168	0.002	907.06	0.000
		25	0.139	-0.109	909.79	0.000
		26	0.108	-0.027	911.46	0.000

Autocorrelogram for data on unemployment rate (male)

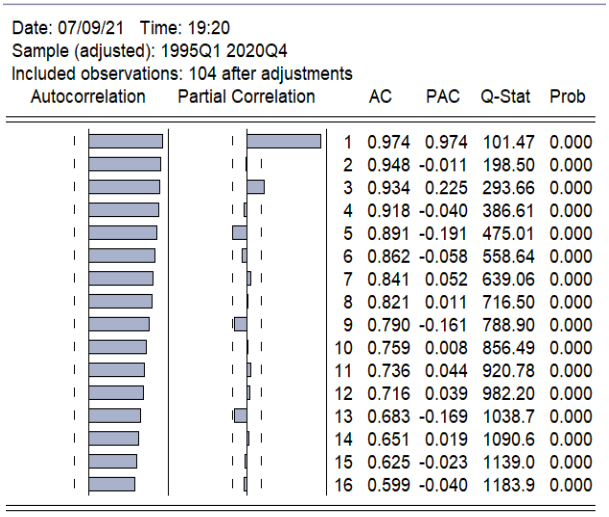


Correlogram of UR_FEMALE

Date: 07/09/21 Time: 19:03
Sample: 1994Q4 2020Q4
Included observations: 105

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.947	0.947	96.909	0.000
		2	0.904	0.072	186.15	0.000
		3	0.888	0.246	273.07	0.000
		4	0.888	0.210	360.75	0.000
		5	0.834	-0.449	438.90	0.000
		6	0.769	-0.216	505.95	0.000
		7	0.725	-0.037	566.13	0.000
		8	0.700	0.010	622.82	0.000
		9	0.653	0.038	672.77	0.000
		10	0.594	0.033	714.43	0.000
		11	0.541	-0.052	749.42	0.000
		12	0.516	0.126	781.64	0.000
		13	0.482	-0.028	810.03	0.000
		14	0.436	-0.014	833.53	0.000
		15	0.399	0.120	853.40	0.000
		16	0.380	-0.024	871.61	0.000

Autocorrelogram for data on unemployment rate (female)



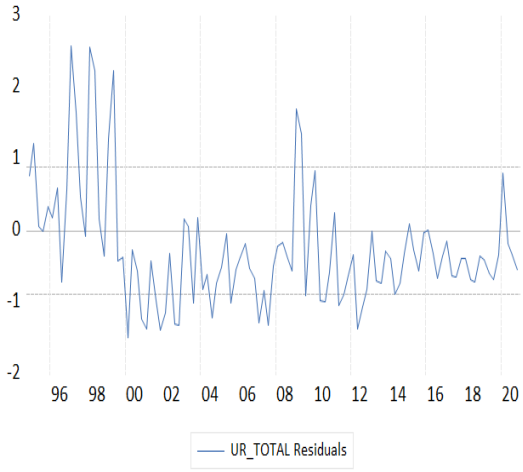
Date: 07/09/21 Time: 19:20
Sample (adjusted): 1995Q1 2020Q4
Included observations: 104 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.974	0.974	101.47	0.000
		2	0.948	-0.011	198.50	0.000
		3	0.934	0.225	293.66	0.000
		4	0.918	-0.040	386.61	0.000
		5	0.891	-0.191	475.01	0.000
		6	0.862	-0.058	558.64	0.000
		7	0.841	0.052	639.06	0.000
		8	0.821	0.011	716.50	0.000
		9	0.790	-0.161	788.90	0.000
		10	0.759	0.008	856.49	0.000
		11	0.736	0.044	920.78	0.000
		12	0.716	0.039	982.20	0.000
		13	0.683	-0.169	1038.7	0.000
		14	0.651	0.019	1090.6	0.000
		15	0.625	-0.023	1139.0	0.000
		16	0.599	-0.040	1183.9	0.000

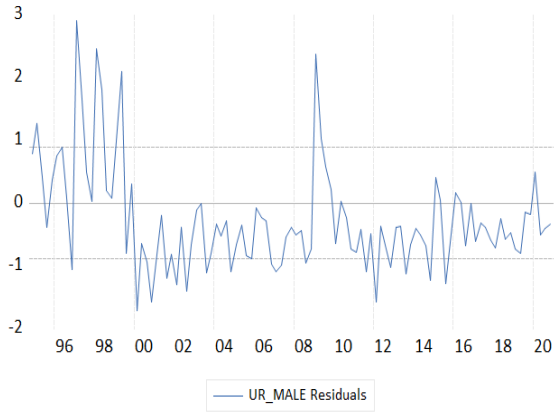
Autocorrelogram for data on LGDP variable

Fig. 2. **Autocorrelograms of data for variables considered in the study**

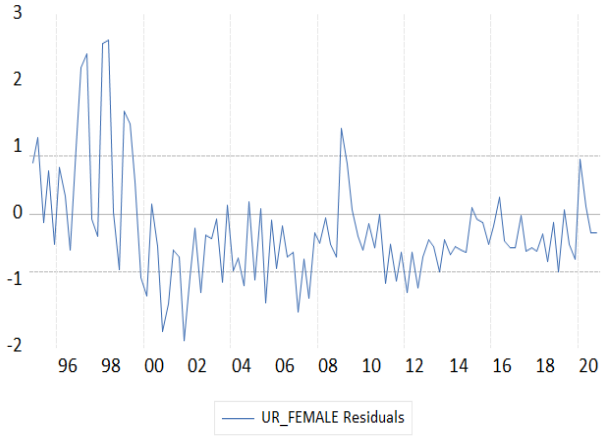
Source: compiled by the author.



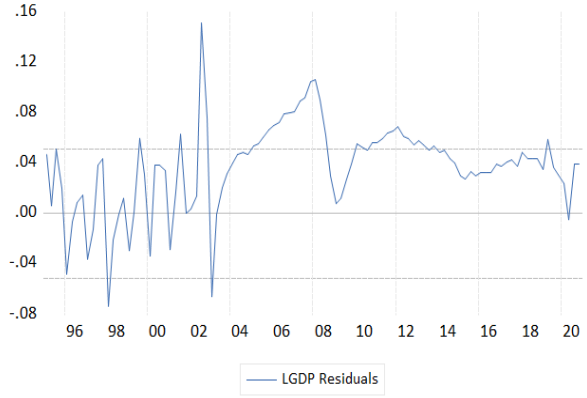
Residuals distribution for data set of unemployment rate (total) variable



Residuals distribution for data set of unemployment rate (male) variable



Residuals distribution for data set of unemployment (female) variable



Residuals distribution for data set of LGDP variable

Fig. 3. **Distribution of residuals for a dataset of variables considered in the study**

Source: compiled by the author.

Appendix 2

Table 1

ADF-tests

Time series name	Deterministic	Lag length (AIC)	t-stat	Significance level (–, *, **, ***)	Conclusion	H0: accepted/rejected
LGDP	C	5	–0.7	***	Unit root	
d(LGDP)	C	5	0.17	***	Unit root	
UR_total	C	5	–1.66	*	Stationarity	Rejected
d(UR_total)	-	5	–0.69	***	Unit root	
UR_ male	C	5	–1.53	*	Stationarity	Rejected
d(UR_ male)		5	–2.1	**	Stationarity	Rejected
UR_ female	C	5	–1.7	*	Stationarity	Rejected
d(UR_ -female)	-	5	–2.10	**	Stationarity	Rejected

Source: compiled by the author.

Table 2

Autocorrelation function assessment results

Dependent Variable: UR_TOTAL
Method: Least Squares
Date: 06/27/21 Time: 15:17
Sample (adjusted): 1996Q1 2020Q4
Included observations: 100 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.232427	0.232554	0.999456	0.3201
UR_TOTAL(-1)	0.847429	0.074395	11.39099	0.0000
UR_TOTAL(-3)	0.311586	0.079677	3.910602	0.0002
UR_TOTAL(-5)	-0.195289	0.074778	-2.611575	0.0105

R-squared	0.923126	Mean dependent var	7.399300
Adjusted R-squared	0.920724	S.D. dependent var	2.461923
S.E. of regression	0.693180	Akaike info criterion	2.144123
Sum squared resid	46.12781	Schwarz criterion	2.248330
Log likelihood	-103.2061	Hannan-Quinn criter.	2.186297
F-statistic	384.2665	Durbin-Watson stat	1.901514
Prob(F-statistic)	0.000000		

Source: compiled by the author.

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ORIGINAL PAPER

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UDC 369.041(045)
JEL H53, I13

Opportunities for Improving Financial Provision of Social Insurance Institutions in the Russian Federation

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Financial University, Moscow, Russia

ABSTRACT

The **subject** of the research is the analysis of priority directions of improvement of financial provisioning of activity of extra-budgetary funds of the Russian Federation that make up the system of social insurance institutions. The **purpose** of the study is to develop active and passive opportunities to improve the activities of the institution of social insurance, allowing to increase the level, stability and volume of insurance contributions to extra budgetary funds by improving the quality of the internal financial environment in certain types of economic activity, in particular "Manufacturing". The **relevance** of the topic is confirmed by the fact that in recent years, the share of insurance contributions in revenues of social insurance institutions does not exceed 65%, i.e. in terms of the insurance mechanism, the budgets of social insurance institutions are deficit. Therefore, financial and economic solutions are required to improve the financial situation of social insurance institutions and stabilize their activities, including through intensive methods to encourage the activity of contribution payers to increase the rate base and reduce non-payments. The **scientific novelty** of the study lies in the development of author's algorithm of forming the financial security program of social insurance institutions, combining active and passive opportunities, including financial instruments of solvency of economic entities. The main methods of the study include the method of content-analysis, tabular and graphical methods, analysis and synthesis as universal methods of scientific knowledge, as well as methods of effectiveness assessment. As a **result** of the study the basic elements of the program of improvement of financial maintenance of institutes of social insurance, including, in particular, offers on formation of passive possibilities at the expense of realization of measures of financial support from Government of the Russian Federation and active support at the expense of inclusion of actions in branch development strategies. And also recommendations are given on the inclusion of proposed measures in the activities of authorities and adopted sectoral strategies, including on the basis of the distribution of powers between the executive authorities and other interested parties on the basis of normative legal acts.

Keywords: social insurance; financial security; insurance contributions; economic activity; solvency; incentives

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INTRODUCTION

As we have already indicated in our previous research, "for the financial support of the activity of the institutions of pension, social and medical insurance the Government of the Russian Federation on the basis of legislative acts regulating legal relations in the field of social insurance, establishes the rates of insurance premiums as a percentage of the wage fund, which must be paid by insured persons. Currently, the general rate of social contributions is 30%, of which 22% goes to the Pension Fund of Russia, 5.1% — to the Compulsory Medical Insurance Fund, 2.9% — to the Social Insurance Fund of the Russian Federation" [1].

The Government of the Russian Federation also sets limit amounts for each insured person, which are awarded individually. Thus, in accordance with the procedure established by the Order of the Government of the Russian Federation No. 11407 from 06.11.2019, "from 1 January 2020, the maximum value of the base for the calculation of insurance contributions for the Pension Fund of Russia is 1 292 000 rub., the Social Insurance Fund — 912 000 rub., for the Federal Fund of the CMI no limit amount".[1]

The assignment of a specific type of economic activity to a certain class of economic activity is regulated by the Rules, which are approved by a resolution of the Government of the Russian Federation. On the basis of the Rules, the Ministry of Labour and Social Protection of the Russian Federation develops and issues an order "On approval of classification of types of economic activity by professional risk classes".

At present, insurance contributions for compulsory social insurance account for more than 1/3 of the Russian Federal budget and more than 7% of GDP. For comparison: insurance premiums (contributions) for all voluntary insurance contracts concluded with individuals, for 2018, amounted to less than 1% of GDP. Thus, at present, the activity of insurance institutes in the Russian Federation is quite an important segment of the national economy [2].

At the same time, there are strong imbalances in the sectoral structure of financial support for the activities of these institutions [3]. As a result of the imbalance, there is an objective need to develop appropriate measures to support those economic activities that are key donors to these funds [4]. That is, there is an objective need for a detailed analysis of the sectoral structure of the financial provision of social insurance to develop measures of targeted state support for the relevant types of economic activity and to stimulate the conditions for maintaining Stability of the entire social security system in the Russian Federation.

LITERATURE REVIEW

A lot of attention in Russian and foreign sources is paid to issues of increasing the effectiveness of social insurance institutions. In particular, the analysis of the main features and most important features, as well as parameters of the current state of the pension insurance system in Russia were considered in detail in the work of D. S. Tulenty with colleagues [5]. In particular, the paper highlighted significant features inherent in solidarity pension relations in modern Russian society.

In turn, A. L. Safonov and Yu. V. Dolzhenkova analyze the Russian economy to identify the factors of financial imbalance of the mandatory pension insurance system [6]. According to the authors, the most important condition for balancing the pension insurance system is to resolve the question of tariff sizing to ensure stable financial security of the social insurance system. We agree with the opinion of A. L. Safonov and Yu. V. Dolzhenkova that the tax approach can be used to meet the requirement of sufficient resources in the insurance process.

[1] Order of the Government of the Russian Federation No. 1407 from 06.11.2019 "Limit on the basis for the calculation of compulsory social insurance contributions for temporary incapacity for work and maternity and for compulsory pension insurance as from 1 January 2020".

Interesting is the opinion of A.K. Solov'ev, which allocates the most important problems of management of social insurance institutions in Russia [7]. In our view, the system of criteria for evaluating the performance of the social security system deserves special attention, in general. The targeted approach proposed by A. K. Solov'ev can be considered as a doctrinal direction in the process of the overdue adaptation of relations between all stakeholders in the Russian social insurance system.

The distribution of responsibilities between the levels of State administration of the social insurance system does not remain without attention. For example, the work of I.B. Kotlobovskii with colleagues rightly raises the issue of increasing the potential of domestic regional parametric insurance programs, which have a high impact in the context of the delegation of some social functions from the federal center to the regions and to the field [8].

It is important to consider that the scientific problem of reforming and adapting the social insurance system is not new. Issues of introduction of innovations in domestic insurance practice are considered quite regularly during the last decade. For example, N. Savvina has sufficiently substantiated the importance of the continuous innovation development of domestic insurance in a dynamic changing financial environment, including, globally [9].

The objective of improving the resources for the activities of insurers and the insurance system as a whole is considered from a variety of perspectives. In our view, specific consideration should be given to proposals for the establishment of supranational funds and a system of relations to ensure payment in the context of active inter-country labour and post-labour migration. I. Yarygina proposes to use specialized inter-state credit institutions to solve this problem [10].

In addition to credit facilities, professionals are actively proposing investment model approaches. For example, E. A. Zvonova with colleagues proposes to improve the effectiveness of institutions promoting investment in the sustainable growth of the national economy in order to create additional financial opportunities for economic entities, used to increase insurance premiums and reduce dependence on other sources of financing. The authors believe that only by optimizing the activities of institutions promoting investment in the sustainable growth of the Russian economy can the prerequisites for increasing the sustainability of the social insurance system be created [11].

Scientific trends in foreign research are aimed at analysing the expansion of the social insurance system and its extension to informal, including self-employed workers. This direction is in demand in the context of the development of information technology, remote work and the appearance of a large number of persons involved in the solution of private tasks. Due to the fact that these persons enter mainly short-term relations with the employer, there is an objective obstacle to the formation of a meaningful fund for their insurance coverage. A. Kolev and J. La are offer special mechanisms to expand the properties of the social insurance system to solve this problem [12].

Special attention is paid to the reallocation of State resources for safety to the most vulnerable categories of citizens. In particular, C. Schmitt and colleagues are proposing appropriate methods for assessing needs and decomposition of social categories to ensure the required level of social protection by the state [13].

Thus, the scientific problem posed is quite relevant, but it requires additional analysis in terms of ensuring the sufficiency of the resources used for the uninterrupted and ineffective functioning of the Russian social insurance system, aimed at achieving the objective of social protection of the population.

MATERIALS AND METHODS

As the basic data of the study materials of official statistics, data on activities

of individual enterprises and economic activities, as well as data from open sources, were used. The basic methods of research were tabular and graphical methods, analysis and synthesis, as well as methods of average, forecasting and contextual analysis of the legal framework. The methodology of the research is based on the generally accepted postulates of economic theory, as well as the publications of other authors in the subject area under consideration. In particular, the modern international principles of individual insurance are considered, as well as the role of certain types of economic activity in the resource provision of activities of social insurance institutions in modern conditions.

RESULTS AND DISCUSSION

The financing of social insurance institutions in the Russian Federation at present cannot be called purely insurance. Assets of extra budgetary fixed assets are formed not only from contributions of insured persons, but also from budget transfers. Thus, in the activities of social insurance institutions there is a constant "insurance" deficit.

This is evidenced by the combined financial indicators of social insurance institutions over the past few years (*Fig. 1*). This situation leads to the conclusion that the financial provision of social insurance institutions with the use of insurance mechanisms (through the contributions of insured persons) needs to be significantly improved [14]. It is recalled that total contributions can be increased in three methods:

1) by increasing the unit rate of contributions (insurance tariff);

2) by increasing the tariff base, i.e. by increasing the overall wage fund;

3) by improving the financial condition of economic entities and reducing defaults in funds.

And, in our opinion, the first method can significantly worsen the already rather difficult financial situation of economic entities, as it will lead to an unjustified increase in labor costs. We therefore suggest that the efforts of stakeholders should focus on the second and third methods.

To this end, it is important to understand what are the main sources of financial security, and what are the opportunities for stakeholders to improve financial security [15]. By stakeholders in the problem we mean the following categories of social insurance participants:

- the State as the main regulator of relations and the indirect beneficiary of the national social insurance system as a whole;
- social insurance institutions as recipients of funds from enterprises and organizations and as distributors of those funds for the compensation of social services to the population;
- enterprises and organizations as payers to the social insurance system;
- owners of enterprises and organizations as persons, at whom financial interest is due to withdrawal of funds from the turnover of the entities of economic activity belonging to them;
- employees of enterprises and organizations in which social protection is the subject of social insurance institutions;
- population indirectly using social insurance institutions to meet their social needs.

To this end, it is worth considering a number of important structural indicators on the basis of which conclusions can be drawn about priority actions of stakeholders to stimulate the growth of financial security of social insurance institutions, offered by M.A. Miryukova and V.F. Sokolova [16]. In particular, the issue of the sectoral structure of financial security is important.

A quantitative analysis of the structure of insurance premiums shows that, at present, of the 18 types of economic activity for which statistics are kept in the Russian Federation, the major part of insurance funds (about 80%) is taken into account pay only six types of economic activities (*Fig. 2*). The figure shows that among the listed economic activities a relatively high proportion of insurance premiums is "Manufacturing industries" —

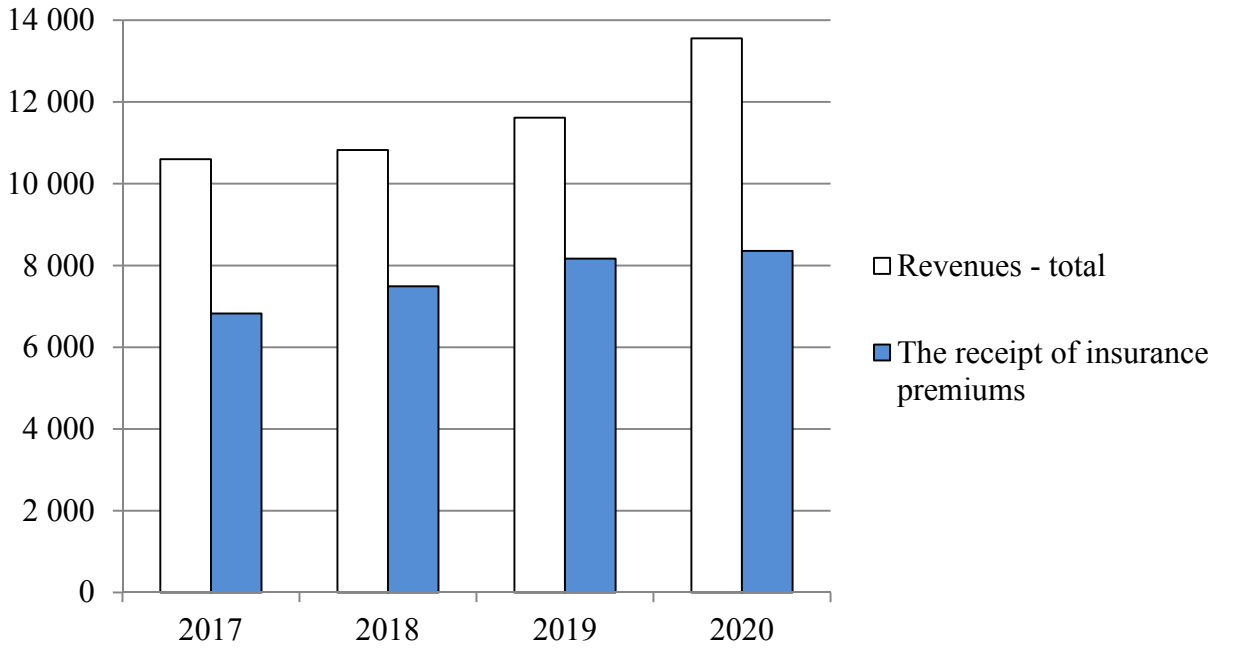

Fig. 1. **Dynamics of the main financial indicators of the social insurance institutions of the Russian Federation, billion rubles**

Source: summarized by the author on the basis of federal laws on the execution of budgets of social insurance institutions.

27.4%; "Transportation and storage" — 14.2%; "Wholesale and retail trade, repair of motor vehicles" — 13.1%.

The leading place in the structure of insurance premiums of the type of economic activity "Manufacturing industries" is due to its high proportion in the turnover structure (25.36%) and in the labor costs (26.01%). By type of economic activity "Wholesale and retail trade, repair of motor vehicles", which has a higher volume of turnover (37.51%) and average annual number of employees (19.10%), and share of insurance premiums is 2 times less than that of manufacturing. This is due to the lower level of pay per employed person (115.6 thous. rub.) than in manufacturing enterprises (297.03 thous. rub.).

If we consider the amount of payments per person employed in an economic activity, we can also identify several leaders whose payments are significantly higher than the national average (*Fig. 3*). As shown in figure, with a large margin of lead "Mining operations" — 223.72 thous. rub./per. In second place is "Provision of electrical energy, gas, steam, air conditioning" — 135.53 thous. rub./per. Other types of activities show relatively high stability of payments with values of about 85 show relatively high demonstrate stability of payments with values of about 85 thous. rub./per. Payments in other economic activities, that not shown in the figure, isn't exceed the average [17].

It can be concluded from the data provided that in the Russian economy there is a situation in which there are types of economic activities that contribute most to the resourcing of social insurance institutions. In our view, such economic activities require additional support from the State to stimulate their further development as donors of social protection system.

To this end, it is advisable to establish an appropriate algorithm of actions allowing stakeholders to coordinate their actions to ensure the sufficiency of resources allocated to the social insurance system (*Fig. 4*). In our opinion, the general type of algorithm should take into account different options and sources for detailing support measures.

Consider the possibility that arise from the analysis of the state of individual

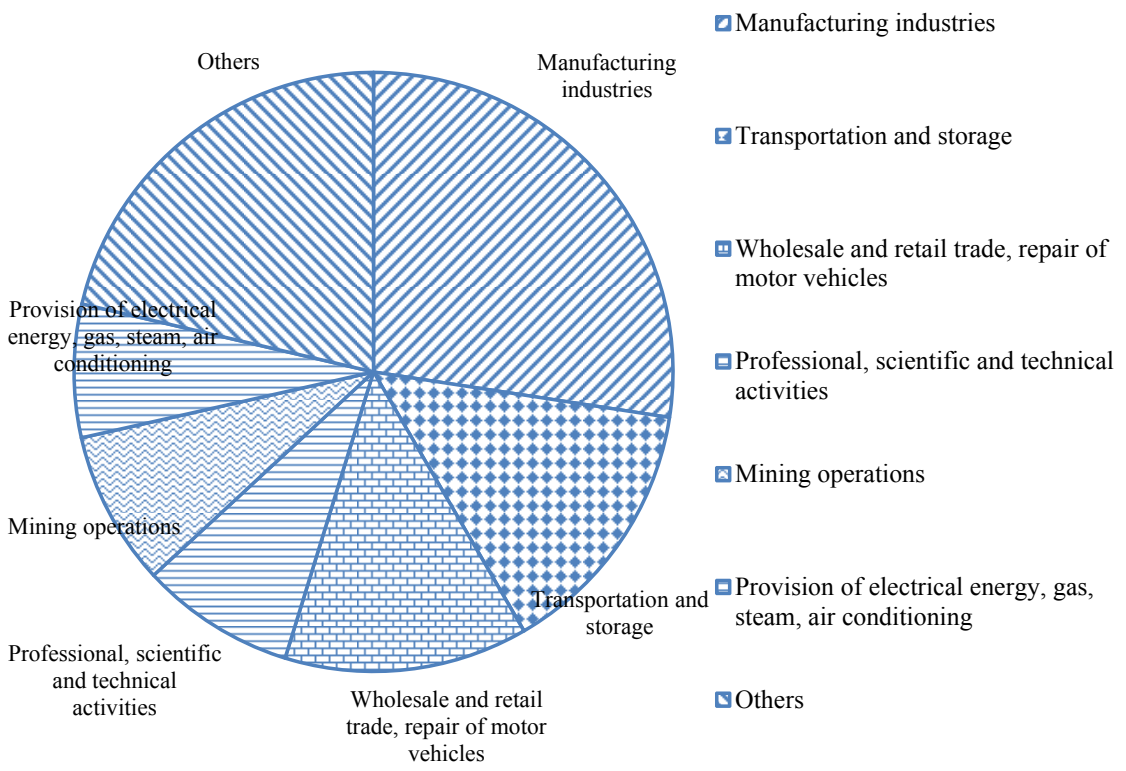

Fig. 2. **Share of contributions to the social insurance fund by type of economic activity**

Source: Rosstat: 1) data are given for the main type of activities of organizations, excluding the activities of financial organizations; 2) without small businesses.

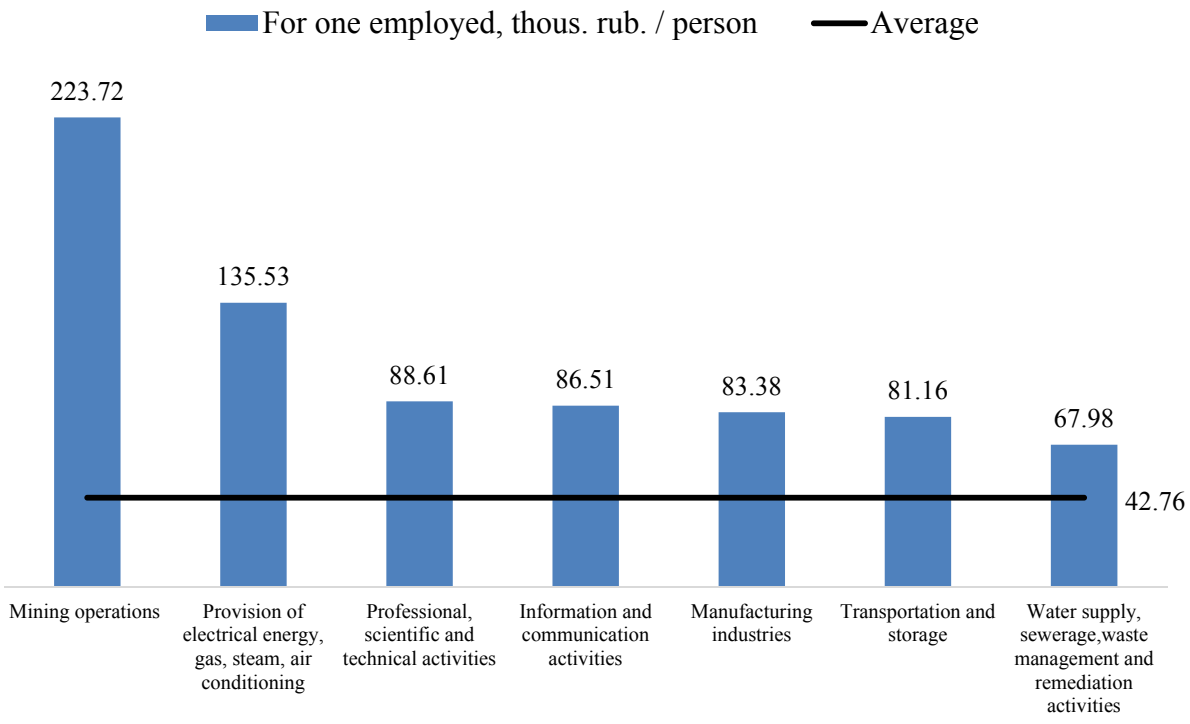

Fig. 3. **The amount of payments to the social insurance fund by type of economic activity per employee**

Source: built by the author based on Rosstat data.

economic activities in Russia. With regard to options for creating passive opportunities for improving the financial security of social insurance institutions, it is important to understand that all incentive measures are usually implemented within the framework of favorable conditions for doing business and reducing negative impacts on the business environment [18].

Expert assessments indicate that "total expenditure of early pensions and other compensatory payments for special working conditions is on average 6–8% of the wage fund in industry, and for selected industries and regions — 20–40% or more" [19]. This practice, on the one hand, has a very negative impact on the competitiveness of domestic products in the world market, and on the other, significantly reduces the resources allocated by society to old-age pensions [20–22].

Federal law No. 250 from 03 July 2016 "On amending the certain legislative acts...", the functions of the insurance premium administrator were transferred to the tax authorities. This was the result У of the Decree of the President of the Russian Federation No. 13 from 15 January 2016 "On additional measures to strengthen payment discipline in payments with the Pension Fund of the Russian Federation, the Social Insurance Fund of the Russian Federation and the Federal Medical Insurance Fund".

This measure is actively "implemented" by representatives of international financial organizations with the aim of reducing employers' costs in the field of payment of compulsory payments. However, in most developed countries with compulsory social insurance, including Germany, In order to ensure close cooperation with employers in the assessment and payment of insurance premiums, the administration of insurance premiums is carried out by the Social Insurance Administration [23–25]. The evolution of the debt situation of organizations of certain economic activities on payments to government extra budgetary funds (at the end of the year) is according to data from *Table 1*.

Official statistics allow us to conclude that for the period from 2017 to 2019, the arrears in payments to government off-budget funds for all types of economic activity increased from 344.5 to 382.8 bln rub., of which 42.7 bln rub.— it is amounts to arrears. To assess the scale of the debt, we note that its amount for 2019 almost tripled the need for financial provision of compulsory social insurance against industrial accidents and occupational diseases (128.3 bln rub.).

The analysis shows that the increase in the non-payment of insurance premiums occurred for most economic activities other than construction, real estate operations and public administration. A positive result is the reduction in total overdue accounts payable, which decreased from 14.7% in 2017 to 11.1% in 2019 [26]. However, it has increased markedly: this applies to culture (more than 4 times growth); mining (13.4% growth) and trade (2.3 times growth).

The share of arrears in payments to government extra budgetary funds by type of activity "Manufacturing production" at the end of 2019 was 12.4%, which exceeded the average for all activities — 11.1%. That is, there is an objective gap between total payments and accumulated debt, the reduction of which is one of the most important possibilities for improving the financial security of social insurance institutions in the current conditions [27].

In our opinion, the growth of accounts payable on insurance premiums payments to government extra budgetary funds — this is not only and not so much the result of the transition to the new system of administration of insurance premiums. We consider that the reasons of this phenomenon are related in the market economy to the efficiency of management of all factors of production, including current assets or working capital. Consider a number of important prerequisites of the current situation in more detail.

One of the criteria of efficiency of management of working capital of an

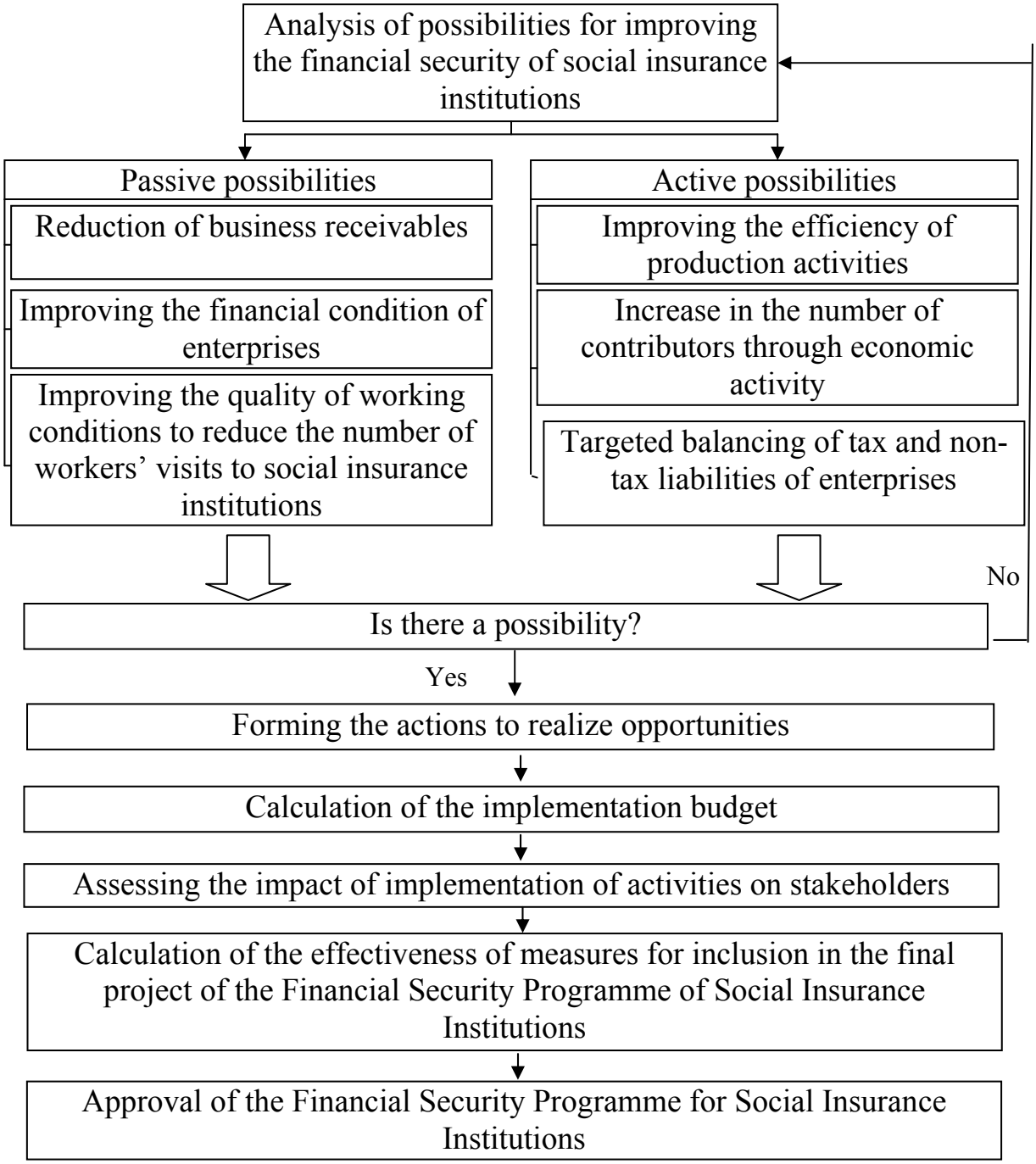

Fig. 4. **Algorithm for the formation of the Program of financial support of social insurance institutions**
Source: developed by the author.

enterprise is the amount of receivables of buyers, including arrears [28, 29]. The presence of such arrears signals the risk of late repayment of funds and their depreciation due to inflation. This occurs when the supplier of the goods does not pay attention to analyse the financial situation of potential buyers of the products, optimize the payment for the goods and services provided, identify the reasons for the delay in payment in a timely manner and prosecute the debtors [30].

Ultimately, the creation of uncontrolled buyers' receivables undermines the financial sustainability of the contributor. Therefore, the analysis of accounts receivable by type of economic activity is an important element

Table 1

Dynamics of arrears on payments to off-budget funds by certain types of economic activity

Economic activities	2019	2017
Water supply, sewerage, waste management and remediation activities	34.65%	34.80%
Manufacturing industries	12.38%	15.68%
Wholesale and retail trade, repair of motor vehicles	1.65%	0.95%
Financial and insurance activities	1.33%	0.98%
Information and communication activities	0.68%	0.75%
Public administration and provision of military security	0.66%	6.55%
Accommodation and food service activities	0.33%	0.99%
TOTAL	11.15%	14.72%

Source: Rosstat: 1) data are given for the main type of activities of organizations, excluding activities of financial organizations; 2) without small businesses.

of managing the resources of insurance institutions. For example, *Fig. 5* shows that total receivables for all economic activities exceeded 50 trn rub., of which 46.4%, or about 23.5 trn rub.— it is the buyers' accounts receivable.

This means that the own funds of organizations — producing goods, works and services are in the economic circulation of buyers and are at risk of non-recovery and loss of their original value due to inflation. In comparison, insurance premiums forecast twice exceed in the Pension Fund of the Russian Federation, the Social Insurance Fund of the Russian Federation and the Federal Compulsory Medical Insurance Fund (11 499.1 bln rub.), provided by federal laws for 2019.

The existence of the risk of non-recovery or late return of receivables by buyers is evidenced by the data on the presence of its arrears, the size of which amounted to the results of 2019–1897.2 bln rub., and exceeded insurance contributions to the Federal Compulsory Medical Insurance Fund (1862.2).

Among the listed economic activities, a significant amount of the buyers' receivables was "Manufacturing industries" 6470.9 bln rub., or 42.8% to total buyer's debt. At the same time, more than 400 bln rub. or 6.2%, there was a arrears.

The analysis of the arrears on the payments of insurance premiums to the social insurance funds showed that it was caused not only by the formation of late receivables of buyers, as mentioned above, but also insufficient economic efficiency of enterprises and organizations. This is evidenced by the level of return on assets, sales and losses incurred by enterprises for 2019.

Summarizing the overall situation in the manufacturing industry, it should be noted that according to officially published statistics, for 2019, a loss of 1 937.8 bln rub. was received for all types of economic activity, and share of loss-making organizations more than 26%.[2]

Considering active opportunities, we believe that the main source of stimulation of financial activity is the development strategies by economic activity. These documents are adopted at the level of the relevant authorities and are intended to create legal conditions for increasing business activity in the production of certain products, works or services.

[2] See, for example, source: Rosstat "Russia in Figures". Official Edition. 2020.

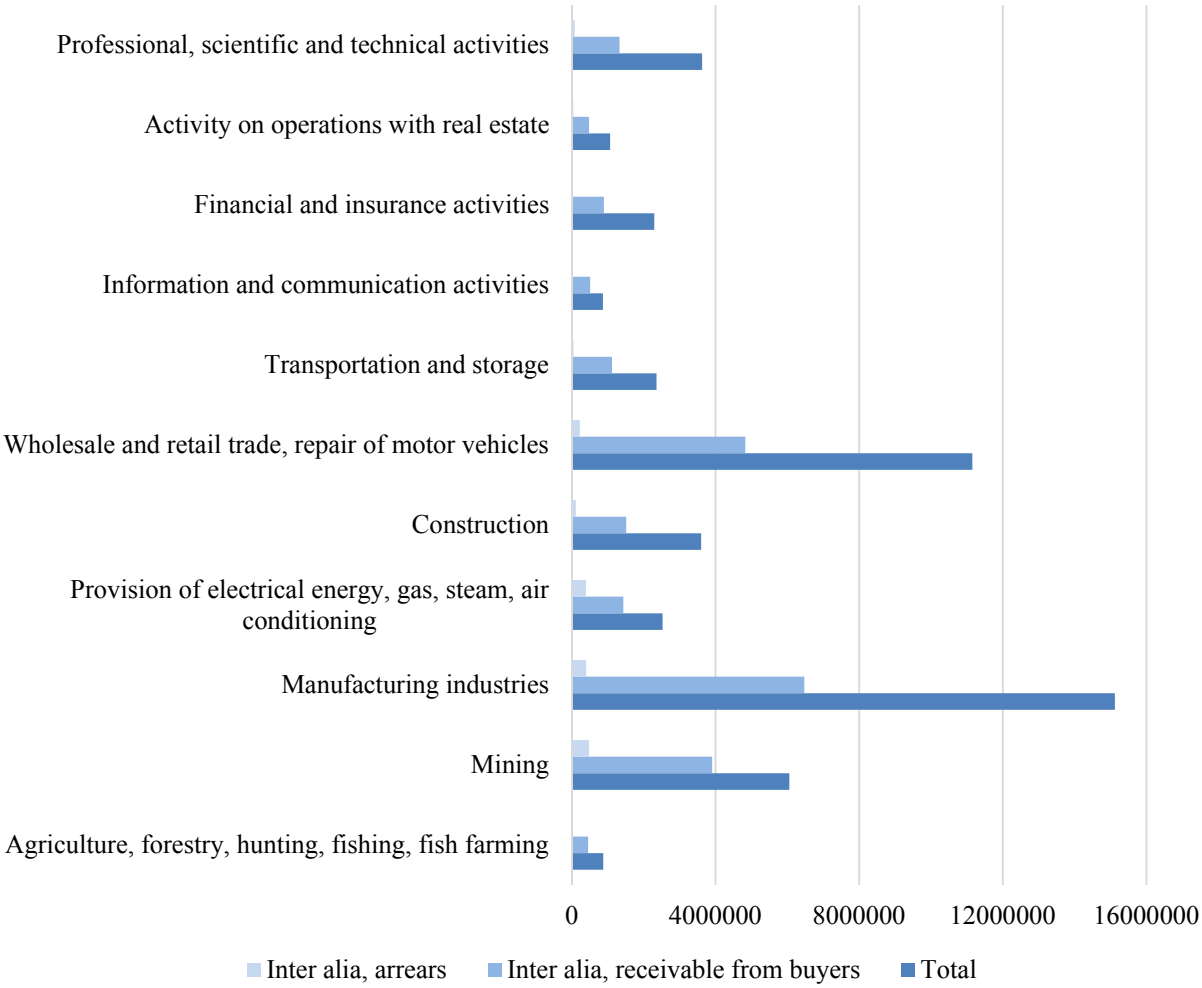

Fig. 5. **Structure of accounts receivable of enterprises by type of economic activity**

Source: Rosstat "Russia in Figures". Official publication. 2020.

In particular, in the Decree of the Government of the Russian Federation No. 1512 from 06 June 2020, on the approval of the Consolidated Strategy for the Development of the Manufacturing Industry of the Russian Federation to 2024 and until 2035, emphasizes, that "at the present stage, the activity of the manufacturing industry is intended to contribute not only to the development of the industrial potential of the country, but also to increase the flexibility to respond to threats in the field of economic, environmental and biological security".[3]

Generally, however, the strategies adopted do not reflect the real needs of enterprises to create the conditions for improving the business environment. For example, our survey among the heads of enterprises belonging to the type of economic activity "Manufacturing industries" allowed to identify the key factors, which, according to the respondents, most likely to improve the efficiency of current industrial production (*Fig. 6*).

Based on the results obtained it is possible to conclude that the most significant factor, according to the respondents (sum of the answers "Strong influence" and "Relatively high influence"), are factors "Productivity growth" — 86.4% respondents, "Improve the quality of products" — 84.8% respondents, "Investment in human capital" — 82.3% respondents, and "Technological innovation" — 82.1% respondents. The

[3] Decree of the Government of the Russian Federation No. 1512 from 06 June 2020 "Consolidated Strategy for the Development of the Manufacturing Industry of the Russian Federation to 2024 and until 2035".

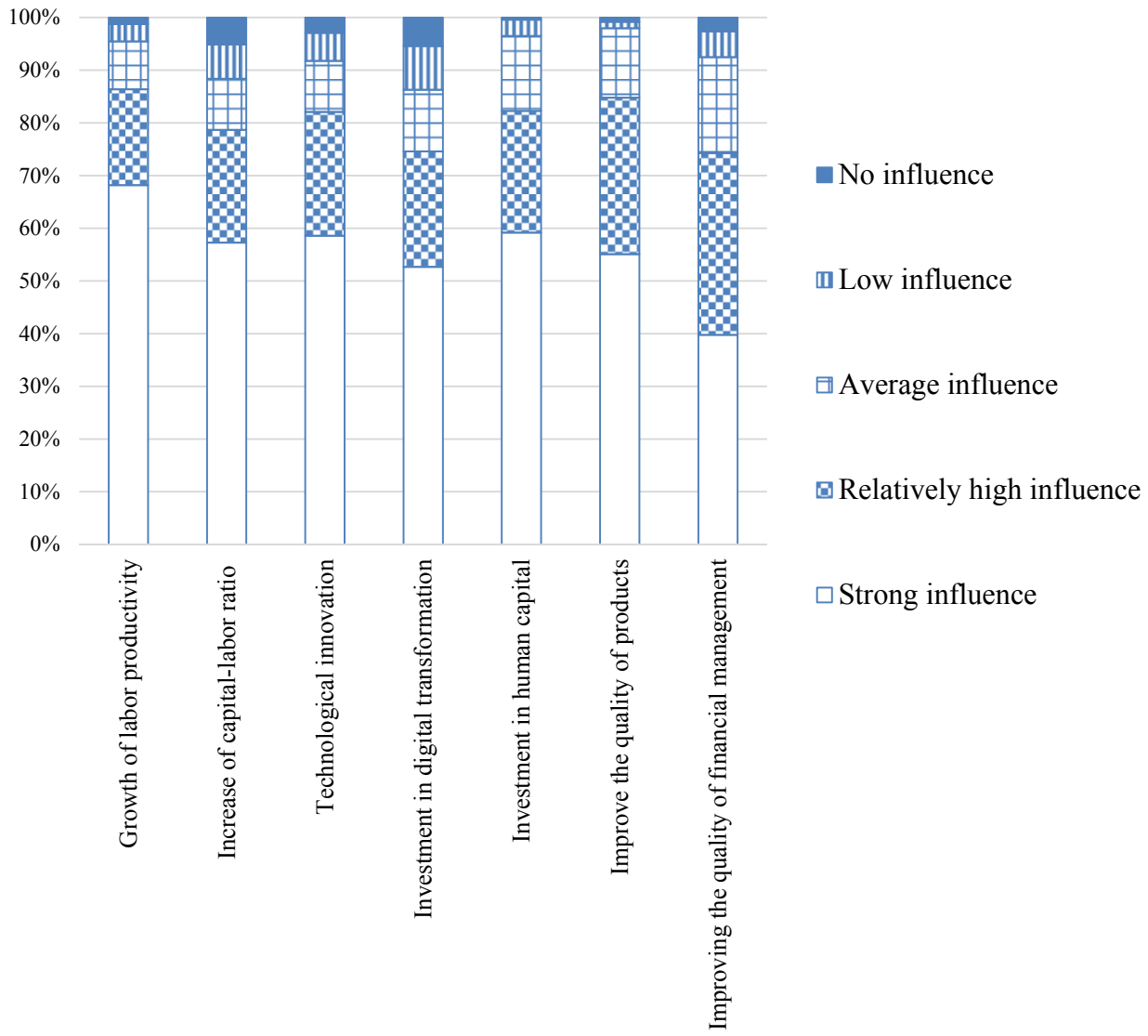

Fig. 6. **Results of a survey on the importance of factors that ensure the efficiency of production activities of enterprises of the type of economic activity "Manufacturing"**

Source: built by the author based on the results of his own surveys.

importance of other factors is between 74.3 and 78.7%.

Thus, it can be concluded that in the current conditions of development of the Russian economy productivity is a key indicator of efficiency of social production [20]. Nevertheless, relatively low labor productivity in Russia (*Fig. 7*) does not allow the domestic economy to successfully compete in manufacturing with the leading countries [32].

Information on the dynamics of growth (decrease) of labor productivity by the main types of economic activity of the Russian Federation (in % from the previous year) in the period from 2015–2018 is presented on *Fig. 8*. From the data shown in the figure, that since 2016, there has been a positive trend in the rate of productivity growth — by the results of 2018 for all economic activities the growth rate was 102.8 points by 2017. The exception is the economic activity "Manufacturing industries", where in 2018 there was a significant decline in the rate of labor productivity growth.

As is known, the main and decisive condition for increasing the rate of productivity growth is the full development and improvement of the means of labour. Living labour becomes more productive when it widely uses high-performance machines, equipment, instrumentation and working

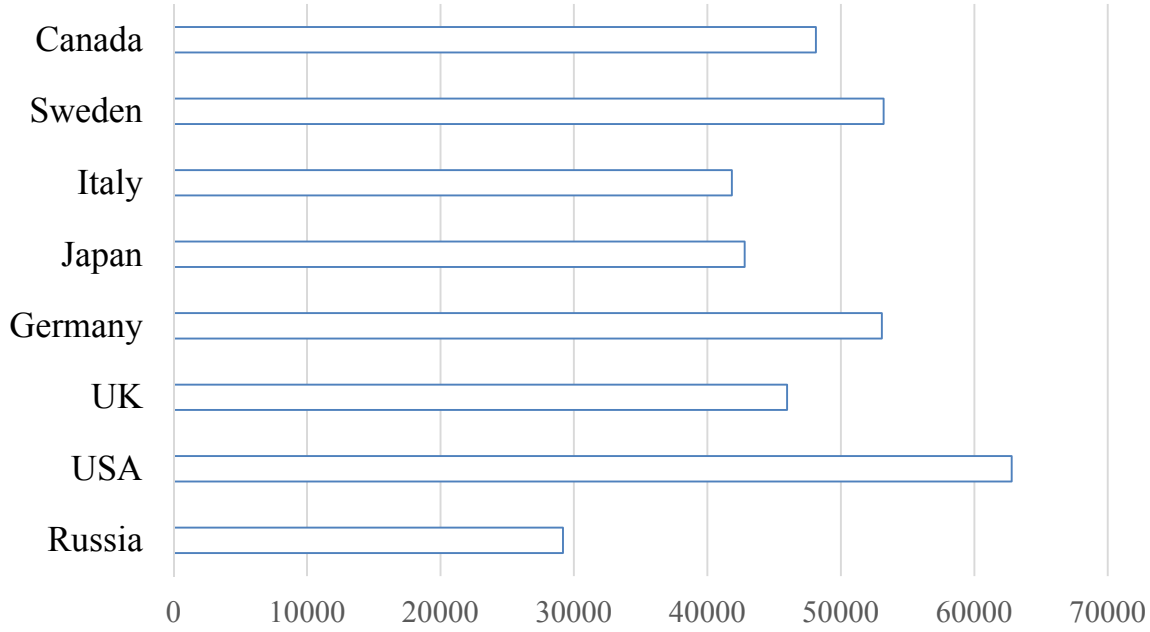

Fig. 7. **Labor productivity at purchasing power parity in US dollars**

Source: compiled by the author based on data from the statistical offices of the respective countries.

tools. Of particular importance is the renewal of productive assets, the timely replacement of obsolete means of labour with more productive ones.

It should be noted here that the manufacturing industry does not have the domestic financial resources to renew the means of labour. Practice shows that many businesses and organizations are finished with negative financial results in 2019. As a result, the industry has a high credit burden and a significant working capital deficit. On the basis of the conducted analysis, it is advisable to formulate a number of important results and record the existing opportunities for improving the financial security of social insurance institutions in Russia (*Table 2*).

From the *Table 2* shows that, according to the most cautious estimates, the most likely to improve the financial condition of enterprises in the long term. Improving opportunities in the short term is not feasible. Therefore, in our view, available opportunities must be taken very cautiously. To this end, it is advisable to use an appropriate methodology for evaluating the effectiveness of activities. To develop the methodology, consider a number of important concepts and assumptions:

— Estimated activity — short-term non-typical set of actions or works aimed at obtaining a given result. Measures are the single object of the effectiveness evaluation, within the framework of the Financial Security Program of Social Insurance Institutions.

— Budget to carry out the activities — a set of cost items, as well as monetary estimates of these items, which amount to the cost of a specific short-term non-typical set of actions or works. Allows to estimate the amount of financial provision required for the implementation of the Program as a whole, as well as its individual stages, blocks and sections.

— Impact of the event on stakeholders — for the purposes of the research the increase in the amount of payments of an individual enterprise, a group of enterprises, and the type of economic activity in the system of social insurance institutions.

Based on the *Table 2* it is advisable to highlight those opportunities that will be most effective in terms of research, i.e. the greatest increase in payments to social insurance institutions. In our view, it is advisable to consider opportunities with the lowest probability, as other opportunities are already

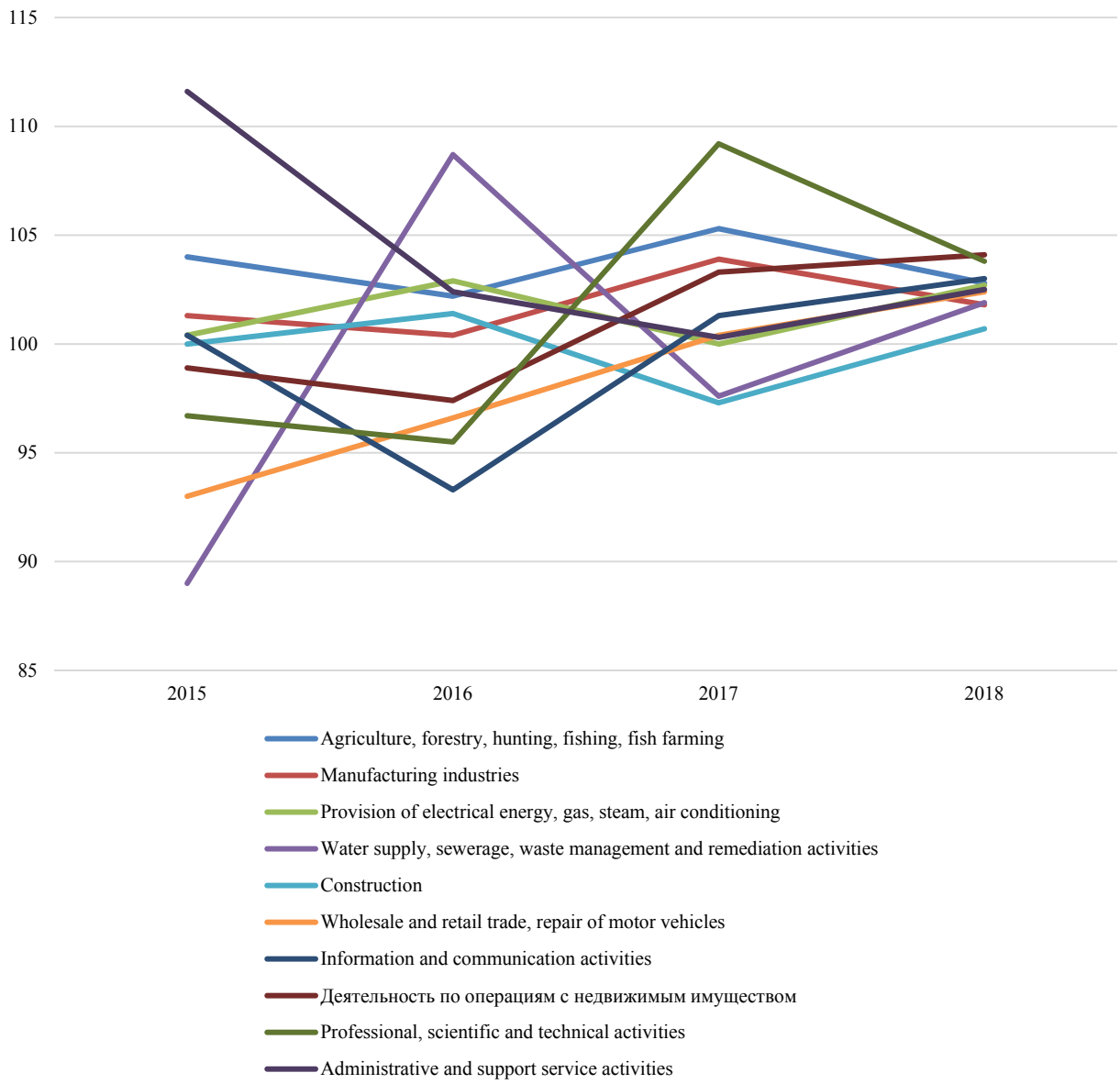

Fig. 8. **Dynamics of labor productivity by type of economic activity in the Russian Federation**
Source: Rosstat "Russia in Figures" official publication 2020.

included in sectoral strategies [33, 34]. Thus, the priorities for the design of the stimulus are:

- business accounts receivable reduction;
- targeted balancing of tax and non-tax liabilities of enterprises;
- increasing the number of contributors through the development of economic activities.

As the analysis of the specialized literature has shown, the problem of evaluating the effectiveness of stimulating the possibilities of financial support for the activities of social insurance institutions is practically not considered. Given the authority of the stakeholders and the decomposition of the Programme by main categories of participants, several sets of activities arise. In this case, the general form of the effectiveness evaluation formula (Ef_{MSII}) will be as follows:

$$Ef_{MISS} = \frac{\sum_{i=1}^{I} Et_i}{\sum_{i=1}^{I}\sum_{j=1}^{J} C_{ij}}, \quad (1)$$

where Ef_{MSII} — effectiveness of measures for social insurance institutions; Et_i — effect (increase of payments to the system of

Table 2

Assessment of opportunities for improving the financial provision of social insurance institutions

	Short-term period	Medium-term period	Long-term period
Reduction of accounts receivable	No probability	The probability is average	The probability is high
Improving the financial condition of enterprises	The probability is low	The probability is high	A reliable event
Improving the quality of working conditions to reduce the number of workers' visits to social insurance institutions	The probability is low	The probability is average	The probability is high
Targeted balancing of tax and non-tax liabilities of enterprises	No probability	The probability is low	The probability is average
Increase in the number of contributors through economic activity	No probability	No probability	The probability is low
Improving the efficiency of production activities	The probability is low	The probability is low	The probability is average

Source: developed by the author based on an analysis of industry strategies.

social insurance institutions) from the implementation of the *i*- activity; C_{ij} — cost of the *j*-й interested party for the implementation of the *i*-activity within the Program.

The effects are estimated on the basis of general statistics on payments to the social insurance institution system, so it is estimated as the aggregate growth of income of social insurance institutions. If sufficient information is available, further factor analysis of the increase in payments is warranted. No such statistics are currently available, so the estimation is based on probability parameter to evaluate. With this approach, formula (1) takes the following form:

$$Ef_{MSII} = \frac{\sum_{i=1}^{I} M\left(Et_i\right)}{\sum_{i=1}^{I}\sum_{j=1}^{J} M\left(C_{ij}\right)}, \qquad (2)$$

where $M(Et_i)$ — mathematical expectation of effect (increase of payments to the system of social insurance institutions) from the implementation of *i*-activity; $M(C_{ij})$ — mathematical expectation of costs of the *j*-й interested party for the implementation of *i*-activity within the Program.

In order to quantify effectiveness, it is advisable to formulate a preliminary list of activities for each opportunity identified. In our opinion, the following activities are in demand:

Possibility 1 — reduction accounts receivable of enterprises:

Activity 1.1 — creation of bill chains to detect defaults under the guarantee of a reliable issuer (Vnesheconombank, Sberbank, VTB and others);

Activity 1.2 — active use of judicial procedures to enforce debt repayment;

Activity 1.3 — Formation of state-owned nodes in payment chains for interim targeted debt.

Possibility 2 — targeted balancing of tax and non-tax liabilities of enterprises:

Activity 2.1 — amending tax legislation to reduce federal tax payments for bona fide contributors in social insurance system;

Activity 2.2 — general reduction of taxes on new property to release funds for current payments to social insurance institutions.

Possibility 3 — increase the number of contributors through the development of economic activities:

Activity 3.1 — introduction of investment tax holidays for newly established enterprises and organizations for a period of up to 3 years, followed by a rolling change in property taxes;

Activity 3.2 — amendment of tax-exempt legislation for the period of return on investment for enterprises that produce products and are a priority for the implementation of the national import substitution programme.

Obviously, this list of activities is not exhaustive, but contains the most relevant proposals for the revitalization of the economic activity "Manufacturing industries", therefore requires appropriate cost and impact assessment. In our opinion, it is advisable to estimate the costs of each activity separately, and as an example we will consider the costs of only one interested party — the State.

The costs of other stakeholders may also be estimated with some assumptions, but to demonstrate the viability of the methodology, the valuation data appear to be redundant and require additional labour cost beyond the scope of this article. However, the estimation of the mathematical expectation of the cumulative effect is possible but will not be fully reliable due to the probabilistic nature of the approximate calculation.

The estimation of the State's expenditures on the measures is made taking into account the main results of the Russian economy's financial activity during the past periods. Under this approach, the cost of activity 1.1 could amount to up to 2% of the total amount of overdue accounts receivable — this is the average value of the bank's financial performance guarantee. On the basis of *Fig. 5*, we can conclude that the preliminary estimate of the cost of Activity 1.1 are 129417.72 mln rub.

Practice shows that the cost of judicial proceedings is up to 1.6% of the total value of disputed amounts. That is, for the interested parties of the activity "Manufacturing industries" this sum as the cost of the Activity 1.2 will amount to 103534.18 mln rub.

In turn, the provision of State-owned nodes in the default chain is cost-free, however, allocation of target subsidies to intermediate arrears may be up to 135888.61 mln rub., i.e. the cost of financing Activity 1.3. Thus, the total maximum amount of expenses for the financing of activities for the implementation of the Possibility 1 will be 368840.50 mln rub., which in comparison with the revenue of the federal budget for 2021, is 1.96%.

In reality, however, it is not possible to implement all activities within one year, so it is advisable to divide this cost by 3 years, which may be required to implement these activities nationwide. Then the annual costs will amount to 122946.83 mln rub., which is comparable to the total amount of payments of a given economic activity to the system of social insurance institutions.

If we consider the complete elimination of defaults in the system of social insurance institutions as an effect of the realization of Possibility 1, the evaluation of the annual efficiency under this assumption will be:

$$Ef_{MSII\,1} = \frac{13300}{122947} \times 100\% = 10.82\%$$

This level of efficiency seems to be high enough for the State's efforts to improve the financial security of social insurance institutions. Similar to the example given of probabilistic evaluation of the effectiveness of measures, if Possibility 1, tax activities may also be evaluated. As a cost to the State is the amount of tax revenue, and as a result — growth in payments as a share of the emerging aggregate wage fund.

The use of probability categories allows account corrections on assumptions and correct the estimates for future years, increasing accuracy for stakeholders. In our opinion, this approach is currently the most appropriate in terms of planning and

forecasting the financial parameters of social insurance institutions.

CONCLUSION

1. The main financial indicators of the income of social insurance institutions have been negative for a number of years — share of insurance contributions of total income not exceeding 65%. This means that additional measures are needed to stimulate the activities of insurers in order to reduce the level of actual debt on insurance premiums and to raise the tariff base.

2. One of the main positions in the structure of insurance contributions to State off-budget insurance funds occupies the type of economic activity "Manufacturing industries", which is due to the priority of enterprises and organizations of this type in the turnover of goods, works, services and labor costs.

3. However, the manufacturing industry has currently significant arrears to social insurance institutions owing to weaknesses in financial management, high depreciation of fixed assets and the use of costly technologies in production.

4. For such economic activities as "Manufacturing industries", that contribute most to the financial protection of the population from social risks, is requires the renewal of the state technological, investment and financial policies and the large-scale involvement of innovative industrial institutions in the modernization of the existing economic mechanism.

5. It would also be necessary to entrust a person, who decision makers on industrial policy in Russia, including specialists from the Ministry of Industry and Trade of the Russian Federation, the Ministry of Finance of the Russian Federation and the Federal Tax Service of the Russian Federation, are develop, together with social insurance institutions, an algorithm of actions to put manufacturing industry on a trajectory of financial sustainability and stabilization of solvency, using tools, contained in the Order of the Government of the Russian Federation No. 1512 from 06 June 2020.

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Financing of Public Health Care for the Population of the Russian Federation: To Maintain Multichannel or Switch to a Single Payer System?

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ABSTRACT

The subject of the research is the models of collection and consolidation (pooling) of resources for payment of public (free at the place of delivery) medical care to the population in developed countries and in the Russian Federation. **The purpose** of the study is to develop practical recommendations on the development of a system for financing medical guarantees for the population of the Russian Federation. **The relevance** of the study is due to the lack of resources to pay for public health care for the entire population in our country. The scientific **novelty** lies in the comparison of single-channel and multichannel pooling models used by developed countries in terms of their financial-economic and medico-social efficiency with the conclusion about a higher level of costs of the multichannel model with a comparable level of coverage with medical services of the population and indicators of its health compared to the model single payer. The research **methodology** is based on the use of complex, statistical, comparative and retrospective analyzes. It was **concluded** that the use of a multichannel pooling model in the financing of healthcare in the Russian Federation with the participation of competing insurers and the use of different channels of budgetary financing for different groups of the population is an important reason for the low efficiency of the Russian healthcare system. **The prospect** of further research is in the formation of a scientific and methodological justification for replacing the multichannel pooling model, which has historically developed in healthcare in Russia, with a single-channel model of a single payer represented by the Federal Compulsory Medical Insurance Fund (hereinafter- CMIF).

Keywords: health care financing; single payer model; competing insurer model; health care efficiency; CMIF; consolidation (pooling) of financing; universal health care

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INTRODUCTION

One of the key functions of the health financing system is the so-called pooling — collection and consolidation of funds for the payment of medical care to the population.[1] Authors identify "single pool" systems; territorially separate pools; geographically overlapping pools in terms of services and coverage; different pools for different socio-economic groups with segmented populations; different pools for different population groups; combination of several competing pools with risk adjustment for pools; fragmented systems with voluntary health insurance, duplicating State funded insurance [1–3]. However, the authors consider that from the point of view of social solidarity and the pooling of risks with the outward diversity of approaches to pooling in different countries the choice between the two main models is a matter of principle: between a single-channel model of a single payer (single pool system) and a multi-channel model involving competing insurers and/or using several different channels (pools) of budget financing for different population groups. Considering that in the Russian practice of health care the concept of "pool" is practically not used, the authors apply the more common and understandable equivalents of the word to Russian-speaking readers: "channel" and "payer".

A single-channel single payer system (State or national insurer) can take two forms. The first (non-market) option concentrates most of the financial resources in the budget of the national Ministry of Health, which finances a subordinate public health infrastructure — i.e. there is no clear separation between buyer and provider of medical services. It is noteworthy that today such a system exists not only in countries with communist backgrounds (for example, Cuba and Belarus), but also in countries with market economies and small, compact territories — for example, Malta, Eswatini, Sri Lanka [4].[2]

The second (market) version of the single-channel single-payer system envisages the delegation of the function of financing public health care to the entire population of the authorized non-profit organization or public agency, which consolidates income from all sources of income (insurance premiums, budget expenditures, etc.) and makes all payments for medical care provided to the population. At the same time, consumers are free to choose competing treatment facilities. Thus, the maintenance of market relations combined with the market power (monopsony) of a single payer makes it possible to obtain high-quality services from medical institutions while keeping prices low. Administrative and transaction costs are reduced, queues are solved and quality growth and cost reduction are stimulated [5]. Single payer systems are usually more progressive and effective, combining risks, offering the government a higher level of control over health costs. They ensure a more effective redistribution of resources: from young to old, from rich to poor, from childless to multi-child [6].

On the contrary, multi-channel systems with more payers sacrifice this control and effectiveness for the benefit of their beneficiaries, which can be, for example, owners of insurance companies, top managers of regional, departmental and corporate channels, as well as privileged groups of consumers. This is the opposite process to the pooling of risks, —

[1] World Health Organization. Financing health systems. 2008. URL: https://www.who.int/healthinfo/statistics/toolkit_hss/EN_PDF_Toolkit_HSS_Financing.pdf (accessed on 02.11.2021); Financing health systems: the way to universal coverage. World Health Report. Geneva: World Health Organization. 2010. 106 p. URL: https://apps.who.int/iris/handle/10665/87685 (accessed on 09.10.2021).

[2] World Health Organization. Global Health Expenditure Database: National Health Accounts. URL: http://apps.who.int/nha/database (accessed on 01.09.2018); Ministry of Health Swaziland. The Second National Health Sector Strategy Plan 2014–2018: Towards attainment of Universal Health Coverage. Draft Zero. 2014. URL: https://extranet.who.int/countryplanningcycles/sites/default/files/planning_cycle_repository/swaziland/swaziland_nhssp_ii_draft_zero_29_aug_2014.pdf (accessed on 30.10.2021).

fragmentation of pools (channels), which is a key obstacle to universal health coverage. Fragmentation contributes to health system inefficiencies. Usually it implies duplication (or multiplication) of the number of agencies needed to manage pools and procurement, increase in administrative costs. System-wide costs of multiple information systems are increasing, and administrative staff are increasing with overlapping responsibilities. Increased costs are also inevitable due to selection of "bad" risks — for example, with voluntary health insurance [7–11].[3]

Historically, the idea of a single-channel single-payer model was first suggested by V. Lenin, which in 1912 at the Prague All-Russian Conference of the RSDLP during the discussion of the bill on state insurance of workers adopted by the Duma of the Russian Empire put forward an alternative program, which provided for a state (non-commercial) The nature of social insurance and the implementation not only of health insurance but also of all types of social insurance by a single authority [12]. However, in practice this approach in health care was implemented much later — in the USA as part of the Medicare Government's Program of Public Funding for Treatment of the Elderly and Disabled. Hence another common name for the model — "Medicare-for-all", often used by politicians to make their health agenda more understandable to voters [13].

Today, Norway, Taiwan, South Korea, United Kingdom, Sweden, Denmark, Finland, New Zealand, Australia, Portugal, Italy, Spain, Iceland, Canada uses a single-channel single-payer system from developed countries. All other developed countries use so-called multi-channel systems in which health-care revenues are fragmented into several budget channels and/or divided among competing insurers [14–16]. The highest level of multi-channel funding today has very different, at first glance, health systems of the USA and Russia.

In the US, the voluntary health insurance market for the working population competes with the commercial insurers, while the non-working population is paid for through many independent budgetary channels. About 35% of the US population receives federal or state-funded health care across a range of programs: Medicare (assistance to all older Americans over 65 years of age, as well as to disabled and haemodialysis patients); Medicaid (assistance to people whose income is equal to or less than the poverty threshold); CHIP (assistance to children from low-income families); Tricare (military personnel, retired military personnel and their families); VHA (war veterans' health care); HIS (health services for the Indian territories); FEHB (for current and retired federal employees); RHP — Refugee Health Program, etc. [17].

In turn, the Russian health care system inherited multi-channel from the Soviet model of Semashko, where assistance to each social group of the population was paid for a separate channel, relatively independent of others. Medical assistance to the rural population in the USSR was partly financed by collective farms (which bore the bulk of the costs), to a lesser extent by local governments (village councils). Autonomous departmental medical systems have been established for officials, the military, individual workers and prisoners, who receive funding from the budgets of the relevant ministries. Enterprises incurred a significant part of the cost of maintaining "their" guild doctors, factory medical units and hospitals. Trade unions-maintained health centres and sanatoriums. After the reforms of the 1990s, the multi-channel funding of assistance to different groups of the population, firstly, was strengthened by the growth of the autonomy of channels. Whereas in the USSR, the interests of

[3] World Health Organization (WHO). Everybody's business-strengthening health systems to improve health outcomes: WHO's framework for action. Geneva: WHO. 2007. URL: https://www.who.int/healthsystems/strategy/everybodys_business.pdf (accessed on 05.11.2021).

affordability to the population dominated departmental interests (for example, military hospitals and factory hospitals worked for the benefit of territorial health systems — for example, were involved in the provision of emergency assistance to the population), today assistance of departmental systems is available to the rest of the population only in the format of paid services. Second, the number of quasi-autonomous departmental and state-owned health-care systems has increased dramatically — as in the form of creation and development of «own» medical organizations, and agreements of voluntary health insurance (VHI), which are paid from income tax advantages, personal income tax and contributions to off-budget funds. Third, to the Soviet multi-channel funding of assistance to certain groups and categories of the population has been added the multi-channel payment of certain services guaranteed by the State. Currently, payment for different phases of one patient's care in one case is often shared by the compulsory health insurance (CHI) system, regional budget, federal budget, Social Insurance Fund and Pension Fund of Russia. Under the CHI, the costs are shared by the competing health insurance organizations, and part by the CHI Federal Fund (with respect to the payment of care provided by federal medical organizations). In addition, there is a duplication of the same medical guarantees — for example, in large cities, many Russians have a package CHI + VHI, CHI + departmental medicine [18, 19].

Years of co-existence of different working models of pooling of public health care finance (often in neighboring States) — the reason why research has been conducted and published for decades to try to compare their effectiveness.

At first glance, the efficiency of multi-channel and single-channel models is about the same. Thus, according to the agency Bloomberg, which regularly publishes the index The Most Efficient Health Care, calculated on the ratio of national expenditures for medicine and achieved life expectancy (*Table 1*), among the top 15 countries, the number of countries with single-channel and multi-channel models is about the same.

Tried to look more closely at the problem of comparing different funding models in 1996 by J. Elola. He compared health indicators (infant mortality, life expectancy, potential lost years of life, health expenditure as a percentage of GDP and per capita) and the satisfaction of the population of some European countries with their health-care system for 1992 year [20]. The author did not find a significant difference in health indicators with lower costs of "single payer" systems and higher subjective satisfaction of the population with health services in countries with a model of competing insurers. The obtained data gave the author the reason to conclude that the goal of the reforms of the European health care should be the mutual convergence of different models in the search for a compromise between consumer satisfaction and cost containment.

After that R. B. Saltman, R. Busse and J. Figueras made another attempt to compare the effectiveness of different models of health financing [21] over a wider range of indicators — not only costs, longevity and user satisfaction, but also waiting lists (queues), equity of funding and quality ratings. Like J. Elola, the authors postulated a higher satisfaction of the population with the model of competing insurers, found no appreciable difference in health indicators and a higher efficiency of the "single payer" model in terms of cost containment. They concluded their work with the conclusion that the evaluation of effectiveness should focus on what is more important: the cost reduction factor (affordability of medical care) or the subjective satisfaction of patients.

N. Kravchenko and A. Ragozin [22, 23] made the first attempt in Russia to compare the effectiveness of different

Table 1

TOP-15 rating by Bloomberg The Most Efficient Health Care 2017–2018. Countries with a single payer model are highlighted in green

Position		Country	Efficiency	Expected average life expectancy	Total health care costs	
2017	2018				% Of GDP	US dollars per capita in PPP
1	1	Hong Kong	87.3	84.3	5.7	2222
2	2	Singapore	85.6	82.7	4.3	2280
3	3	Spain	69.3	82.8	9.2	2354
4	6	Italy	67.6	82.5	9.0	2700
5	4	South Korea	67.4	82.0	7.4	2013
6	7	Israel	67.0	82.0	7.4	2756
7	5	Japan	64.3	83.8	10.9	3733
8	10	Australia	62.0	82.4	9.4	4934
9	12	Taiwan	60.8	79.7	6.2	1401
10	9	UAE	59.7	77.1	3.5	1402
11	20	Norway	58.9	82.3	10.0	7464
12	14	Switzerland	58.4	82.9	12.1	9818
13	-	Ireland	58.2	81.5	7.8	4757
14	13	Greece	56.0	81.0	8.4	1505
15	-	New Zealand	55.6	81.5	9.3	3554

Source: compiled by the authors based on: Bloomberg.com. URL: https://www.bloomberg.com/graphics/infographics/most-efficient-health-care-around-the-world.html. (accessed on: 18.08.2021).

health financing systems, which did not compare the satisfaction of the population, a Focused on assessing the ratio of health expenditure to managed health indicators. As a result, they concluded that national health systems in countries using the single-payer model are more efficient than those with a multi-channel model, and this pattern does not depend on geographical location, and development of the country's economy.

MATERIALS AND METHODS

This study compared some indicators of health expenditure, resource endowment, effectiveness of HiAP policies ("Health in All Policies") and achieved of health indicators, on the one hand, by developed countries (IMF classification) with single-channel single-payer model (Norway, Taiwan, South Korea, United Kingdom, Sweden, Denmark, Finland, New Zealand, Australia, Portugal, Italy, Spain, Iceland, Canada), on the other hand — countries with multi-channel model (Austria, Belgium, Cyprus, Czech Republic, Estonia, France, Germany, Greece, Israel, Japan, Latvia, Lithuania, Netherlands, Slovakia, Slovenia, USA and Switzerland), as well as (separately) using the multi-channel model of the Russian Federation. Taking into account the specificity of the US health system and the impact of its population on the statistics of the group of countries with a multichannel model, data from this group with and without US indicators are given.

Although in terms of pooling (pooling) of resources, there is no difference between a "non-market" and a "market" option to a single-channel single-payer system (see above) their effectiveness is significantly affected by differences in other parts of the health-care financing technology chain — for example, differences in payment mechanisms for health services and cost management. Therefore, the study compared market systems only.

Results of comparison are shown in summary *Tables 2–5*.

DISCUSSION

Healthcare cost comparison

The data obtained support the conclusions of other authors that the use of the model of competing insurers is related, on the one hand, to statistically significant growth in total health expenditure: in 2018–1.4% more GDP excluding the United States, and with the United States included — 4.4% more GDP than with the single payer model. Consequently, a multi-channel model requires significantly higher public health spending as absolute (in 2018–786 USD per capita), and as a share of total public spending (in 2018–2.8% more) compared to the single payer model.

At the same time, the use of the single payer model requires a higher share of personal expenditures of the population (Out-of-Pocket) in current health care expenditures (in 2018–20% versus 12.5%) in countries with a multi-channel model. However, this factor is largely offset by the lower absolute cost. For example, in the 2018 study, the weighted average personal expenditure of the population in countries with a single payer model was 838.6 USD per capita, which is only 151.4 USD more than in countries with a multi-channel model (687.1 USD per capita in year). In view of this fact, the growth of the share of personal expenditures of the population in current health expenditures in the single-payer model is of little significance for the population of developed countries in terms of reduced financial access to health care.

The level of both total and public health expenditure in the Russian Federation, both in absolute and relative terms, is many times lower than that of developed countries. It seems that this makes it impossible to adequately fund modern public health care for the entire population and objectively requires a pronounced de facto inequality of the rights of Russian citizens to health care. The scarcity of resources is compounded by the Russian Federation's use of a knowingly more expensive multi-channel health-care

Table 2

Healthcare costs (2018)

Weighted average	Countries with a single payer model	Country with multichannel model		Russian Federation (multichannel model)
		All	Without USA	
Total health care costs, % Of GDP[a]	9.2	13.6	10.6	5.32
Current health expenditure per capita in PPP, US dollars[b]	4193	7649	4979	1488
Government spending on health care per capita PPP, US dollars[c]	3101	4514	3759	885
Government spending on health as a percentage of total government spending, %[d]	15.4	19.7	18.2	9.49
Share of personal spending of the population (Out-of-Pocket) in current spending on health care, %[e]	20.0	12.5	13.8	45.85

Source: compiled by the authors based on data from the World Health Organization.

Notes: [a] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/total-expenditure-on-health-as-a-percentage-of-gross-domestic-product (accessed on 20.09.2021); [b] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/current-health-expenditure-(che)-per-capita-in-ppp-int-usd (accessed on 01.09.2021); [c] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/domestic-general-government-health-expenditure-(gghe-d)-per-capita-in-ppp-int (accessed on 01.09.2021); [d] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/general-government-expenditure-on-health-as-a-percentage-of-total-government-expenditure (accessed on 20.09.2021); [e] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/out-of-pocket-expenditure-on-health-as-percentage-of-total-health-expenditure (accessed on 20.09.2021).

Table 3

Provision of health care resources and efficiency of their use (2015)

Weighted average	Countries with a single payer model	Country with multichannel model		Russian Federation (multichannel model)
		All	Without USA	
Hospital bed availability (per 10,000 population)[a]	43.1	59.2	87.2	81.6
Physicians density (per 1000 population)[b]	3.2	3.0	3.3	3.98
Skilled health professionals density (per10 000 population)[c]	114.9	131.5	144.3	126.6
Provision of nurses and midwives (per 10,000 population)[d]	83.3	128.0	112.0	45.33
Health service coverage index, % of population, 2017[e]	85	83	81	75

Source: compiled by the authors based on data from the World Health Organization.

Notes: [a] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/hospital-beds-(per-10–000-population) (accessed on 25.09.2021); [b] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/physicians-density-(per-1000-population) (accessed on 25.09.2021); [c] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/skilled-health-professionals-density-(per-10–000-population) (accessed on 22.09.2021); [d] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/nursing-and-midwifery-personnel-(per-10–000-population) (accessed on 22.09.2021); [e] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/uhc-index-of-service-coverage (accessed on 25.10.2021).

Table 4

Some indicators of the effectiveness of the HiAP policy ("Health in All Policies")

Weighted average	Countries with a single payer model	Country with multichannel model		Russian Federation (multichannel model)
		All	Without USA	
Prevalence-of-obesity among adults (bmi over 30), 2016[a]	23.8	26.9	17.6	25.7
Alcohol consumption among persons 15 and older, liters of pure alcohol per person per year, 2019[b]	10.0	10.6	11.2	10.5
Share of smokers among persons aged 15 and over, 2018[c]	21.7	26.2	27.1	28.3
Environmental mortality, deaths per 100,000 population, 2012[d]	49.1	53.7	50.4	176.3
Suicides per 100,000 population, 2019[e]	12.3	14.8	13.7	14.1
Road traffic deaths per 100,000 population, 2019[f]	5.1	8.3	4.3	12.0
Homicides per 100,000 population, 2019[g]	1.0	3.1	0.7	7.9

Source: compiled by the authors based on data from the World Health Organization.

Notes: [a] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-obesity-among-adults-bmi-=-30-(crude-estimate)-(-) (accessed on 25.09.2021); [b] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/alcohol-consumption-among-adults-aged-=-15-years-(litres-of-pure-alcohol-per-person-per-year) (accessed on 25.09.2021); [c] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/age-standardized-prevalence-of-current-tobacco-smoking-among-persons-aged-15-years-and-older (accessed on 25.09.2021); [d] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/age-standardized-deaths-attributable-to-the-environment-(per-100-000-population)- (accessed on 05.10.2021); [e] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/suicide-mortality-rate-(per-100-000-population) (accessed on 06.10.2021); [f] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/estimated-road-traffic-death-rate-(per-100-000-population) (accessed on 06.10.2021); [g] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/estimates-of-rates-of-homicides-per-100-000-population (accessed on: 06.10.2021).

Table 5

Population health indicators

Indicators	Countries with a single payer model	Country with multichannel model		Russian Federation (multichannel model)
		All	Without USA	
Maternal mortality rate (number of mothers who die per 100,000 live births), 2015[a]	6.7	11.4	5.4	17.0
Neonatal mortality rate (deaths between birth and 28 days per 1000 live births), 2019[b]	2.2	2.7	1.8	2.6
Infant mortality rate (the number of deaths between the ages of birth and 1 year per 1000 live births), 2019[c]	3.1	4.1	2.8	6.0
Under 5 mortality rate (number of deaths, both sexes, per 1000 live births), 2020[d]	3.5	4.9	3.1	7.0
Total mortality of the adult population of working age 15–60 years old (number of deaths per 1000 population), 2015[e]	62.1	86.7	65.4	202.7
Probability of dying between the ages of 30 and 70 from cardiovascular diseases, cancer, diabetes, respiratory diseases, %, 2019[f]	9.2	11.9	10.4	24.2
Life expectancy at age 60 (years), 2019[g]	25.0	24.2	25.1	19.9

Table 5 (continued)

Indicators	Countries with a single payer model	Country with multichannel model		Russian Federation (multichannel model)
		All	Without USA	
Healthy life expectancy (HALE) at age 60 (years), 2019[h]	19.0	17.9	19.3	15.0
Life expectancy at birth life (years), 2019[i]	82.5	80.6	82.6	73.2
Healthy life expectancy (HALE) at birth, (years), 2019[j]	71.4	69.2	72.1	64.0

Source: compiled by the authors based on data from the World Health Organization.

Notes: [a] URL: 1https://www.who.int/data/gho/data/indicators/indicator-details/GHO/maternal-mortality-ratio-(per-100–000-live-births) (accessed on 28.10.2021); [b] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/neonatal-mortality-rate-(per-1000-live-births) (accessed on 28.10.2021); [c] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/infant-mortality-rate-(probability-of-dying-between-birth-and-age-1-per-1000-live-births) (accessed on 28.10.2021); [d] URL: https://population.un.org/wpp/DataQuery/ (accessed on 28.10.2021); [e] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/adult-mortality-rate-(probability-of-dying-between-15-and-60-years-per-1000-population) (accessed on 28.10.2021); [f] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/probability-(–)-of-dying-between-age-30-and-exact-age-70-from-any-of-cardiovascular-disease-cancer-diabetes-or-chronic-respiratory-disease (accessed on 28.10.2021); [g] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/life-expectancy-at-age-60-(years) (accessed on 28.10.2021); [h] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/gho-ghe-hale-healthy-life-expectancy-at-age-60 (accessed on 28.10.2021); [i] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/life-expectancy-at-birth-(years) (accessed on 28.10.2021); [j] URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/gho-ghe-hale-healthy-life-expectancy-at-birth (accessed on 28.10.2021).

resource pool system. Natural result — forced to compensate for the lack of public resources by imposing paid services, hence the abnormally high share of personal expenses of the Russian population in current health care expenditures — 45.85%, which corresponds to the countries of the "third world", for example, Haiti (in 2018–44%), Benin (45%), Central African Republic (42%) or Sierra Leone (45%).

Comparing the availability and effectiveness of health resources

The data obtained suggest that the use of multi-channel systems, compared to the single payer model, is associated with significantly higher resource requirements for almost all the indicators studied (availability of hospital beds, specialists, nurses and midwives), in addition to medical expertise, which is practically comparable.

At the same time, the higher resource requirements of multi-channel systems do not change the coverage of health services compared to the single-payer model, which suggests a better use of resources by single-channel models. Thus, in 2017, the index of population coverage of health services in developed countries with a single-channel model was 85%, in countries with a multi-channel model (excluding the USA) — 83%.

The higher efficiency of single-channel models further confirms that these models are generally used by countries with low population densities and poor transport networks [10], which objectively requires better resourcing and reduces the effectiveness of their use.

Comparison of HiAP policy performance indicators ("Health in All Policies")

On the one hand, countries with a single payer model have more effective health policies HiAP ("Health in All Policies") by several indicators: people in these countries smoke less, consume less alcohol, and there are fewer deaths due to pollution and suicide.

On the other hand, in countries with multi-channel pooling without US data, prevalence of obesity, traffic death rate and homicide. However, the situation changes to the opposite in the case of inclusion in the USA group — "champion" in the multi-channel pooling of health resources among developed countries. Taking into account the US, multi-channel countries lose in HiAP policy effectiveness for all studied indicators.

Research suggests that the commitment of the population of the Russian Federation to a healthy lifestyle (consumption of alcohol, tobacco, weight control) is comparable to the attitudes of the population of developed countries. At the same time in Russia mortality from pollution, road accident and criminal accidents is many times higher — what influences not the behavior of the population and the health system, but the effectiveness of general public policy and inter-agency collaboration in the field of health.

Comparison of health indicators

The study shows that developed countries' use of a more expensive model of competing insurers does not provide statistically significant advantages in health indicators, and if competing insurers are included in the group of countries — significantly worsens most of these indicators.

The Russian Federation, which uses a multi-channel model, loses significantly for most of the health indicators studied in developed countries, regardless of the model they use. It seems that a key role in this is played by the low financial availability of health care as a natural result of an unfavorable combination of severe funding shortfalls and the use of a knowingly more expensive and less effective multi-channel pooling model.

CONCLUSION

The use of multi-channel pooling by developed countries to pay for public health services is less effective than the single-channel single-payer model because:

а) requires higher levels of both general and public spending on health;

б) higher resource requirements for health care with almost equal health coverage;

в) limits the effectiveness of public health policies;

г) loses single payer models on managed health indicators.

The data of other authors about the higher level of subjective satisfaction of the population with medical care in developed countries with a multichannel model appear to be of little relevance in most territories of Russia, where the most significant problem is the apparent underfunding of guaranteed health care.

For the above reasons, the replacement of the more expensive and less efficient multi-channel pooling model with the

single-channel single-payer model represented by Federal Compulsory Health Insurance Fund seems to be an important condition for increasing the efficiency of health care financing in the Russian Federation, which should consolidate all, or at least most, channels for financing health care.

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A. L. Safonov — development of the research concept, selection of indicators for analysis, formation of research conclusions.
A. V. Ragozin — description of the methodology used and calculations, analysis of the results obtained, formation of the conclusions of the study.
V. V. Grishin — collection of statistical data, tabular and graphical representation of the results, analysis of the findings.

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REVIEW ARTICLE

This article is dedicated to memory D. E. SOROKIN, Dr. of Economic Sciences, Corresponding member of the Russian Academy of Sciences, Professor of the Financial University.

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Vectors, Stages and Problems of Nonortodoxal Foundations of Economic Science Formation

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ABSTRACT

The relevance of the study is underpinned by continuing sharp scientific and practical discussion on the evolution of economic science aimed at obtaining exhaustive answers to such questions as: "What is orthodoxy in economic science? Why is it that the theoretical and methodological orthodoxy that accompanies the emergence and transformation of alternative directions of world economic thought cannot be overcome not only in the past but also at the present time? What is the historical significance of a retrospective analysis of vectors, stages and problems of the formation of unorthodox foundations in the development of this branch of human knowledge? and others. The findings of prominent Russian and foreign scientists-economists, allowing to reveal and comprehend the diverse methodological and theoretical components of orthodoxy in the past and present set **the subject** of this review article**. The purpose of the study** is to consider, systematize and generalize the evidentiary warnings published in the works of prominent modern researchers about the urgent need to overcome the negative consequences of orthodox maxims, which, having been absolutized since the time of the "fathers of political economy", continue to manifest themselves to this day. **The key research methods** include systematic approach, evolutionary and cross-industry analysis. **The results of the review** incorporate conclusions and evidence that make it possible to unbiasedly comprehend the key scientific and practical problems for the fate of this science in the past and present. In particular, the author's position is argued that the examples of postulating judgments about the presence and coexistence of "Western-non-Western", "bourgeois-non-bourgeois" economic science, which are still found in Russian economic literature, are based solely on the class-formational research approach and therefore are completely untenable. It has been proved that from its "ancestors" and "fathers" of economics, i.e. adherents mercantilism and classical political economy principles to modern economists (from institutionalists to Keynesians and neoliberals) the existing palette of orthodox theoretical and methodological innovations accompanying the development of economic science explicitly or implicitly along with its commitment to the class analytical approach are due to a certain subtext of the absolutization of "objective economic laws".

Keywords: unorthodox foundations of economics; the main directions of economic thought; class analytical tools; system analysis; intersectoral approach

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INTRODUCTION

The purpose of this article is to provide the community of economists and a wide readership with an overview of the essential aspects of the diverse theoretical and methodological components of orthodoxy that constantly accompanies the evolution of economic science and to offer the author's conceptual vision of vectors, stages, and problems of the process of formation of unorthodox foundations in its development based on the innovations of modern researchers.

To fulfill this research purpose and achieve a logically consistent understanding of the problems of the emergence and overcoming of orthodoxy in economics, the author's definition of the term "orthodoxy" is given in the article. The author's concept of levels of systematization of economic ideas and views is proposed (*Fig. 1*) and the author's classification of epochs, periods, and directions in the development of world economic thought is given (*Fig. 2*).

The term "orthodoxy" (derived from the Greek words: orthos meaning 'straight, correct' and doxa meaning 'opinion') is formulated in the article, based on the fact that this concept, once being the purely religious a priori axioms, is now intersectoral — going beyond the scope of science — a priori axiomatic judgment. In this regard, both before and now the essence of "orthodoxy" is reduced to a priori "correct" opinion, concept, and category, or to an a priori "correct" system of views and teachings that form a universal evaluation scale of knowledge and a system of irrefutable (dogmatic) convictions. For this reason, the concepts, views, and teachings, which in their content include the term "orthodoxy", by virtue of their introduction into circulation by an authoritative person representing the relevant sphere of religious, state, philosophical, scientific public life, should be taken as a given, having for all researchers fixed and mandatory for understanding and use.

The phenomenon of the palette of theoretical and methodological orthodoxy that has developed in economic science is considered in the article through the prism of studying economic ideas and views and their systematization by many generations of researchers of different levels (*Fig. 1*).

The beginning of orthodoxy is associated with the first political and economic research paradigms in the history of world economic thought, such as mercantilism and classical political economy (*Fig. 2*).

Turning to the completed review material, first and foremost, to the scientific and economic community of modern Russia, it should be noted that the original research message in the work takes into account the uniqueness of Russian economic science and economic life [1, 2].

This approach allows us to characterize the centuries-old Russian history as a special civilization and force in the world community, experiencing the scientific and practical realities of the transition from the Orthodox maxims of the formation model of the recent Soviet past to the civilizational one. The completion of Russia's transition to the values of the civilizational model will make it possible to overcome the orthodox understanding of evolution as a unilinear process capable of describing "only tomorrow for the less developed", and will make it possible to talk about the rejection of "the monopoly on truth, the recognition of the natural and logical diversity of different views and approaches" [3, p. 5, 6].

However, unfortunately, we have to admit that over the course of three decades of the post-Soviet period, in the spirit of more than seven decades of the Soviet era, the structure and especially the content of scientific publications, including historical and economic literature, are undergoing changes very often accompanied by clear, completely unambiguous anti-market-class-formation stamps of orthodoxy [4, p. 3; 5–8]. In particular, in the process of university education and the formation of personal professional competencies, a post-Soviet economist is strongly advised to know that now in Russia, as in other modern countries,

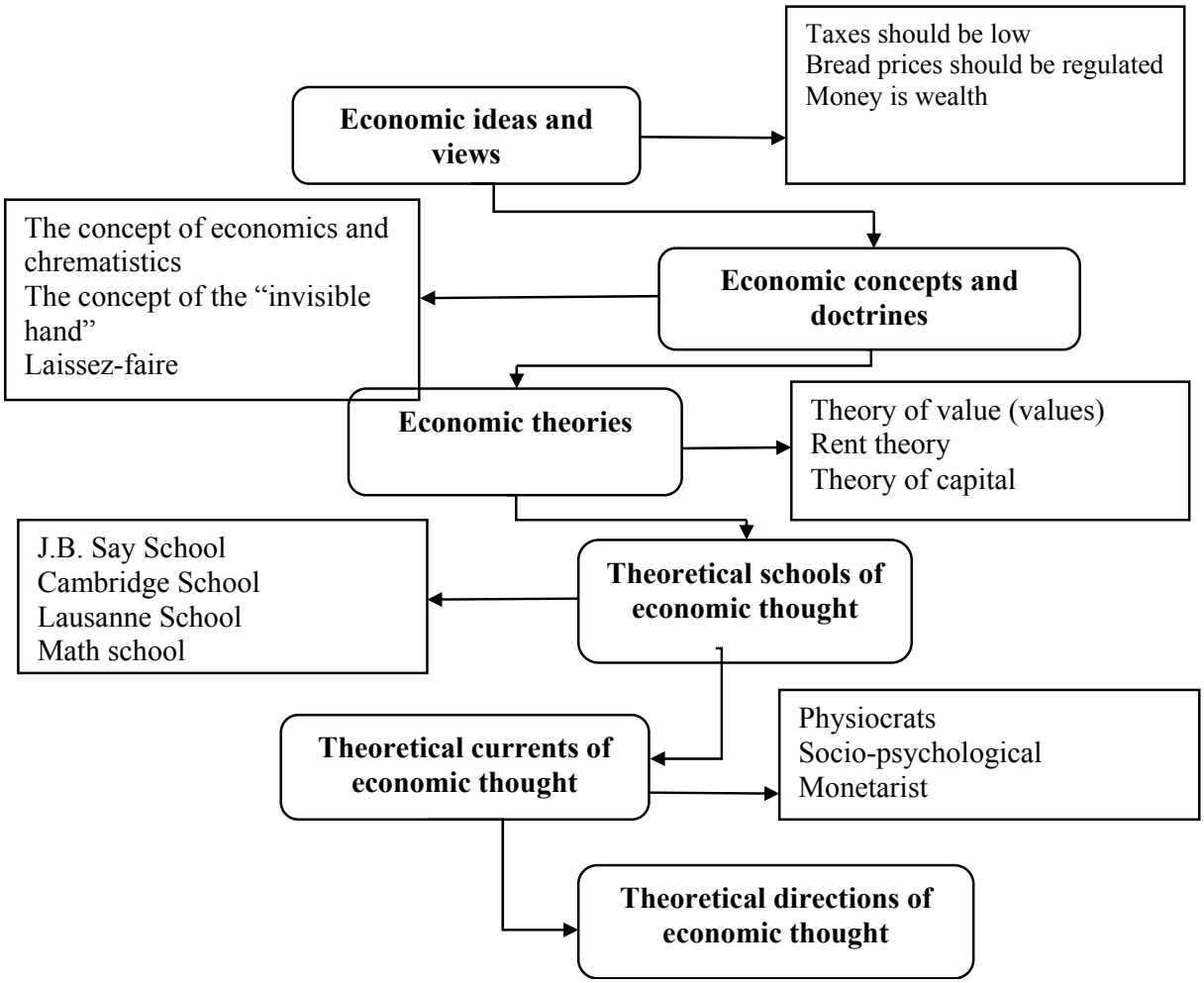

Fig. 1. **Economic ideas and vision statements classification**

Source: Yadgarov Ya. Epy History of Economic Thought. Moscow: INFRA-M; 2020. P. 15.

there is a "capitalist path of development",[1] to remember that "in a narrow sense, economic history studies economic activity ... classes".[2] In addition, he must also understand that the "capitalist evolution" at the beginning of the 20th century, having determined the "completion of the process of monopoly capitalism",[3] preserved the class-antagonistic structure of society, that each "social class" is "a large group of people, different from other groups in terms of wealth and income level",[4] etc.

The a priori dogmatic and odious parting words of the "class-formation" orientation given above indicate that post-Soviet domestic economic science has not yet passed the path of an unbiased and de-ideologized understanding of the achievements that have taken place in the world economic life and those values of the scientific and practical heritage that are associated with the work of the best representatives in the history of the world and Russian economic thought. Moreover, it is orthodoxy that has historically embraced the Russian economic community on an equal footing with the world scientific community, which determines the well-founded distrust in the past and present of the well-known theoretical and methodological innovations of those pioneers who are commonly called the founders of the main

[1] Konotopov M., Smetanin S. The History of Economics. Moscow: Academic Prospect; 1999. P. 76, 77.

[2] Kovnir V. The History of the Russian Economy. Moscow: Logos; 2005. P. 17.

[3] Ibid P. 274, 275.

[4] Orekhov A. Methods of economic research. Moscow: INFRA-M; 2009. P. 361.

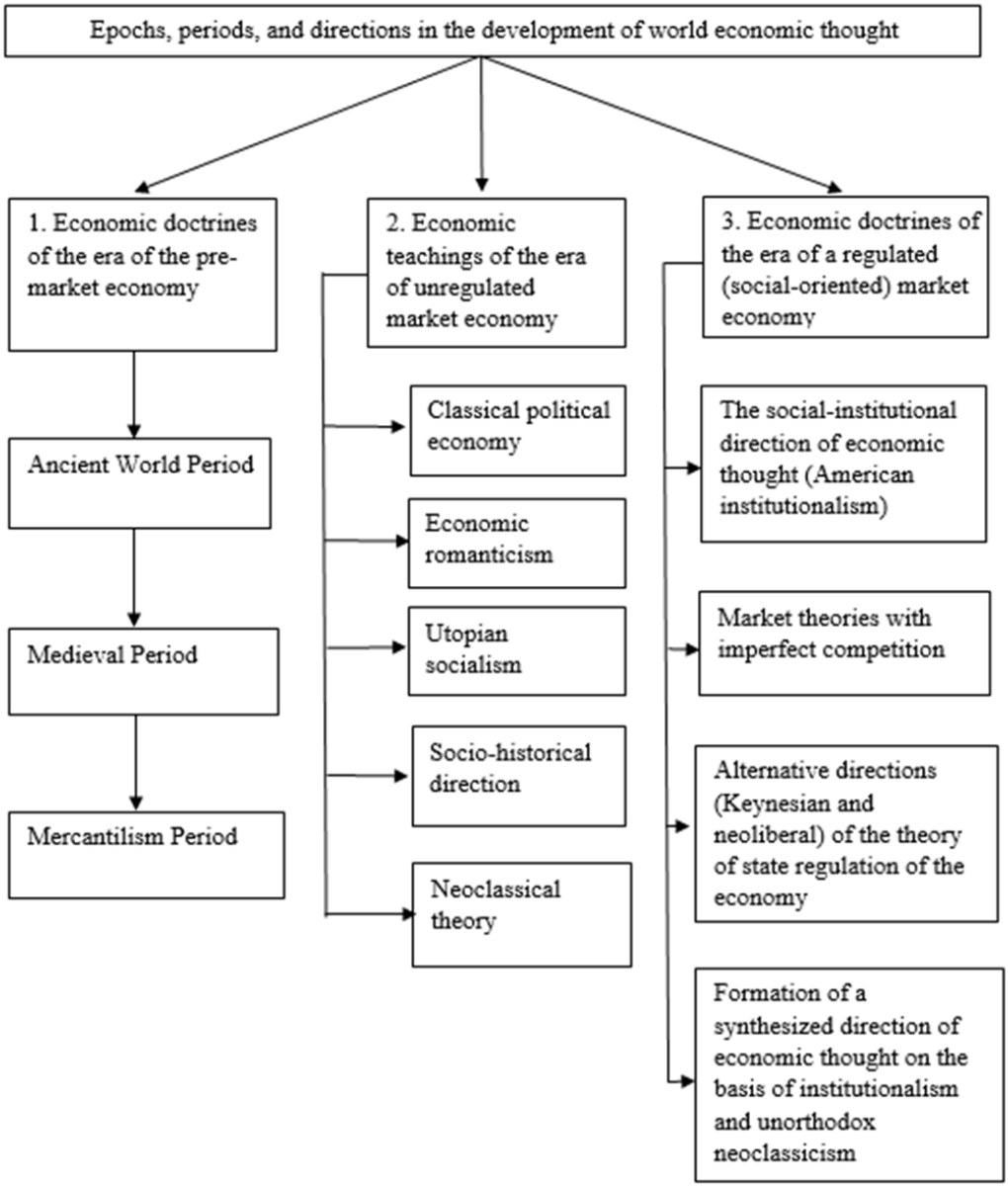

Fig. 2. **World economic thought development periodization**

Source: Yadgarov Ya. Epy History of Economic Thought. Moscow: INFRA-M; 2020. P. 16.

directions, currents and theoretical schools at different stages of economic science development.

Permanently manifesting features of innovations of the leaders of economic science throughout the 19th, 20th, and first decades of the 21st century are considered in the article in the context of the most important periods of disagreement and attempts to overcome the orthodoxy of the mercantilists and the "classics" by the generations of their opponents that followed them. Such is the first half and the middle of the 19th century, for example, there was a post-manufacturing period associated with economic romanticism, utopian socialism, and the German historical school. This was followed by periods of marginalism, Chamberlain, and Keynesian revolutions, which led to the innovations of subjectivism, early neoclassicism, and institutionalism (respectively from the 70s — 90s of the 19th century to the 20s — 30s of the 20th

century). Then the time of Keynesian and neoliberal innovations came (from the 30s of the 20th century to the present), during which attempts to overcome orthodoxy in economic science and the formation of unorthodox foundations in its development have continued and continue to this day.

Particular attention is supposed to be paid in the work to the consideration of each of these periods (and directions) and the stages, vectors associated with them and, accordingly, their inherent problems on the way, so to speak, to the "final" overcoming of the maxims of orthodoxy in economics and the formation of a "truly scientific" synthesized unorthodox research paradigm. At the same time, the fundamental result in each section of the review should be a reasoned justification for the generalizing conclusions of the author. Their essence briefly boils down, on the one hand, to the fact that in the past and especially in the present, the formation of unorthodox foundations of economic science is increasingly manifested in the context of a permanent process of synthesis (interpenetration) of once-opposite conceptual positions, doctrines, and theories. On the other hand, to the fact that this process is still hindered, firstly, by an explicit or implicit commitment to "class analysis", which goes beyond the scope of science, and the absolutization of "objective economic laws" and, consequently, the rejection of intersectoral, evolutionary and systemic analysis methods. And, secondly, tendentious mathematization, deliberately excessive mathematical formalization of the analytical, methodological, and theoretical apparatus, also acts as a deterrent in overcoming orthodoxy.

Thus, the implementation of this study, which is devoted to a review of the prehistory and history of the emergence and overcoming of orthodoxy in economics and the identification of vectors, stages, and problems of the formation of its unorthodox foundations, is essential and has an urgent and relevant scientific and practical nature.

1. THE BEGINNING OF ORTHODOXY IN ECONOMIC SCIENCE DURING THE PERIODS OF MERCANTILISM AND CLASSICAL POLITICAL ECONOMY

Economics is one of the young branches of human knowledge. It arose after a relatively long period of the historical dominance of the natural and economic ideology of the times of the Ancient World and the Middle Ages, during the 16th –17th and partly the 18th centuries this ideology was pushed into the background by the market economic ideology of the supporters of the research paradigm of mercantilism and the mercantilist political economy concept based on the principles of protectionist economic policy. Further from the end of the 17th — the beginning of the 18th centuries. Until the second half of the 19th century, another theoretical and methodological metamorphosis became apparent, which led to the formation and self-assertion of economic science as a separate branch of scientific knowledge in the field of economic life. The reason for this was the emergence of an alternative research paradigm to mercantilism, called "classical political economy" in K. Marx's "Capital" [9], and the corresponding concept of political economy, based on the principles of the dominance of liberal economic policy.

Mercantilism [10] laid the foundation for economic science, but at the same time laid the foundations of orthodox maxims. Then the adherents of the liberal research paradigm of classical political economy, seeking to overcome the orthodoxy of mercantilism, uncompromisingly (according to the "either-or" principle) strive for positive scientific and practical results through the indispensable absolutization of the principles of laissez-faire, just like the mercantilists, could not exclude "sliding along surface of economic phenomena", falling into the "capture" of their own orthodoxy.

In a generalized form, the orthodox maxims of the mercantilists and classics elevated to the rank of an absolute manifested themselves in a number of orthodox dogmatic ideas, which are presented in *Table 1*.

Table 1 data analysis seems appropriate to anticipate to conclusion, on the one hand, that the transition from a subsistence economy to the dominance of entrepreneurial activity and commodity-money relations and, as a result, the emergence of a market economic system (market economy) is historically conditioned mercantilism. Hence, it is logical and understandable why the prominent historian of modern economic thought M. Blaug considered it possible to characterize the supporters of mercantilism and the mercantilist research paradigm proper as follows: "...uneducated authors, caught up in the stream of public opinion, discovered amazing and sometimes convincing reasons for defending mercantilist economics from the layman and, in a fight with the logical consequences of their presumptions, revealed economic theory in infancy" [11, p. 15].

On the other hand, it was the mercantilists, being adherents of the mutually exclusive principle of "either-or", that actually predetermined the need for their adherents to recognize the first theoretical and methodological components of orthodoxy introduced into economics. They raised to the rank of an absolute the position that "mercantilism, no matter how persistently it raised universal commercialization to the rank of national policy, took care of the development of the market system in completely non-market ways ..." [12, p.12]. In this context, we are talking about such orthodox postulates as:

1) reducing the subject of economic analysis to the primary study of the problems of the sphere of circulation in isolation from the sphere of production;

2) the lack of a systematic study of the spheres of the economy due to the absolutization of empiricism and "sliding on the surface of economic phenomena";

3) he dominance of protectionist economic policy in economic life and the rejection of the policy of economic liberalism;

4) identification of "wealth of the country" and "personal wealth" exclusively with money;

5) understanding the theoretical essence of money in the context of their artificial invention by people and the contract between them;

6) theoretical understanding of the value of goods through the prism of the natural properties of money (gold, silver) and their quantity in circulation;

7) vision of the only source of wealth in foreign trade through constant regulation (coordination) of economic life by the state.

The maxims of mercantilist orthodoxy, well-known from the heights of modern economic science, are quite clearly manifested, for example, in the writings of the Frenchman A. Montchrestien and the Englishman T. Mun. Each of them, addressing their conclusions to the monarchs of the country, counted, in the words of N. D. Kondratiev, on protectionist "practical politics" in order to correctly answer "the question of what the national economy should be like and how the government should behave in relation to it" [13, p. 292].

Thus, in A. Montchrestien's book "Treatise on Political Economy" (1615), the ways of dynamic economic growth and the increase of monetary national wealth in France are closely linked with a permanent protectionist economic policy, coupled with the postulation of orthodox ideas that [14, p. 168–182]:

- trade exchange between nations ... like art has something admirable ... in the form of honor and profit;
- merchants are more than useful to the state;
- trade ... depends only on the condition of which merchant is engaged in it: respected or despicable;
- the ruler of the state...measures everything from the point of view of necessity, usefulness..., and never goes beyond the power given to him by laws;
- credit is the soul of any trade, it is necessary to maintain its reputation;
- rulers must order and see to it that ... limit the arbitrariness of product monopolists.
- T. Mun [15, p. 153–161], unlike A. Montchrestien, relies on his own many years of practical experience in the East India

Table 1

Orthodox components in research fundamentals of Mercantilism and Classical Economics

Mercantilism doctrine	Classical Economics
The main principle of Orthodoxy in economic policy	
• Absolutization of protectionism, which can lead to the narrowing of the domestic market ("colbertism"); • the policy of free competition is objectively impossible	• The absolutization of the policy of economic liberalism or complete freedom of entrepreneurial activity (laissez-faire)
Orthodox aspects in the subject of economic analysis	
• Primary study of the problems of the sphere of circulation in isolation from the sphere of production	• Primary study of the problems of the sphere of production in isolation from the sphere of circulation
Orthodox aspects in the method of economic analysis	
• Absolutization of empiricism; • description on a causal basis of the external manifestation of economic processes; • absence (due to observance of the mutually exclusive principle of "either-or") systematic study of economic spheres	• Absolutization of the causal method of analysis and the method of logical abstraction; • underestimation (due to observance of the mutually exclusive "either-or" principle) of the reverse influence on the sphere of production of the factors of the sphere of production; • class (class-formational) analysis of socio-economic processes; • division of the nature of labor into productive and unproductive
Orthodox aspects in the concept of economic growth	
• By increasing the exclusively monetary wealth of the country, thanks to the achievement of an active trade balance (surplus in foreign trade)	• By increasing national wealth created by productive labor in the sphere of material production
The orthodox principle of achieving macroeconomic equilibrium	
• Due to coordinating and regulatory measures of the state	• Self-balancing of aggregate demand and aggregate supply due to Say's Law of the Market
Orthodox principle in the field of money theory	
• Money is an artificial invention of people and an agreement between them; • money is the only main factor in the growth of national wealth	• Money is a spontaneously released commodity in the world of commodities, which is a technical tool and a thing that facilitates the process of exchange
The orthodox principle in the field of value theory	
• he cost of goods is due to the natural properties of money (gold, silver) and their quantity in circulation	• Costly interpretation of the nature of the origin of value (based on labor costs — thorium labor, or total production costs — cost theory)
Orthodox positions in the field of population theory	
• Reasonableness of keeping wages low due to population growth (labor supply)	• Adherence to the Smithian doctrine of a working fund that provides for a living wage ("Iron Law of Wages" by Malthus), taking into account the supply and demand for labor

Source: developed by authors.

Company, on the basis of which he states in his book "England's Treasure by Forraign Trade ..." (1664):

- enrichment is possible by increasing the amount of money in the country, "increasing the export" of goods, and reducing the "consumption of foreign goods";
- the source of wealth and money is foreign trade;
- annual exports must exceed imports;
- should be sold cheaply so as not to "lose the sale of goods".

Meanwhile, adherents of mercantilism tried to consolidate their personal and public conviction that the creation and increase of monetary wealth require appropriate legislative acts by some inherently orthodox legal conclusions. This, in particular, is noted in the "Principles of Economics" (1890) by A. Marshall, emphasizing that the mercantilists, through a huge number of legal documents, "pursued the goal of predetermining to each individual what he should produce and how he should do it, how much he should earn and how he should spend his earnings" [16, p. 186].

As for the adherents of classical political economy, they (especially A. Smith) [17], following the mercantilists, did not avoid the mutually exclusive principle of "either-or", which determines orthodoxy. But in the end, the classics further expanded the odious tools of orthodoxy in economics, which contributed, firstly, to the absolutization of the principles of unlimited freedom of entrepreneurial activity (or the principles of laissez-faire) in a market economy and, secondly, to the postulation of the comprehensive nature of universal "objective economic laws". As a result, for the classics (and then for the early neoclassicists), it became an a priori statement of the fact that Orthodoxy unconditionally acquired an axiomatic (dogmatic) status, manifesting itself as an "economic doctrine", which, in turn, allegedly due to its corresponding content, "economic law", which is "immutable" and does not depend on the will, consciousness, desire of the individual.

The main components of the orthodoxy of the classical political economy appear in the following a priori and dogmatic maxims:

1) reducing the subject of economic analysis to the predominant study of the problems of the sphere of production in isolation from the sphere of circulation;

2) the lack of a systematic study of the spheres of the economy due to the absolutization of the causal method of analysis, the methods of deduction, induction, and logical abstraction;

3) absolutization of the concept of complete freedom of entrepreneurial activity (economic liberalism);

4) division of society (for research purposes) into main (basic) classes interested in the harmonization of relations;

5) postulation of provisions on "pure" ("perfect") competition, which determines the self-regulation of economic life;

6) vision of the goal of political economy in the identification of "objective economic laws" that do not depend on the will, consciousness and desire;

7) understanding the theoretical essence of money in the context of its interpretation as a technical means and a thing that can facilitate the process of exchange;

8) commitment to a costly (dead end) approach to understanding the nature and mechanism of value formation;

9) division of the nature of labor in a market economy into productive and unproductive types;

10) the theoretical proposition about the always temporary and automatically transient nature of crises in the economy of free competition.

As for the narrowness of the boundaries (framework) of the subject of study by representatives of classical political economy and, accordingly, the orthodoxy of non-systemic economic analysis and the narrowing of the field of study of economic science (political economy), associated with clearly reasoned critical judgments among other modern scientists, in particular, J. Schumpeter. Having singled out in this respect the four

most striking, in his opinion, classics (J.-B. Say, J. McCulloch, N. Senior, J.S. Mill), he points out the subtle differences in their methodological positions on the boundaries of the subject matter of political economy, consisting only in the fact that [16, v. 2, p. 700]:

- J.-B Say "defined political economy as 'the account of how wealth is created, distributed and consumed'";
- J. McCulloch "defined political economy as "the science of the laws of production, accumulation, distribution, and consumption of those items that are necessary, useful or pleasing to a person and which at the same time have an exchange value"";
- N. Senior — as "a science that considers the nature, production and distribution of wealth";
- J.S. Mill was "satisfied with what he called political economy, the science of 'the essence of wealth, the laws of its production and distribution. Directly or indirectly, this includes the operation of all the causes that determine the prosperity or growth of mankind'".

Well-known foreign and domestic researchers of our time are also very critical of the subsequent components of a wide range of methodological and theoretical provisions of orthodoxy, noted above in the works of the classics of political economy. This applies, for example, to such general scientific methods of analysis as deduction and induction, which were actively used by the classics (and later by the early neoclassicists) quite arbitrarily, as if according to a template projected in their political and economic terms. research work. This circumstance prompted, in particular, P. Samuelson to state the following: "... the exaggerated statements of classical authors about the power of deduction of a priori reasoning that existed in economic theory ... make me tremble for the reputation of my science" [cit. by: 19, p. 149]. I. Schumpeter agreed with P. Samuelson and noted that the author of The Principles of Political Economy, J.S. Mill [20] "placed excessive emphasis on 'deduction'", which, in essence, "explains the ridiculous dispute of later times about the preference for one of the methods: induction or deduction" [18, v. 2, p. 704].

In the final section of the article, the main components of orthodoxy noted above in the works of adherents of mercantilism and classical political economy, are considered in the context of their rejection by followers of historically established alternative research paradigms and introduced innovations that determined the vectors, stages, and problems of the formation process unorthodox foundations of economic science, which continued over the past two centuries.

2. FORMATION OF UNORTHODOX FOUNDATIONS OF ECONOMIC SCIENCE IN THE RESEARCH PARADIGMS OF THE XIX — BEGINNING OF THE XXI CENTURY

The main qualitative shifts in the evolution of economic science and the breakthrough evidence-based research associated with them on the way to overcoming heterogeneous orthodox maxims in it were manifested in the newly emerging research paradigms of the 19th and early 21st centuries, which became widely known among the scientific economic community. These are the paradigms of economic romanticism, utopian socialism and the German historical school, marginalism (including subjectivism and neoclassicism) and institutionalism, Keynesianism and neoliberalism, as well as the now emerging synthesized research paradigm.

At the indicated time, first in the post-factory period — in the first half and middle of the 19th century — research paradigms that are essentially illiberal and alternative to classical political economy, such as economic romanticism, utopian socialism, and the German historical school, have declared themselves. Based on the non-absolutization of the principles of laissez-faire, the innovations of their representatives laid the foundation for a real refutation of the orthodoxy of their outstanding predecessors (mercantilists and classics), who were perceived as the "ancestors" and "fathers" of political economy — economic science.

Further strengthening in the second half of the 19th century in developed countries, the trends of monopolization of economic life, and improvement in the 1870–1890s in economics, "marginalist" revolutions were exogenous preconditions for the completion of classical political economy. However, the theoretical and methodological innovations of the adherents of the research paradigms of marginalism (both subjectivists and neoclassicals), based on the same principles of laissez-faire, turned out to be by no means sufficient to overcome the orthodoxy of the times when the views of mercantilists and classics of the political economy dominated.

Then carried out contrary to "Say's law" [21] in 1929–1933 the global economic crisis has shown its lack of self-sufficiency in the process of overcoming orthodoxy in economics, not only marginalist innovations but also those isolated by the 1920s-1930s research paradigm of institutionalism. But the "Chamberlain" and "Keynesian" revolutions that occurred after the global economic crisis led to a fundamentally new metamorphosis in economics, which has been manifesting itself since the 1930s of the 19th century to the beginning of the 21st century within the framework of the process of formation of a synthesized research paradigm.

The features of this synthesized paradigm, due to the interpenetration and addition of once alternative theoretical and methodological provisions, are manifested, on the one hand, in the process of synthesizing the tools of marginal economic analysis with newly emerged research paradigms of state regulation of the economy, i.e. Keynesianism and neoliberalism (the current stage in the evolution of the neoclassical direction of economic thought). On the other hand, the synthesis of the analytical tools of modern neoclassicism with intersectoral, evolutionary, and systemic methods for analyzing the research paradigm of institutionalism (the social-institutional direction of economic thought).

Thus, it is the interpenetration of the research paradigms of neoclassicism (including Keynesianism and neoliberalism) and institutionalism that creates real opportunities for modern researchers to form a synthesized research paradigm that makes it possible to exclude sliding on the surface of economic phenomena and tendentious mathematization and formalization of research and to overcome orthodoxy, which is still manifested in economics.

2.1. Milestones of overcoming orthodoxy in economics in research paradigms of the first half — the middle of the 19th century.

Evaluative judgments about the milestones of overcoming orthodoxy in economics in the first half and middle of the 19th century are associated with the post-manufacturing period and research paradigms of economic romanticism, utopian socialism, and the German historical school. In their work, their leaders advocate the need to overcome the diverse orthodox maxims that have become commonplace among adherents of mercantilism and classical political economy, considering it unacceptable to absolutize either the postulates of mercantilist protectionism or those conditioned by the action of Smith's "invisible hand", i.e. some objective economic laws, the basis of economic liberalism. Moreover, rejecting this concept of A. Smith, based on the principles of complete freedom of enterprise (laissez-faire) and all-powerful "objective" economic laws, they deny the supposedly guaranteed by the "invisible hand" ("laws") functioning of the economy of free competition as a self-regulating system in which only random, temporary, automatically transient (in line with "Say's law") crises are possible.

Clear evidence of this is, for example, the position of the founder of economic romanticism, S. Simondi, for whom, as K. Marx noted, "crises are not an accident, but essential manifestations of immanent contradictions that flare up in a stormy form ... and repeat after certain periods" [22, p. 527]. It is precisely the overcoming of orthodoxy in modern economic science that S. Sismondi, in essence, is devoted to his main work, in which,

contrary to D. Ricardo's book "Principles of Political Economy" (1817) [23], he added one more word to the first word the title of his work is "new". And, having published his "New Principles of Political Economy" (1819) just two years after the Ricardo's "Principles", the founder of economic romanticism declared that political economy is a "moral science" and "largely an ethical science" [24, p. 291, 360]. Unequivocal in New Beginnings is his judgment that political economy cannot be reduced "to a simple ... principle of laissez-faire" [24, vol. 1, p. 1, p. 133]. He also insists that "the growth of wealth is ... only a means to ensure universal happiness", and "an increase in wealth and population is only an abstraction ..." [24, vol. 1, p. 1, p. 134, 143].

It is important to add to the above that, opposing D. Ricardo, S. Sismondi (from the point of view of the Ricardo's "labor theory of value") very critically characterizes in his New Principles the position of the "classics" about the unconditional balance and efficiency of economic life on the principles of economic liberalism. Disagreeing with them, he put forward a reformist concept based on the principle he formulated: "Better directed private interests themselves will correct the evil they have caused to society" [24, vol. 1, p. 2, p. 176]. Only reforms aimed at state regulation of the market mechanism, the leader of economic romanticism is convinced, are capable of guaranteeing the dominance of small businesses in it through constant interference in the economic life of the state, ensuring the social orientation of the crisis-free developing economy and solving closely related socio-economic problems of overcoming the principles of economic economy, absolutized by the classics. liberalism.

Based on the foregoing, the positive assessments of C. Gide and C. Rist expressed at the turn of the 19th-20th centuries regarding the innovative, including reformist ideas "from above" of their compatriot S. Sismondi aimed at overcoming orthodoxy, seem quite understandable and appropriate. In particular, for the latter, they argue, "... the whole interest of political economy from a theoretical point of view was reduced to explaining crises, and from a practical point of view to finding measures to prevent them and improve the situation of workers" [29, p. 145]. They also have no doubts that the author of the New Principles, "not leaning towards socialism... greatly undermines liberalism", proving "the falsity of the position... about the natural coincidence of private and public interests" [25, p. 154].

The rejection of orthodoxy in post-manufactory political economy in the work of S. Sismondi is given credit among modern economists by M. Blaug, P. Samuelson, and other researchers. According to P. Samuelson, "each era gave birth to people who dreamed of a more perfect world, a world in which altruism took the place of selfishness, and equality or joint ownership of property would take the place of inequality". Among them, among the now "famous names of the 19th century," he writes, is S. Sismondi, who "was convinced that capitalism would periodically suffer from underconsumption and insufficient purchasing power" [26, vol. 2, p. 342].

M. Blaug, like P. Samuelson, sees S. Sismondi's indisputable merits in understanding in his "New Principles" the phenomenon of insufficient aggregate demand in an economy of free competition. For this reason, according to Sismondi, "the new industrial system is doomed to inevitable recurring crises and a chronic trend of underconsumption", which can only be overcome through "deep state intervention" in order to ensure [27, p. 274–275]:

- a guaranteed minimum wage for employed and unemployed people;
- limitation of minimum working hours;
- limiting the maximum/minimum working age;
- introduction of a profit distribution system.

Believing this, M. Blaug admits that of the two well-known outstanding post-Ricardians in the person of S. Sismondi and T. Malthus, "the main opponent of Pax Ricardia" (post-

Ricardianism) [11, p. 162], from his point of view, is S. Sismondi. The reason for this, according to Blaug, is that "... in fact, the spirit of Keynesianism in the work of Sismondi is much stronger than in the work of Malthus" [27, p. 275].

The position of rejecting the orthodoxy of the post-manufacturing period is very close to the position of S. Sismondi in another prominent representative of economic romanticism — P.-J. Proudhon [28]. Unlike S. Sismondi, P.-J. Proudhon advocated immediate reforms in the name of crisis-free development of the economy, social justice in society, and giving the leading role in economic life to small proprietors, small commodity production — small business — not "from above" (with the participation of the state), but "from below" — on the initiative of workers.

In his most famous work, The Philosophy of Poverty (1846), P.-J. Proudhon, claiming the first experience of implementing a dialectical-analytical approach to understanding economic life outside the context of the maxims of the orthodoxy of his predecessors, categorically rejected judgments about the revolutionary transformation of socio-economic conditions in society, which was the decisive reason for breaking off friendly relations with K. Marx. In particular, on the eve of the publication of this book, P.-J. Proudhon wrote that he did not accept "revolutionary action as a means of social reform, because this imaginary means would be a call to violence, to arbitrariness, in a word, would be a contradiction. He concluded: "I set myself the following task: to bring into society, by means of an economic combination, the wealth that came out of society with the help of another economic combination" [cit. by: 25, p. 511].

By the way, C. Gide and C. Rist, paying tribute to their compatriot P.-J. Proudhon, among his creative merits highlighted his desire to instill in humanity "a deep sense of the unconditional necessity for industrial societies of individual freedom as the engine of economic activity". Guided by this feeling, they noted, the author of The Philosophy of Poverty considered it possible to insist that "every deep reform must be based on this freedom", which, in turn, is based on "a deep sense of economic reality". It is precisely the legitimacy of these feelings, in their opinion, that testifies to the fact that "the social task today is set within the same framework in which it was put by P-J. Proudhon: to implement justice in freedom" [25, p. 245].

Orthodox stereotypes and myths in the economic science of the post-manufacturing period were perceived in a special way in their works, along with romantic economists, by adherents of the research paradigm of utopian socialism: from the triad of scientists Owen — Saint-Simon — Fourier to their numerous followers. In the spirit of adherents of economic romanticism, they sought to refute the stereotypes of mass consciousness that had developed in the specified period and the wider research and analytical approaches. But in their work, peculiar socially oriented reformist ideas are manifested, guaranteeing the overcoming of orthodoxy in modern economic science and "refusal to understand the unity of market mechanisms and state regulation" [29, p. 7]. Therefore, it is by no means accidental that the leaders of utopian socialism R. Owen, H. Saint-Simon, and Ch. Fourier are classified by R. Heilbroner among the "philosophers of this world" and "the reformers of the 19th century, which we call 'utopian socialists'" [30, p. 137], and M. Blaug refers them to the "100 great economists before Keynes" [27].

For example, R. Owen [31], a co-owner of a textile factory at the beginning of the 19th century, was ahead of factory legislation by almost half a century by reducing the working hours of adult workers from 17 to 10 hours at his enterprise, banning the work of children under 10 years of age and abolishing fines for workers [25, p. 69].

H. Saint-Simon [32], according to Blaug, believed that "he can be better described by the term "utopian reformer"" [27, p. 269]. He proceeded from the fact that this utopian socialist advocated that the government

should not be a political, but an economic unit, guided by "the law that establishes property and regulates its use".

Ch. Fourier connected the reforms with the need to form a "public order" and "social regime" in the phalanstery — the socio-economic structures of the future. He expressed the conviction that thanks to his reforms, "women will very soon return to the role that nature intended for them, the role of rivals, and not male subjects" [33, vol. 1, p. III, p. 307].

Declared themselves in the middle of the 19th century B. Hildebrand [34] and other founders of the German historical school differed, on the one hand, in their orientation towards the reformist postulates of the prominent predecessor F. List [35]. On the other hand, they proceeded from the provisions on the need to form a market economic system with its inherent factory and farm structures, taking into account the national and historical characteristics of the country and allowing protectionist measures within the framework of appropriate reforms. Obviously, therefore, characterizing their innovations, the American historian of economic thought B. Seligman noted that "representatives of the German historical school rebelled against the rigid classical doctrine that seemed to them". This was manifested in the fact that they understood "an increased awareness of the role of the human factor" and expressed frank doubts about "whether a simple imitation of physics is enough for the development of a practically useful social science" [36, p. 20, 23].

The position on the rejection of "simple imitation of physics", put forward by B. Seligman as a merit of German researchers in the middle of the 19th century, is also manifested in the value judgments of N. D. Kondratiev, who understood the non-identity of the nature of economic and natural laws (including physical ones), which invariably appear under the influence of previously known components and elements. Therefore, according to Kondratiev, the founders of the German historical school deserve respect for the fact that they "rely on the fact of the diversity and dynamism of historical life and therefore deny the possibility of abstract laws of political economy in general and laws of economic development in particular". Moreover, the Russian scientist explains, that they proceed from the conclusion about the "relativity of the laws of economic life" in order to "give specific empirical laws for the development of the economy" [13, p. 97].

Finally, adherents of the German historical school, guided by the principles of non-class formational historicism, which takes into account the impact on the economic life of traditions, customs, religion, and other non-economic factors, for research purposes began to focus on the need to publish fundamental historical and economic monographic works, the results of which contributed to further disagreements and scientific research discussions devoted to the topical and the current problem of overcoming orthodoxy in economics.

2.2. Milestones for overcoming Orthodoxy in the economy in research paradigms of the late 19th — early 20th centuries

The accomplishment of the "marginalist revolution" at the end of the 19th century, which led to the change of the research paradigm of classical political economy by subjectivist and neoclassical paradigms and then the emergence in the first third of the 20th century, as opposed to early neoclassicism, of the research paradigm of institutionalism, became the most important milestones in the process of refutation of diverse theoretical and methodological components of orthodoxy in economics that began in the post-manufacturing period. In this regard, special attention is drawn to the innovations that arose in this period as a result of alternative research by subjectivists, neoclassics and institutionalists in the field of theories of exchange and value.

The innovation associated with overcoming the orthodox notion of the classics about the allegedly proportional (equivalent) nature

Table 2

C. Menger's arithmetic table characterizing the relationship between the processes of value formation and the exchange

I	II	III	IV	V	VI	VII	VIII	IX	X
10	9	8	7	6	5	4	3	2	1
9	8	7	6	5	4	3	2	1	0
8	7	6	5	4	3	2	1	0	
7	6	5	4	3	2	1	0		
6	5	4	3	2	1	0			
5	4	3	2	1	0				
4	3	2	1	0					
3	2	1	0						
2	1	0							
1	0								
0									

Source: Menger C. The Fundamentals of Political Economy [37, p. 91].

Note: Roman numerals denote different types of goods; Arabic numerals — the number of acts of consumption of a small amount of each of them.

of the exchange and opposing it with the position of mutually beneficial exchange was introduced into scientific circulation for the first time (at the end of the 19th century) in the theory of exchange by K. Menger, an adherent of the subjectivist research paradigm and head of the Austrian school of marginalism. Then (at the beginning of the 20th century) J. Commons, an adherent of the research paradigm of institutionalism, made his contribution to overcoming orthodoxy in the theory of exchange. At the same time, both K. Menger and J. Commons are unanimous that there is no exchange of goods of equal value and that it is impossible for an individual who is selfish by nature to receive the necessary benefits for free since the quantities of exchanged goods are not proportional to each other and are not "equivalents".

B. Seligman, in particular, drew attention to this innovation in the field of exchange theory among modern researchers, noting that, according to K. Menger, "buying and selling do not simply mean an equal exchange, as assumed by the labor theory of value; precisely because there is no such equivalence, an exchange can take place" [36, p. 163].

We note further that K. Menger in his "Principles" devoted the third chapter to the theory of value and the fourth — to the doctrine of exchange. As from the table he proposed (*Table 2*) [37, p. 91], both of these teachings are interrelated and complement each other, which makes it possible to understand the principle of diminishing the marginal utility of goods in the process of their consumption and make sure that the process of exchanging economic goods is always non-equivalent.

At the same time, J. Commons, developing K. Menger's ideas about the always non-equivalent, but mutually beneficial nature of the exchange of goods, added a behavioral component to the understanding of the mechanism of value formation, pricing, and exchange of goods, which is closely related to his concept of legal relations between collective institutions. As a result, according to J. Commons, in line with

Table 3

Marginal and Behavioral Value Theories Conceptual Foundations

Marginal Value Theories Fundamentals	Behavioral Value Theories Fundamentals
• The concept of marginal utility; • the concept of marginal utility and marginal production costs; • concepts of marginal utility and labor cost	• Concept of consumer behavior; • the concept of imperfect competition market; • the concept of the behavior of collective institutions

Source: Developed by authors based on: Yadgarov Ya. Epy History of Economic Thought. Moscow: INFRA-M; 2020:452.

K. Menger, in the process of assessing future benefits, one should take into account the economic behavior of the exchanging parties, considering the time factor and the possibility of the future affecting the present, since transactional values can disappear with unjustified expectations reflecting the state of affairs throughout the economy [38, p. 429].

A significant contribution to overcoming orthodoxy was made by the authors of the newly emerging at the turn of the 19th-20th centuries (largely due to the rejection and critical understanding of costly theories of value) various versions of marginalist and behavioral versions of the interpretation of the theory of value, the conceptual foundations of which are given in *Table 3*.

Among such innovators are K. Menger and other pioneers of the subjectivist-marginalist theory of value in the 1870s designated as its basis the concept of marginal utility inherent in economic goods. Thus, they emphasized the importance of a subjectivist (psychological) approach to understanding the phenomenon of value and the conclusion that "marginal" utility is formed in the sphere of consumption (demand), manifesting itself only in monetary terms of value (market prices) in human consciousness. Hence, if for the classics the "reason" for the formation of the cost of goods (pricing) is seen in the costs in the sphere of production, then for the subjectivists it is in the level of marginal utility formed in the sphere of demand, because outside the consciousness of the individual it cannot exist in principle.

A. Marshall in his "Principles of Economics" (1890), and then his like-minded people, introduced the two-criteria marginalist theory of value into scientific circulation, concluding that the formation of value (market pricing) is based on two principles — marginal utility and marginal costs. Marshall's figurative judgment in this regard about the two blades of scissors is reduced to the following proposition: "When one blade is stationary and cutting is carried out at the expense of the second, we can say with carefree brevity that the second blade cuts, but such a conclusion must be carefully defended because it is not a matter of those when one can confine oneself to a formal derivation" [16, vol. 1, p. III, p. 282, 283]. This is an innovation of A. Marshall, according to V. S. Avtonomov, "made an attempt to synthesize the main achievements of the classical school, marginalists, and the historical school became the founder of the neoclassical trend in economic theory" [39, p. 98, 99].

Further, following the neoclassics, adherents of the research paradigm of institutionalism successfully attempted to substantiate the synthesized foundations of the value formation mechanism in its behavioral versions in the first third of the 20th century. T. Veblen considered it necessary to take into account the simultaneous influence on the process of value formation, both economic prerequisites and habits, instincts, inclinations, and other psychological factors that determine the behavior of an individual. According to him, the classical and

neoclassical interpretation of the theory of value, in essence, was reduced to "reducing the purpose of economic science to the evaluation of goods without an appraiser", believing that they managed to "reveal the normal cost and the normal state of equilibrium from the normal equations of supply and demand" [40, p. 175]. J. Commons, in the same connection, saw the role of behavioral factors in the process of market pricing in that, under their influence, and primarily due to various legal measures, to influence the behavior of the collective institutions of society in order to achieve a "reasonable" cost; that is why, outside of legal transactions between people, reflecting their attitude to an economic good, which is subject to transfer (alienation) within the framework of legal norms, up to a change in the title of ownership of this good, a scientifically based interpretation of value is impossible [38, p. 390]. According to W. C. Mitchell, political economy can be recognized as a "full-blooded science" only when A. Marshall's theory of value is no longer "recognized as the only true and exhaustive one" [41, p. 371].

2.3. Milestones for overcoming orthodoxy in economics in the research paradigms of the 1930s 20th — early 21st centuries

Diverse components in overcoming orthodoxy in economics from the 1930s to the present, it is possible, as noted above, to link with the period of the interpenetration of the theoretical and methodological foundations of the research paradigms of neoclassicism (including the paradigms of Keynesianism and neoliberalism) and institutionalism, which are now widely known to the modern scientific and economic community, and institutionalism, which determines the formation of a holistic — synthesized research paradigm.

In this context, the world-famous book by P. Samuelson "Economics" attracts attention. In it, starting from the fifth edition (1961), the concept of "neoclassical synthesis" is permanently mentioned, recommended "to denote a wider range of ideas — a synthesis of those truths that were established by classical political economy, and the provisions proven by modern theories of income formation" [26, vol. II, p. 211]. Taking into account this Samuelson's position on the milestones of overcoming orthodoxy in economic science, the achievements of adherents of the research paradigms of Keynesianism and neoliberalism are briefly considered below in terms of such innovations as the justification of the synthesized theoretical essence of value, the rejection of the concepts of productive and unproductive labor, as well as the rejection of class economic analysis, the absolutization of mathematical analysis and "economic laws".

The Keynesian research paradigm, as one of the components of modern unorthodox neoclassicism, is associated with the "Keynesian revolution", which became the scientific and practical support of F. Roosevelt's "New Deal" launched in January 1933, which made it possible to overcome the main hardships and devastating consequences of the global economic crisis of 1929–1933. The key innovation of J. M. Keynes, according to the value judgments of M. Blaug, is as follows: "If there is anything truly new in Keynes's theory, it is precisely a thoughtful criticism of this belief in the internal restorative forces of the market mechanism. After reading Keynes, one can reject every single element of his argument, one can even question the logical validity of the entire Keynesian scheme, but one cannot maintain faith in the ability of a free market economy to automatically maintain full employment ... In any case, the Keynesian revolution marked the true end of the "doctrine of laissez-faire" [19, p. 607]. At the same time, this historian of economic thought is convinced that "... only Keynes proposed an effective and realistic remedy against the Great Depression" [27, p. 122].

Without a doubt, the innovative "basic psychological law" formulated by J. M. Keynes, in defiance of the adherents of the "objective economic laws" of the classics and neoclassics, reduced them to the following postulate: "The psychology of society is such that

with the growth of aggregate real income, aggregate consumption also increases, but not to the same extent as income grows" [42, p. 155]. Thus, according to Keynes, the validity of state regulation of economic life is predetermined, rather, by the "psychology of society" than by the "laws of economics" and the psychologically determined (in the process of overcoming people's tendency to see their savings in liquid form) effect of the investment multiplier. Apparently, this Keynesian maxim allowed M. Blaug to state one of his eloquent statements: "The capitalists, Keynes taught us, can pull themselves out of a predicament with the help of their own shoelaces, namely, through a multiplier. The decisive moment, in this case, is the incentive to invest" [11, p. 235].

Within the framework of unorthodox neoclassicism, a neoliberal research paradigm arose, also emerging in the 1930s. Keynesianism is united by the idea of achieving conditions for the domination of free competition not in spite of state intervention in the processes of economic life, but thanks to its intervention. At the same time, if the Keynesians are in favor of measures of active state intervention in the economy, then the neoliberals are in favor of relatively passive measures of state regulation. More precisely, the former prefer direct state investments in various spheres and sectors of the economy and the fulfillment of orders and purchases by the state, as well as the tightening of tax policy, despite the possible state budget deficit and inflation. And the latter prefer the dominance of the principles of free pricing, and private property, relegating the state to the role of a "sports referee" or "night watchman" within the framework of the principle once proclaimed by one of their leaders L. Erhard "competition wherever possible, regulation where necessary". Moreover, their ideological predecessor A. Müller-Armak, having introduced the "concept of a social market economy" into scientific circulation in 1947, expressed confidence that the "fundamental differences" of alternative models of a non-self-regulating economy would become much more obvious to us. He is convinced, moreover, that "if we turn to the market core of the social market economy, then we will encounter fundamental differences ..." [43, p. 249].

The interpenetration (synthesis) of the research paradigms of Keynesianism, neoliberalism and institutionalism clearly manifests itself, among other things, in the concept of "neoclassical synthesis" by P. Samuelson, interpreted in the context of the synthesis of marginalist and behavioral theories of value, which (theories) were mentioned above in Section 2.2 of this review article. It is important to note that marginal and behavioral research principles allow modern scientists to display the value of any product in the context of the mutual penetration of economic and social factors (preconditions), including the human factor. In addition, understanding the phenomenon of value as a synthesized characteristic allows one to take into account the psychological inclinations of the individual, the expanding scope of the practice of market pricing and the assessment of future benefits through negotiation principles.

The synthesized research approach based on the synthesis of the paradigms of modern (in the works of Keynesians and neoliberals) neoclassicism and institutionalism has become breeding ground for the final refutation of orthodoxy, which has been conditioned since the time of classical political economy by the class interpretation of the theory of productive and unproductive labor according to the principle: creates or does not create a specific type of labor tangible material object (product). Obviously, for this reason, in the words of M. Blaug, "the distinction between productive and unproductive labor introduced by Smith is perhaps one of the most pernicious concepts in the history of economic thought" [11, p. 48]. But now, as L. Robbins rightly notes, "modern theory has so far moved away from the point of view of Adam Smith and the physiocrats that it does not recognize even labor that creates material objects as productive if the latter have no value." Now, he concludes, it

is clear that "the work of an opera singer or a ballet dancer is part of the wealth and economic science investigates the formation of prices for them in the same way as, for example, for the services of a cook" [44, p. 14].

Meanwhile, during the 20th — beginning of the 21st century in economics, orthodox research stamps of "generalization" of innovative achievements are still explicitly or implicitly obvious either in the context of the absolutization of mathematical analysis or through class analysis, tying the a priori conclusions arising from them to some "objective economic laws". Moreover, adherents of this kind of archaic instrumentation of orthodoxy are convinced that their argumentation is impeccable and convincing and can neither be revised, nor transformed, nor rethought. It seems that W. W. Leontief addressed them with his warning, noting that "dozens of mathematical models" created by theoretical economists continue to "adapt algebraic functions of various types and forms" using previous sets of statistical data, "not being able to make significant progress in a systematic understanding of the structure and principles of functioning of the real economic systems" [45, p. 25]. No less convincing is the warning of Academician L. I. Abalkin in connection with the odious class analysis on which the theory of productive and unproductive labor is based, stating the following: "The primitive class approach (which is still widespread!) is fundamentally wrong. It determines in advance those who make mistakes, according to criteria that go beyond the limits of science" [46, p. 4].

Finally, with regard to the explicit and implicit absolutization of "economic laws" on the way to the formation of unorthodox foundations of economic science, it seems appropriate to confine ourselves to a very impressive warning and a message of P. Samuelson about the need for the modern scientific economic community to realize: "...how insidious economic "laws" are in economic life", including such as: "Pareto's law on constant income inequality; Denison's law on the constancy of the savings rate in the private sector; Colin Clark's 25 percent cap on the share of government spending and taxes; Modigliani's law on the constancy of the ratio of wealth to income; Marx's law on the fall in the real wage rate and/or the fall in the rate of profit; no one knows who owns the law on the constancy of the ratio of capital to output. After all, he is convinced: "...if all these are laws, then Mother Nature is a born criminal" [cit. by: 19, p. 227].

CONCLUSIONS

The results of the study performed allow us to formulate the following conclusions.

1. According to the author's definition proposed in this review article, the essence of the term "orthodoxy" in economics lies in a priori axiomatic judgments about a knowingly "correct" opinion, a "correct" system of views and undeniable dogmatic convictions. As a result, the content of economic concepts and theories postulated and put into circulation by an authoritative person should be taken as a given and even as an "objective economic law", which is mandatory for all researchers and has no alternative to understand and use.

2. The content aspects of the author's vision of the vectors, stages, and problems of the formation of unorthodox foundations of economic science are obvious from the understanding of the prehistory and history of the emergence and comprehensive dissemination in this industry of knowledge of Orthodox maxims about the declared "objective economic laws" through the prism of "class analysis". This circumstance, in essence, predetermines the reasons why many generations of economists up to the present day do not accept the expediency of the dominance of intersectoral, evolutionary and systemic methods of analysis in it, they absolutize empirical or causal analytical tools, which do not allow them to be avoided a priori, as J. S. Mill of frivolous statements. Indeed, in Mill's "Principles" (1848!), which is associated with the postulates of the "economic law of value" and the "class structure of society", the expensive (and therefore dead-end) theory

of value by the classics of political economy is allegedly self-sufficient and complete and does not require its rethinking either by current or future generations of researchers.

3. The adherents of the research paradigm of mercantilism and classical political economy, having marked the beginnings of economic science, at the same time laid the foundation for odious theoretical and methodological orthodox foundations in it, demonstrating their commitment, at first glance, to uncompromising (according to the "either-or" principle) aspirations for positive scientific and practical results. But the mercantilists, while absolutizing the research principles of empiricism, did not exclude in their conclusions "sliding over the surface of economic phenomena". The classics (and later the early neoclassicists), being committed exclusively to the principles of laissez-faire, turned out to be "captive" to a priori universal "objective economic laws", which must be accepted and unconditionally followed, because they (the laws) are allegedly identical to natural ones and, therefore, do not depend on the will, consciousness and desire of the individual.

4. The formation of unorthodox components in the innovations of the research paradigms of the 19th — early 21st centuries is associated with economic romanticism, utopian socialism, the German historical school (19th century), subjectivist and neoclassical trends in economic thought (late 19th — early 20th centuries), institutionalism, Keynesianism, neoliberalism and with the currently emerging synthesized research paradigm (from the beginning of the 20th century to the present). The adherents of these paradigms (with the exception of the marginalists of the late 19th century) deny the orthodox stereotypes and myths of numerous adherents of the concept of the "invisible hand" (i.e., "objective laws") about the functioning of the economy as a self-regulating system, within which (thanks to "Say's law") only occasional, temporary, and for this reason, automatically transient crises are possible.

5. Overcoming the orthodoxy of the ancestors and fathers of economic science after the marginalist, Keynesian, and Chamberlain revolutions that took place at the turn of the 19th-20th centuries in this branch of knowledge is facilitated, firstly, by a scientifically based refutation of the orthodox conceptual position of the classics about the invariably proportional and equivalent exchange by opposing this position of integral systemic teaching about the principle of mutual benefit of exchange. Secondly, the introduction into scientific circulation of the Samuelsonian theory of the synthesis of theoretical and methodological research paradigms of Keynesianism, neoliberalism, and institutionalism, which, among other things, is manifested in the concepts of the interpenetration of Keynesian and neoliberal models of state regulation of the economy, the synthesis of marginalist and behavioral research principles in the field of theory cost, taking into account the simultaneous influence of economic and social factors.

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A Novel Weighted Hybrid Recommendation System using Sharpe Ratio for a Profitable Diversified Investment Portfolio

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ABSTRACT

Identifying where to invest and how much to invest can be very challenging for common people who have limited knowledge in the domain. Portfolio managers are financial professionals who spend a lot of time and effort to help investors in investing funds and implementing investment strategies, but not all can afford to consult them. The study aims to develop a weighted hybrid recommendation system that recommends an optimized investment portfolio based on the investor's preferences regarding risk and return. Generally, investors usually ask investment for advice from friends or relatives with similar risk preferences or if they are interested in a particular item, the investors ask for the experience of someone who already has invested in the same item. Therefore, the methodology considers the investor's past behavior and the past behavior of the nearest neighbor investors with similar risk preferences. Using user-based collaborative filtering the number of stocks is recommended using Pearson correlation based on the investor's income, then using another user-based collaborative filtering the number of stocks is recommended based on the investor's age. Weights are assigned to the recommended number of stocks generated based on income and age and their weighted average is finally considered. Finally, the feasibility of the proposed system was assessed through various experiments. Based on the received results, the authors conclude that the proposed weighted hybrid approach is robust enough for implementation in the real world. The novelty of the paper lies in the fact that none of the existing approaches make use of more than one type of weighted recommendation algorithm. Additionally, the final results obtained this way have been never further fortified with the highest Sharpe ratio and minimum risk for the investor. This combination of hybrid and Sharpe ratios has never been explored before.

Keywords: Sharpe ratio; hybrid filtering; investment portfolio; recommendation system; collaborative filtering; investor-based filtering

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INTRODUCTION

A recommendation system can be seen as an algorithm that helps to identify items that are most preferred by a certain investor. These algorithms help companies to cater to their customers in a highly personalized manner. They are broadly classified into three types mainly being, content-based filtering [1], collaborative filtering [2, 3] and hybrid filtering [4]. However, regardless of the algorithm the general idea behind the system is that it takes implicit information like timestamps, geographical location and clicks along with explicit information like recent activity history, gender, birthdate, and profile of the investor and tries to find certain similarities between either item-to-item or user-to-user to identify an item that would be preferred by that user.

An investment portfolio is usually made up of various securities, such as stocks, mutual funds, bonds, exchange traded funds, money market funds and other financial assets. Investment portfolios are usually made with the aim to grow in value and gain high returns. Types of investors can be identified based on their objectives, their investment strategies and investment type. Three main types which can be identified are commercial banks, financial intermediaries and individual investors. Commercial Banks mainly invest in bills, inter-bank bonds and national debt [1]. When choosing an investment portfolio, they aim to minimize risk and meet the expected earnings. Financial intermediaries mainly invest in stocks, mutual funds, etc. and they focus on minimizing unsystematic risk, determining the weight of each security according to investors utility and time management of investment behavior. Individual investors usually invest in bank deposits, stocks, bonds, securities investment funds, etc. Individual investors have a simple objective and that is to maximize profits at a risk tolerable level [1].

Lack of relevant knowledge and inexperience would cost the individual investors a lot of time, effort and cost to invest by themselves and if investment advisors/managers are hired it would result in high cost and low efficiency [1]. Therefore, a recommendation system that can help create an optimal portfolio to meet the investors risk preference and objectives of individual investors is necessary. We now present various filtering methods and Sharpe Ratio.

A. Collaborative Filtering (CF)

Collaborative Filtering (CF) algorithms use the historical interactions between the users and the items to create new recommendations based on the estimated proximity of similar users or similar items. These interactions are stored in a "user-item interaction matrix".

There are mainly two types of CF methods:

- Memory Based CF: They make use of the values of user-item interactions directly, with no model and are usually based on nearest neighbors (NN) search. NN search predicts ratings by referring to users who have similar ratings to that of the target user, or to items rated similar to that of the target item. This assumes that when two users have similar ratings on a few items they have similar ratings on the other items as well also known as user-based CF, or if two items are rated similar by a portion of users, the two items have similar ratings by the remaining users as well also known as item-based CF [2, 3].
- Model Based CF: Here a model is fitted to the training data which is later to predict unseen ratings and produce recommendations. Cluster-based CF, Bayesian classifiers, and regression-based methods are famously used in model-based Collaborative Filtering algorithms [2, 3].

B. Content Based Filtering

Content based filtering takes into consideration not only the "user-item interaction matrix" but also the underlying features of the users like age, gender and profession. It also takes into consideration the item features like price and category.

C. Hybrid methods

A hybrid filtering method uses both collaborative filtering and content-based methods. Since collaborative filtering is able to get more accurate recommendations as more users interact with more items, this approach only uses past user-item interactions making it difficult to recommend to new users who do not have any past interactions also known as the cold start problem, therefore here content-based filtering is used to overcome that problem [4].

It is notable that a recommendation system named "PB-ADVISOR" which is based on fuzzy and semantic technologies and recommends investment portfolios to private bankers has also been explored [5].

D. Sharpe Ratio

The Sharpe Ratio is a well-known ratio that can be used to measure an investment portfolio or even a single stock or investment [6, 7]. Here, we use the Sharpe Ratio to measure the performance of the investment portfolio by adjusting for its risk. Usually, a high Sharpe Ratio means, the investment return is high relative to the amount of risk taken, making it the better investment portfolio [6, 7]. The ratio is compared to a grading threshold of:

1. "Less than 1" — Bad
2. "Between 1 to 1.99" — Adequate/good
3. "Between 2 to 2.99" — Very good
4. "Greater than 3" — Excellent

The purpose of this paper is to propose a recommendation system that can recommend an optimal investment portfolio for individual investors with varying risk preferences.

The rest of this paper is structured as follows. Section two reviews related literature on the various methods used for recommending securities in investment portfolios. Section three introduces the investment portfolio hybrid recommendation model based on the related work. Section four demonstrates the feasibility of the investment portfolio hybrid recommendation model through various demonstrations and finally, section five talks about conclusions and future work.

LITERATURE REVIEW

Research has been done on various methods for recommendations and portfolio optimization in investment portfolios. Recommendation systems for recommending an investment plan for various investors on the internet using the Value at Risk (VaR) method to measure the risk level of the stocks and applying a collaborative filtering algorithm to recommend a portfolio based on the historical behavior of the similar investor have been explored [1]. The investment patterns of a person have been found based on their characteristics using fuzzy data mining techniques. The result is in the form of clusters of investment patterns of similar people [8]. Using Big Order Net Inflow of stock, a selection of stocks with a higher value to the net inflow was added to the pre-recommended stock set and presented to the target investor. Fuzzy clustering methods were used to categorize similar investors and stocks were chosen by the stock set that was once operated by a similar investor. This technique proved to show that the recommended stocks have higher gains after the recommendation [9].

A recommendation system based on a case-based recommendation pipeline of three steps i.e. first the retrieval and reuse of similar investment portfolios, second the revision of portfolios wherein the final set is filtered out and third the review and retain where the human advisor can review and modify the final investment portfolio was explored. The prototype generated personalized portfolios, and the performance was evaluated against real users, which showed the yield obtained by recommendations overcame that of human advisors [10]. For portfolio optimization, many approaches like Value at Risk (VaR) [1], a combination of both VaR and Sharpe ratio [6] and network topology [11] have been proposed.

In one research study, the optimum number of clusters for k-means clustering for stock market data was found using the Davies-Bouldin Index [12]. In another study, portfolio selection from companies that fall in the same cluster based on K-means clustering was done wherein, the financial data of fifty Nifty companies from the year 2012 were taken and the K-means algorithm was applied to it to find the clusters based on the financial data of Price Earning Per Share of the companies. It was found that portfolios could be generated from the clusters which have the minimum average distance [13].

An agent-based framework for diversified portfolio management was also proposed based on the investors high-level goals regarding risk and return. The highest ranked goals were taken into consideration for clustering using a suitable algorithm. The validation agent then selects the most compact cluster from which the portfolio is made and analyzed using the Markowitz model [14, 15].

G. Connor et al. [16] and J. Chen et al. [17] presented semi-parametric models for the selection of portfolio which is optimal. S.E. Satchell and O.J. Williams [18] have lamented the lack of skills and difficulties in predicting the future of financial markets. On the same lines, M. Baddeley et al. [19] lamented the herding behavior in the financial markets. K.D. Shilov and A.V. Zubarev [20] presented the discussion on Bitcoin as a possible investment venue. E.V. Sapir and I.A. Karachev [21] presented a discussion on the investment portfolios in wake of the Russian government's new investment policies. I.A. Ezangina and A.E. Malovichko [22] highlighted the risks in the

investments and financial markets in the pandemic era. O.V. Efimova et al. [23] presented the experimental results, on returns on investments, by taking into consideration the three factors of environmental, social and governance performance. A. O. Ovcharov and V.A. Matveev [24] elaborated on the factor of fear while investing in the digital financial asset markets. L. G. Pashtova [25] went a step ahead of investment portfolios and discussed the impact of such investments on the growth of the Russian economy. W.B. Freitas and J.J.R. Bertini [26] advocated the significance of tactical asset allocation for investments resulting in profitable portfolios. Various quantitative techniques have been proposed by P. Brugiere [27].

A detailed structural analysis of various options for the distribution of investment portfolios has been presented by O. S. Sukharev [28]. Various strategies for investment portfolios have been presented by M. Zhang et al. [29]. They have taken into consideration the effect of multiple policies on the optimization of portfolio distribution in the sector of renewable energy. B.B.T. Carmo et al. [30] presented a PROMETHEE V method with linear programming for helping investors with various options and scope of customization for investment portfolios. N. Eriotis et al. [31] investigated and presented a report on the investment portfolios spread over a period of one and a half decades in Greece. An important finding presented by them suggested that the diversification of the portfolio was not successful almost 50% of the time. With a focus on risk management, M. B. Bulturbayevich and N. G'ovsiddin [32] presented a discussion on the possibilities of investment portfolios for commercial banks. Y. Deng et al. [33] presented a specific case of investment portfolio through blockchain by deployment of the Artificial Intelligence techniques. K. T. Park et al. [34] proved that peer-to-peer lending could be a lucrative investment portfolio. M. Li and Y. Wu [35] used the notion of network communication and artificial intelligence to propose a framework for investment portfolios in the field of real estate.

It is noteworthy that all of the above approaches make use of only one type of recommendation

Table 1

Investor attributes considered

Sr. No.	Attribute
1	Age
2	Income
3	Number of Stocks

Source: extracted by authors based on the Federal Reserve Board — 2013 Survey of Consumer Finances by Board of Governors of the Federal Reserve System. URL: https://www.federalreserve.gov/econres/scf_2013.htm (accessed on 23.08.2021).

Table 2

Stock data from four companies

Date	Barclays	Goldmans Sachs	JP Morgan	Morgan Stanley
2017–01–03	20.867758	226.374527	77.569687	39.263435
2017–01–04	21.256769	227.836365	77.712753	39.783302
2017–01–05	21.006685	226.140228	76.997421	39.418495
2017–01–06	21.006685	229.495026	77.006355	39.993069
2017–01–09	20.886276	227.611450	77.059998	38.953350

Source: stock data reported by Yahoo Finance. URL: https://in.finance.yahoo.com/ (accessed on 23.08.2021).

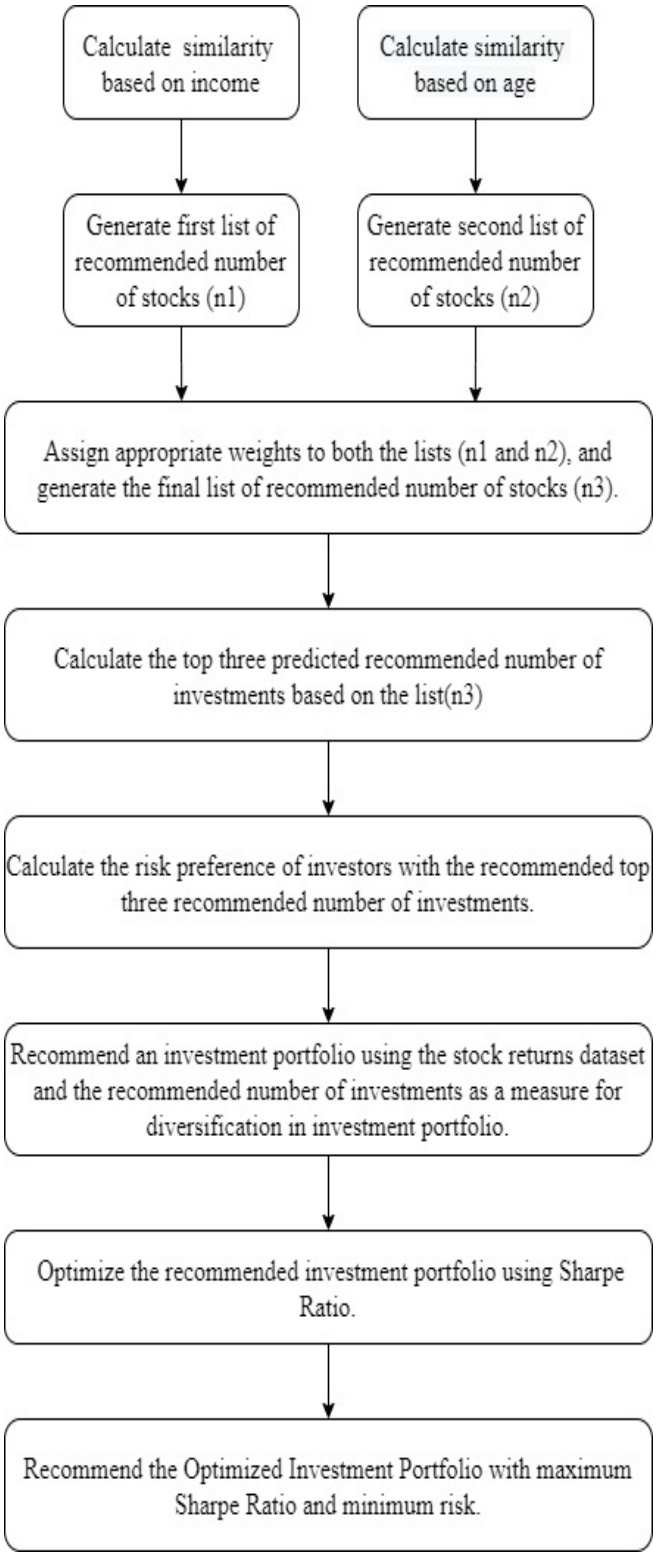

Fig. **Proposed hybrid recommendation model process**

algorithm. In the current paper, the proposed methodology uses a weighted hybrid approach which uses two recommendation algorithms along with the Sharpe ratio for portfolio optimization. This combination of hybrid and Sharpe ratios has not yet been explored before. Generally, investors usually ask for investment advice from friends or relatives with similar risk preferences or if they are interested in a particular item, the investors ask for the experience of someone who already has invested in the same item.

Along with this, tacit knowledge like age, gender, and income level is also considered. Therefore, we used a weighted hybrid recommendation algorithm where the recommendation system has two components:

- one component from the collaborative filtering where users with age are grouped together
- another component from users with similar income

The output of the two components is combined using a weighted average to generate the neighbors list consisting of recommendations of a number of stocks. Additionally, the portfolio is further optimized using the Sharpe ratio.

METHODOLOGY FOR THE PROPOSED PORTFOLIO RECOMMENDATION MODEL

A. Dataset

The investment dataset is taken through publicly available data from The Survey of Consumer Finances (SCF) 2013, which is a survey of families from the USA.[1] The survey includes data about the income of families as well as other financial characteristics as shown in *Table 1*. Live Stock returns data from yahoo finance and is extracted for the investment data.[2] *Table 2* shows the stock data of four companies considered for the present research work.

B. Process of the Proposed Recommendation Model

To provide recommendations for the target investor having specific risk preferences, the proposed model in this paper selects the top three stocks with their respective risk preference. Using user-based collaborative filtering the number of stocks is recommended using Pearson correlation based on investors income, then using another user-based collaborative filtering the number of stocks is recommended based on the investors age. The final recommendation follows a weighted hybrid recommendation system by giving appropriate weights to the recommended number of stocks generated based on income and age and their weighted average is considered. The risk preference of investors is calculated using their number of stocks held in equity shares by their nearest neighbor. The top three recommended number of stocks along with their risk preference is then given to the target investor.

Table 3

Recommended number of stocks based on age

Age-Bin	Correlation	Number of Stocks
46–50	1.0000	2.5194
41–45	0.9940	2.2007
86–90	0.9920	7.2410
51–55	0.9918	5.2424
76–80	0.9912	7.4709
81–85	0.9912	5.2323
66–70	0.9902	6.7517
36–40	0.9899	11.6138
61–65	0.9885	8.9040
71–75	0.9873	9.1750
26–30	0.9837	0.2995
Greater than 90	0.9693	2.2000
56–60	0.9678	4.6550
31–35	0.8549	1.2838
Less than 20	0.1046	0.1538
21–25	–0.4978	0.2771

Source: authors' calculations.

[1] Board of Governors of the Federal Reserve System. Federal Reserve Board — 2013 Survey of Consumer Finances. 2013. URL: https://www.federalreserve.gov/econres/scf_2013.htm (accessed on 23.08.2021).

[2] Yahoo Finance. Yahoo is now a part of Verizon Media. 2020. URL: https://in.finance.yahoo.com/ (accessed on 23.08.2021).

Table 4

Recommended number of stocks based on income

Income-Bin	Correlation	Number of Stocks
Very High	1.0000	13.7324
High	0.5807	1.4659
Medium	0.5331	0.5791
Low	0.4768	0.4192

Source: authors' calculations.

Table 5

Top three recommended stocks of age and income along with respective weights

Age Correlation	Number of Stocks (NS)	Weight (W)	Weighted NS (WNS)	Income Correlation	NS	W	WNS
1.0000	2.5194	0.5	1.2597	1.0000	13.7324	0.5	6.8662
0.9940	2.2007	0.5	1.1003	0.5807	1.4659	0.5	0.7329
0.9920	7.2410	0.5	3.6205	0.5331	0.5791	0.5	0.2895

Source: authors' calculations.

Table 6

Final weighted recommended number of stocks

WNS from Age Correlation	WNS from Income Correlation	Final WNS	Final Recommendations	
			Rounded Value of WNS	Equity Risk Preference
1.2597	6.8662	4.0629	5	Low
1.1003	0.7329	0.9166	1	Low
3.6205	0.2895	1.9550	2	Low

Source: authors' calculations.

Using the recommended number of stocks, a portfolio is created and optimized using the Sharpe risk ratio. The final portfolio with a maximum Sharpe ratio and minimum risk is recommended to the target investor.

A detailed step-by-step procedure of the proposed process is given below while the same is diagrammatically represented in *Fig*.

- Step 1: Calculate the similarity between the target investor (i) and the other investors based on income using Pearson correlation measure. This gives us the first list of recommended numbers of stocks.
- Step 2: Generate the second list of neighbor investors (n2) based on the target investors age.

Table 3 presents the recommended number of stocks based on age. Similarly, with the investor entering their annual income, the model gives the recommended number of stocks to invest in based on the income. Results can be seen in *Table 4*. Using a weighted hybrid recommendation system, the weighted average of the number of stocks is calculated. Here an equal weightage of 0.5 is given to both the factors. The results are shown in *Table 5* and *Table 6*. Assuming the recommended number of stocks is four for the following case, we

Table 7

Recommended optimized portfolio

Portfolio for Maximum Sharpe Ratio		Portfolio for Minimum Sharpe Ratio	
Returns	0.000272	Returns	0.000064
Standard Deviation	0.020553	Standard Deviation	0.019698
Sharpe Ratio	0.013229	Sharpe Ratio	0.003243
Barclays	0.005380	Barclays	0.009600
Goldmans Sachs	0.859740	Goldmans Sachs	0.335106
JP Morgan	0.123275	JP Morgan	0.644385
Morgan Stanley	0.011605	Morgan Stanley	0.010908

Source: authors' calculations.

create an investment portfolio with four different company stocks. The choice of company depends on the target investor. Using the Sharpe Ratio, we can optimize the investment portfolio. The results shown in *Table 7* have the optimized investment portfolio with the maximum Sharpe ratio and the minimum risk. Therefore, the target investor has the option to choose between the two portfolios, i.e. the portfolio with the maximum Sharpe ratio (i.e. the highest risk adjusted returns) and the portfolio with the minimum volatility or variance.

CONCLUSION

This paper proposed a hybrid recommendation model for investors who wish to invest their money efficiently but are unable to get proper financial advice from investment portfolio managers. The proposed model helps investors to maximise their returns and minimise their risk. The proposed model follows a hybrid recommendation system where a weighted average is taken from two user-based recommendation systems, and an optimised investment portfolio is recommended using optimization measures like the Sharpe ratio, a combination that has not been explored before. The proposed model was tested on data from the 2013 US study. Though being tested on the historical dataset is one of the limitations of the present work, neither it subdues the uniqueness of the proposed approach nor does it change the working of the model. We opted for this dataset as it is publicly available, standardized and unbiased. Further, as this dataset contains sufficiently aggregated values and is voluminous enough for benchmarking, we believe that the results obtained on experimentation with this dataset are promising and relevant for analyzing the investor's behavior and making the recommendations. As more features may help the model to provide more accurate recommendations, the future study will be done using more features as well as a dataset comprising historical as well as the latest information of the investors.

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