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Monetary and Fiscal Policy Measures during the COVID-19 Economic Crisis in Russia

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ABSTRACT

The author examines how monetary and fiscal policy influences the shocks facilities in the Russian economy caused by the coronavirus pandemic. The article **aims** to provide an economic assessment of the monetary measures by the Central Bank and the Government of the Russian Federation to overcome the consequences of the COVID-19 crisis. The author exploited **the methods** of content analysis, benchmarking, and logical analysis. The study covers the period of March – July 2020 and relies on the analysis of data from international organizations, analytical centers, mass media, official data sources of the Government of Russia and the Central Bank of the Russian Federation. The literature review and the analysis of the Mundell-Fleming model contribute to the better understanding of monetary policy of countries in its connection with fiscal policy. The author analyzed the monetary and fiscal measures against the COVID-19 crisis in Russia and other countries. The study provides the assessment of the COVID-19 shocks and the remedial actions. **The conclusion** is that when most economic activity is prohibited, lower interest rates cannot stimulate it in the short term. More visible are the efforts to maintain liquidity in the economy, as financial institutions often have troubles. During the analysis, the work focuses on the theoretical foundations of monetary policy and its connection with fiscal policy, as well as provides a number of stylized facts of its implementation in Russia during the coronavirus pandemic. This can be useful for further empirical research and practical recommendations in the field of monetary and fiscal policy in the Russian Federation.

Keywords: coronavirus; monetary policy; fiscal policy; economic shocks; Russian economy; Russian Federation

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INTRODUCTION

The onset of the coronavirus crisis coincided with a difficult economic situation in Russia. Since 2014, the country has been under pressure from political and economic sanctions from Western states as a result of the crisis in Ukraine. According to IMF estimates, losses from the Western sanctions and counter-sanctions by the Russian government for the Russian economy are estimated at 1–1.5% of GDP per year.[1] According to Bloomberg, Russia lost 6% of its GDP in 2014–2018, which, in addition to the sanctions, is also affected by structural restrictions and the fall in oil prices.[2]

At the beginning of 2020, the Russian economy was already in recession. According to the Central Bank of Russia (CBR), in the first quarter of 2020, Russia's trade surplus deteriorated significantly due to the decrease in the cost of exports and the sharp drop in oil prices. Due to the decrease in foreign liabilities and the growth of Russian assets of foreign banks and enterprises, there was a net capital outflow from the domestic private sector. Due to negative external shocks, the dollar-rouble exchange rate fell by more than 20%.[3]

Due to COVID-19, most of the economic activity was frozen. This situation has led the country to three types of shocks. The first is an external shock associated with a drop in world oil prices. The second is an internal shock due to government regulatory decisions aimed at limiting the spread of coronavirus within the country. The third shock is also associated with external pressure to reduce demand for a wide range of Russian export goods due to the slowdown in the global economy [2]. All these shocks are certainly interconnected.

This article considers the above shocks in the context of monetary and fiscal policies pursued by the Central Bank and the Government of the Russian Federation to overcome the economic crisis associated with coronavirus in Russia.

The question is how monetary policy along with fiscal policy has helped to overcome the macroeconomic shocks in the Russian economy caused by the COVID-19 crisis. The research methodology is based on an economic assessment of monetary measures taken by the Central Bank and the Government of the Russian Federation to overcome the consequences of the COVID-19 crisis. The author used the methods of content analysis, benchmarking, and logical analysis.

The article consists of four main parts. The first part is devoted to the literature review and analysis of the Mundell-Fleming model for understanding the monetary policy of countries in its connection with fiscal policy. The second part analyzes the monetary and fiscal responses to the COVID-19 crisis by the Central Bank and the Government compared to the policies of other countries. The third part assesses the shocks of COVID-19 and the corresponding macroeconomic measures. The last part provides the conclusions.

The research employs the data analysis provided by international organizations, analytical centers, mass media, official data sources of the Government of Russia and the Central Bank of the Russian Federation.

THEORETICAL BACKGROUND

From a theoretical point of view, the relationship between fiscal and monetary policy was first examined in J. Keynes's IS-LM model for a closed economy. The model describes the interaction between the commodity market and money market, where the IS curve represents all equilibria in the commodity market, and the LM curve represents all equilibria in the money market. The model helps to find

[1] IMF (2015). Russian Federation: Staff Report for the 2015 Article IV Consultation. URL: https://www.imf.org/en/Publications/CR/Issues/2016/12/31/Russian-Federation-Staff-Report-for-the-2015-Article-IV–Consultation-43143 (accessed on 19.07.2020).

[2] Bloomberg (2018). Here's One Measure That Shows Sanctions on Russia. 16 November, 2018. URL: https://www.bloomberg.com/news/articles/2018–11–16/here-s-one-measure-that-shows-sanctions-on-russia-are-working (accessed on 19.07.2020).

[3] Central Bank of the Russian Federation (2020). Central Bank of Russia, external sector statistics. URL: https://www.cbr.ru/eng/statistics/macro_itm/svs/ (accessed on 27.07.2020).

the relationship between the key rate and the production level in the economy. The ultimate effect of both fiscal and monetary measures depends on the characteristics of the economy reflected in the elasticities of the IS and LM curves. The elasticity of the interest rate in the economy will determine the degree of policy impact [1].

The IS-LM model does not directly address inflation and public debt issues, which were later considered in the correlation analysis of monetary and fiscal policies. Economists T. Andersen and F. Schneider managed to explain the influence of both fiscal and monetary policy on aggregate demand, while solving the traditional problem of a compromise between the output and inflation level. According to the authors, the independence of monetary and fiscal policies does not contribute to the public good. The absence of monetary incentives does not allow achieving optimal output and minimal inflation [11].

Since the IS-LM model was primarily designed for a closed economy, it was further developed to analyze an open economy. The model was extended by R. Mundell and M. Fleming, who added a balance of payments (BP) component. The new IS-LM-BP model is known as the Mundell-Fleming model (MFM). It applies to a small open economy, subject to monetary and fiscal policies along with the balance of the capital account and the current account.

Given that the article discusses primarily monetary policy, the focus will be on the LM curve analysis. The following equation describes the money market

$$M / P = L (r, Y),$$

where M / P is the real balance of money; L is the demand (r, Y), which negatively depends on the interest rate and positively — on the income Y. The money supply (M) is an exogenous variable controlled by the national Central Bank, while the domestic interest rate is equal to the world interest rate. To account for country risk, the final domestic interest rate includes the risk premium (rp), so $r = r^* + rp$. The price level is also considered exogenously constant, since the MFM considers only the short-term situation [12].

The model assumes perfect capital mobility and the fact that domestic and foreign securities are fungible. This allows for predicting the domestic rate at the same level as the world interest rate plus the country risk premium [10]. However, in the real world, due to exchange rate expectations and country-specific factors, the domestic interest rate differs from the global one. Exchange rate expectations can contribute to different outcomes that diverge from the original monetary policy objective [4].

The model assumes that the behavior of the economy depends on the adopted exchange rate system. The model explains the impact of the exchange rate regime on monetary and fiscal policies [3].

The MFM shows that monetary policy does not affect total income at fixed exchange rates. With each stimulus measure, the money supply must be adjusted to the declared exchange rate. Thus, the MFM stipulates that at a fixed exchange rate, monetary policy is usually not effective, since it does not affect income [3]. Expansionary monetary policy is only effective with the floating exchange rate.

Despite the fact that the model has been expanded, there are a number of disadvantages. First, according to the MFM, any economic shock will lead to a change in the demand for money and a change in interest rates, which will automatically return the economy to equilibrium. In reality, the demand elasticity for money to changes in interest rates is not permanent and may reflect different situations in the economy.

Second, the LM curve is criticized, especially its top and bottom. In reality, in the event of a strong excess or shortage of money in circulation, the economy will react not only to a change in the interest rate, but also to a

change in prices. This can affect the general equilibrium of the model and increase the inflation rate in the economy.

Third, the model does not consider such an important component as the labor market and such an important macroeconomic variable as inflation, which is also the subject of both fiscal and monetary policies [20].

Fourth, the real situation of many countries further complicates the application of the above theoretical positions. Policy measures by the national central banks (CBs) of industrialized countries to stimulate economic activity are limited, given that key rates are already close to zero in many of these countries. However, monetary authorities often rely heavily on unconventional measures by increasing their central bank's balance sheet and buying government bonds. Thus, the Central Bank closely cooperates with the fiscal authorities, providing opportunities for financing the budget deficit. This case of quasi-monetary policy serves the interests of fiscal policy. It cannot be fully analyzed by all the assumptions of the IS-LM-BP model.

Fifth, the regime and volume of monetary and fiscal interventions often depend on the depth of the recession. The current empirical evidence testifies that an incentive measure cannot be substantially less than the shock itself. For example, if the contraction of the economy in the first quarter amounted to 4.8% of the US GDP, then the stimulus deal, worth about 10% of the US gross domestic product, is not excessive.[4]

Finally, with a floating exchange rate, monetary policy cannot achieve the expected results. The reason is the depreciation of the national currency. This increases the price of imports. If the economy depends on imports, the price level increases and the real money supply decreases. Households can also respond to increased risk by holding more money. This scenario happened in the Russian economy and will be discussed further.

A lot of works contributed to further research into the relationship between monetary and fiscal policies. These papers provide an empirical study of the effects of both types of policy on closed and open economies. There are two directions in the economic literature. Representatives of the first one, M. Bruno, S. Fischer and A. Drazen [13, 14] investigated the impact of fiscal and monetary policies on public debt. The second scientific direction was formed by A. Blinder [15], G. Tabellini [16], A. Alesina [17], M.L. Petit [18], W.D. Nordhaus, C.L. Schultze and S. Fischer [8]. It focused on studying the strategic interaction of the two types of policies that affect the output and inflation in the economy.

Most of these works judge on the interaction of monetary and fiscal policy through several mechanisms [19]. The first is the interaction of fiscal policy with monetary transmission channels. Fiscal measures influence directly on domestic demand and indirectly on interest rates. Thus, the impact of fiscal policy on domestic demand can change the demand in the economy and, as a result, affect interest rates. Fiscal policy can also influence the government policy risk premium that is an integral part of the interest rate. Fiscal policy also carries monetary implications through inflation.

The second mechanism is the impact of fiscal policy on the long-term sustainability of monetary policy. In particular, uncertainty about the sustainability of fiscal policy can undermine the political objectives of monetary policy [5].

ANALYSIS OF MONETARY MEASURES TO OVERCOME SHOCKS IN THE RUSSIAN ECONOMY

The previous section provided a critical description of the MFM model for an open economy. Most of its provisions are valid both for the Russian economy and for an open economy with a flexible (floating) exchange rate regime. This part of the article will look at both

[4] Detrixhe J. The US is preparing $ 2 trillion to stimulate its economy. Will it be enough? Quartz. 2020. URL: https://qz.com/1824986/us-plans-2-trillion-stimulus-to-battle-coronavirus-led-recession/ (accessed on 19.07.2020).

monetary, quasi-monetary and fiscal policies pursued by the Central Bank of the Russian Federation and the Russian government during the outbreak of the COVID-19 crisis.

Table 1 reflects the wide range of monetary measures taken by the Russian government during the COVID-19 outbreak. They are associated with the provision of liquidity, bank subsidies for loans, easing rules for financial institutions. Nevertheless, the reduction in the key rate from 5.5 to 4.5% on June 19, 2020 and to 4.25% on July 24, 2020 became the most significant monetary measure of the Central Bank during the crisis. This was the fourth decline during 2020, falling from 6.25% to 6.0% and to 5.5% on February 10 and April 27, respectively.[5]

These measures were due to factors such as containing the consequences of COVID-19, a significant drop in external demand, a decrease in business activity in the service and industrial sectors, a decrease in new orders in the external and domestic markets, income depreciation as a result of growing unemployment rate, which increased from 4.6% in March to 6.1% in May 2020.[6] Moreover, the unemployment rate is expected to reach 10% by the end of 2020.[7]

Along with the problems in the real sector of the Russian economy, it is necessary to outline some problems in the financial sector, i.e. a decrease in interest rates on deposits and mortgage loans, as well as a decrease in yields on the federal loan bond market. These trends supported the decision of the Central Bank of the Russian Federation to continue cutting the discount rate. Thus, the rate cut was aimed at supporting lending, including in the most vulnerable sectors of the Russian economy.

The decrease in the key rate is also explained by the decrease in inflationary pressures. The inflation rate was 2.5% in the first quarter of 2020 in annual terms (which is less than the indicator for the first quarter of 2019 at 5.5%) [9]. Today, a stimulating monetary policy is aimed at returning to the target inflation rate of 4%. This is consistent with the experience of other countries and provides flexibility in monetary policy to mitigate crisis situations [5].[8] The measure is also intended to stimulate aggregate demand, which should put pressure on the money supply in the economy, despite a slight increase in cash demand. In March 2020, the cash in circulation (aggregate M0) increased by 1.9% compared to that of February 2020, and by 2.9% compared to that of December 2019.[9]

Along with the exports decline (mainly due to the drop in oil prices), the increase in the key rate led to the depreciation of the Russian currency by more than 20% against the US dollar.[10] As a result, imports became more expensive. The decline in real disposable income led to a drop in import demand. In Q2 2020, compared to Q2 2019, it decreased by 13.5% (from $ 62.0 billion in Q2 2019 to $ 53.6 billion in Q2 2020).[11]

Some measures in *Table 1* can be attributed to both fiscal and monetary policy. For example, bank loan subsidies were intended to prevent unwanted restrictive effects. Subsidies as part of fiscal policy will enable to implement monetary policy. Other measures, such as expanding the Lombard List, weakening the rules

[5] Central Bank of the Russian Federation (2020). Central Bank of Russia. Key rate. Database. URL: https://www.cbr.ru/eng/hd_base/KeyRate/ (accessed on 12.10.2020).

[6] Rosstat (2020). Employment and unemployment in the Russian Federation in May 2020. Official website of the Russian Statistical Agency. URL: https://gks.ru/bgd/free/B 04_03/IssWWW.exe/Stg/d05/119.htm (accessed on 12.10.2020).

[7] Kommersant (2020). Kudrin allowed an increase in unemployment in Russia to 10%. URL: https://www.kommersant.ru/doc/4332155 (accessed on 12.10.2020).

[8] Russian Government (2020). Measures of the Russian government to combat coronary infections and support the economy. URL: http://government.ru/support_measures/category/finance/ (accessed on 12.10.2020).

[9] Central Bank of the Russian Federation (2020). Performance Indicators of Credit Institutions 2020. URL: https://cbr.ru/statistics/bank_sector/pdko_sub/ (accessed on 12.10.2020).

[10] Central Bank of the Russian Federation (2020). Central Bank of Russia. External Sector Statistics. URL: https://www.cbr.ru/eng/statistics/macro_itm/svs/ (accessed on 12.10.2020).

[11] Central Bank of the Russian Federation (2020). Estimate of Key Aggregates of the Balance of Payments of the Russian Federation in January-June 2020. URL: https://www.cbr.ru/eng/statistics/macro_itm/svs/bop-eval/ (accessed on 12.10.2020).

Table 1

Key monetary policy measures to support the national economy

Measures	Description	Validity
Providing liquidity	To prevent a decline in cash flow to banks and an imbalance between the long-term and medium-term funds, the Bank of Russia facilitated access to liquidity for credit institutions. In particular, the Lombard list was expanded to include a number of mortgage bonds, the irrevocable credit line fee of the Bank of Russia was reduced from 0.5 to 0.1%, as well as credit institutions and non-bank financial institutions were entitled to recognize equity and debt securities, acquired before 1 March 2020, at fair value in the accounting records	2020
Bank loan subsidies (financial sector)	Providing subsidies from the federal budget to Russian credit organizations for reimbursement of shortfalls in their income on loans issued in 2020 to systemically important organizations for working capital replenishment	2020–2021
Collective investment market support	Simplified rules for stress test scenarios for non-governmental pension funds (NPFs). The Bank of Russia allowed NPFs not to bring their portfolios in line with the regulatory requirements after stress testing until 1 January 2021, if their asset deficiency was induced by market factors.	2020
Simplifying the rules for financial institutions	Weakening the rules of control and supervision of the Bank of Russia in relation to financial institutions	Until July 1 2020
Capital provision	Reducing credit risk assessment requirements to free up bank capital and provide additional opportunities for lending to the real sector of the economy	2020

Source: Russian Government (2020). Russian government preventive measures against the coronavirus and support the economy. URL: http://government.ru/support_measures/category/finance/ (accessed on 12.10.2020).

of control and supervision of the Central Bank in relation to financial institutions, simplified rules for stress test scenarios for non-governmental pension funds, as well as reducing the requirements for assessing credit risk for banks, are associated with easing regulation.

These regulatory facilitation measures became important, especially during the period of self-isolation, when economic activity was frozen and many financial institutions were experiencing liquidity problems. A liquidity crisis during the quarantine can only exacerbate the difficult situation for many businesses. It was very important to provide liquidity and ensure the smooth functioning of financial markets with simplified regulation.

It is rather difficult to assess the impact of the key rate cut at the current stage, however, there are expert estimates of quasi-monetary measures in support of fiscal policy. According to the IMF, these measures make up 1% of Russia's GDP.[12] Among the G20 countries,

[12] IMF (2020). Database of Fiscal Measures of Countries in Response to COVID-19. URL: https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19/ (accessed on 12.10.2020).

these measures were negligible. This indicator is the highest for Italy and Germany — 34% and 31.5% respectively. In the US, this figure was 2.6% of GDP. Recent US measures are related to the extension of the simplified procedures for issuing mortgage loans until August 31, 2020.[13]

ANALYSIS OF SHOCKS IN THE RUSSIAN ECONOMY

It is important to analyze the main shocks in the Russian economy which monetary policy was designed for. The introduction mentions the three significant types of shocks. These include: an internal shock due to regulatory decisions of the government aimed at limiting the spread of coronavirus, an external shock from the drop in global oil prices, and an external shock from a decrease in demand for a wide range of Russian export goods due to a slowdown in the global economy. The second and third shocks are interconnected and will be discussed below.

To protect the population from the spread of COVID-19, the Russian government took a number of restrictive measures to block economic activity. This contributed to an internal shock over government regulatory decisions aimed at limiting the spread of coronavirus. According to experts from the Gaidar Institute, the internal shock is most likely close to the situation in the early 1990s associated with Russia's transition from a planned to a market economy, when there was a gap in the existing economic and logistic ties [2].

The research by O. Blanchard and M. Kremer [6] showed that the depth and duration of industrial downturns often depend on the complexity of the value added chain (the number of participants in the production process). In the context of social distancing, the toughest restrictions are applied in the service sector, where these chains are short. We can conclude that cancelling restrictive measures can contribute to a relatively rapid economic recovery. Consequently, this shock is eliminated by cancelling restrictions and supporting the economy by fiscal and monetary packages. Fiscal policy measures have become a higher priority for the Russian Government. According to ING, they account for about 2% of the country's GDP.[14]

Moreover, a number of fiscal measures taken by the Russian government prevail over monetary ones (*Table 2*). Big problems in the healthcare sector in Russia produced advanced fiscal measures. They are associated with a shortage of medical personnel, beds and lung ventilators in medical institutions. Lung ventilators are currently required in different regions for 2–9% of the total number of COVID-19 cases [7]. The measures to solve this problem included preferential loans for producing medical goods, purchasing medical devices, a preferential duty on medical supplies, support for scientific, educational and medical institutions, VAT benefits on medical supplies (*Table 2* mentions most of them).

The decline in demand was another significant reason. To revitalize economic activity, the Government took steps to reduce the tax burden, subsidies for citizens, as well as direct and indirect subsidies for various sectors of the economy, such as air travel, tourism, etc.

Since this article deals with an open economy model, the external sector should also be considered. As noted above, the external shock is primarily associated with a decrease in demand for a wide range of Russian export goods due to a slowdown in the global economy. This is accompanied by a drop in oil prices, as well as in the supply of oil and gas for export.

This shock is of greatest importance to Russia, due to the low volumes of non-resource

[13] FHFA (2020). Federal Agency for Housing Construction Financing. URL: https://www.fhfa.gov/Media/PublicAffairs/Pages/FHFA-Extends-COVID-Related-Loan-Processing-Flexibilities-for-FannieMae-and-Freddie-Mac-Customers-Through-August.aspx/ (accessed on 12.10.2020).

[14] ING (2020). Russia's central bank cuts rates and signals more could be on the way. 24.04.2020 URL: https://think.ing.com/snaps/bank-of-russia-cuts-rate-by-50-bp-guides-for-another-100/ (accessed on 12.10.2020).

Table 2

Key fiscal measures by the Government of the Russian Federation to support the national economy

Measures	Description	Validity
Tax measures		
Reduced insurance premiums	For organizations and individual entrepreneurs included in the Unified Register of SMEs, the overall rate of insurance premiums has been reduced from 30% to 15% for the part of the wage that exceeds the minimum monthly wage (12,130 roubles). The insurance premium rate for compulsory pension insurance will be 10%, for compulsory health insurance — 5%. Insurance contributions for compulsory social insurance in case of temporary disability and in connection with maternity are not paid	From April 1, 2020
Tax incentives (industries affected)	Companies operating in affected sectors may receive a deferral or installment plan for taxes (advance payments), including insurance premiums, if they engage in certain economic activities, with due dates in 2020, excluding VAT, minerals, mining tax, excise taxes and tax on additional income from hydrocarbon production	An installment plan can be provided for a period of up to 3 years with a decrease in income by more than 50% or in the presence of losses with a decrease in income by more than 30%
Extension of the tax payment deadline for SMEs	For companies included in the SME register and operating in the affected sectors, the deadlines for the payment of almost all taxes (except VAT), including insurance premiums, have been extended. It will be possible to repay the debt formed after the expiration of the extended payment period, in equal installments during the year	From April 2, 2020
Exemption of individual entrepreneurs from taxes	Individual entrepreneurs from the industries most affected by the coronavirus epidemic are exempt from taxes, fees, insurance premiums for Q2 2020	Q2 2020
Tax exemption for SMEs and NGOs	Organizations included in the unified register of small and medium-sized enterprises from the sectors most affected by the coronavirus epidemic, as well as organizations included in the register of socially oriented non-profit organizations, religious and other non-profit organizations, are exempt from taxes, fees, insurance premiums for the II quarter of 2020	Q2 2020
Backbone companies support	Backbone organizations can apply for one or more support measures: 1) subsidies for reimbursement of costs in connection with the production (sale) of goods, works, services; 2) deferred tax payments, advance tax payments; 3) state guarantees for loans or bonded loans attracted by backbone organizations*	2020
Suspension of collection	No fines will be imposed for SMEs from the affected sectors for already established tax arrears. The decisions to suspend account transactions will be prohibited to enforce the decision to collect taxes, fees, insurance premiums, interest and / or fines	From March 25 to May 31, 2020 inclusive

* The total amount of a loan issued to a group of companies should not exceed 3 billion roubles, and the rate should be 5% per annum. The term for subsidizing rates is 1 year from the date of the loan agreement.

Table 2 (continued)

Measures	Description	Validity
Subsidies for citizens		
Payments to employees of social institutions	Payments to health workers and social workers range from 10 to 60 thousand roubles per month	Payments are calculated for the period from April 15 to September 15, 2020
Payments for children from 3 to 7 years old	Families whose average per capita income does not exceed the subsistence minimum per capita established in the constituent entity of the Russian Federation began to receive payments for children up to 5.5 thousand roubles	From June 1, 2020
Payments for children from 3 to 16 years old	Citizens of the Russian Federation living on its territory can receive a lump sum payment of 10 thousand roubles for each child from 3 to 16 years old who has the citizenship of the Russian Federation	Transfer of payments started on June 1, 2020
Subsidies for lost jobs after March 1, 2020	Citizens dismissed after March 1, 2020, unemployment benefits, regardless of the length of service and the level of earnings at the previous place of work in April – June, the maximum amount is set at 12,130 roubles	From April 1, 2020
Payments for children under 3 years old in April – June	Monthly payment of 5 thousand roubles paid to all families with children under 3 y.o. Payment is assigned to each child of this age	April – June 2020
Subsidies for self-employed citizens	Citizens who applied the special tax regime "Professional income tax" (self-employed) in 2019 are entitled to a subsidy in the amount of the professional income tax paid by them for 2019 as of April 30, 2020. The subsidy is provided in a lump sum	2020
Subsidies for entrepreneurs	The government will pay free financial assistance of 12,130 roubles per employee to small and medium entrepreneurs from the most affected sectors of the economy. This money can be spent on any expenses of the SME, including salaries. 104.4 billion roubles will be allocated for these purposes. More than 1.7 million companies and individual entrepreneurs can count on direct payments	May – July 2020
Subsidies for different sectors of the economy		
Preferential mortgage (financial sector)	Mortgage loans are provided to citizens for the purchase of real estate in the primary market at a rate of 6.5% for the entire loan term	April 17 – November 1, 2020
Subsidies for airports	Russian airports and organizations belonging to the same group of persons will receive subsidies from the state in the amount of up to 10.9 billion roubles	2020
Preferential loans for exporters of agricultural products	Preferential loans are provided to all agricultural producers that have concluded agreements on increasing competitiveness (with the exception of agricultural credit consumer cooperatives), organizations and individual entrepreneurs engaged in the production, primary and (or) subsequent (industrial) processing of agricultural products, their storage, transshipment and sale	2020

Table 2 (continued)

Measures	Description	Validity
Working capital loans	Loans to replenish working capital and provide employment for backbone companies. The loan rate will be subsidized by the Central Bank rate; 50% of the loan will be secured by government guarantees	2020
Decision to support the insurance market	Decision not to apply measures for violations of the requirements for the structure of assets where insurance reserves and the insurer's own funds (capital) are invested	Until September 30, 2020
Support for Russian car manufacturers	The government provided 25 billion roubles as support	2020
Recapitalizing public MFOs	Financial support for the national project "Small and Medium Business and Support for Individual Entrepreneurship Initiatives" in 2020 will increase by 12 billion roubles. The funds will be used to recapitalize state microfinance organizations that provide soft loans to small and medium-sized businesses in the constituent entities of the Russian Federation. Increasing the availability of microloans at reduced rates is especially important for companies affected by the impact of the spread of COVID-19	Until May 13, 2020
Subsidies for airlines	Russian airlines were allocated 23.4 billion roubles to cover losses	Until May 13, 2020
Preferential loans for producing medical goods	Financing of enterprises producing equipment and products for the detection, prevention and treatment of epidemic diseases, as well as the production of personal protective equipment, medicines and medical products within the framework of the Industrial Development Fund program	Unlimited time
Reduced fees from tour operators (tourism)	The government has adjusted the contributions of outbound tour operators to personal liability funds. In 2020, it will amount to 0.25% of the total cost of the tourism product against the previous 1%	2020
Preferential duty on medical supplies	Exemption from import customs duty on medicines and medical devices used to prevent the spread of coronavirus, including personal protective equipment and materials for their production, vaccines and disinfectants	March 16 — September 30, 2020
Benefits for payment of VAT on medical supplies	VAT exemption for medical goods imported from abroad and donated to medical institutions for the treatment of patients	March 16 — September 30, 2020
Purchase of medicine	27.7 billion roubles to purchase medicine	2020
For the support of scientific, educational and medical institutions	15.8 billion roubles to support federal educational, scientific and medical institutions	2020
Creation of temporary jobs	In 2020, more than 4 billion roubles will be allocated to the regions for partial reimbursement of labor costs for employees when creating temporary jobs	2020

Source: Russian Government (2020). Russian government preventive measures against the coronavirus and support the economy. URL: http://government.ru/support_measures/category/taxes/ (accessed on 27.07.2020).

exports and the dependence of domestic investment activity on export oil and gas revenues. This shock has repeated over the past 20 years (1998–1999, 2008–2009, 2014–2015) as a result of financial and economic crises [2]. However, it does not resemble the situation in 2009, when the Russian economy was exploding: GDP growth in 2007–2008 was 8–10%.

Decreasing demand for oil and falling oil prices resulted in the Russian currency depreciated against the US dollar by more than 20%. The drop in exports led to a shortage of foreign exchange to finance imports. According to the forecast of the Gaidar Institute, by the end of 2020, imports will decrease by 20%, amounting to $ 208 billion due to low domestic demand [2].

To solve this problem, the government took measures to support Russian exporters (*Table 2*). They include preferential loans for exporters of agricultural products, support for Russian car manufacturers, and reduced fees for tour operators. However, since the global downturn in trade and demand is also largely the result of various restrictive measures, the duration of the fall will be limited by the duration of the quarantine measures, after which demand will recover. Thus, government measures of financial support for exporters will be less important.

In the near future, the current account balance of Russia will be significantly affected by changes in oil prices, a decrease in global demand for major Russian export goods, restrictions on oil exports under the OPEC + agreement, a decrease in prices for non-hydrocarbon exports, a depreciation of the national currency and temporary travel ban. Imports demand is also expected to decline due to the decline in real disposable income and the depreciation of the rouble. According to the forecast of the World Bank, these factors will contribute to a decrease in the GDP level by the end of 2020 by 6%.[15]

CONCLUSIONS

The coronavirus pandemic made most governments to use both monetary and fiscal policy instruments. The drop in overall demand, driven by lower household incomes and uncertainty about the future as a result of the self-isolation regime, showed the Central Bank of Russia that the key rate would drop to its historically lowest level.[16]

The article identifies three types of shocks faced by the Russian economy. All these shocks are interconnected. However, the drop in world oil prices and in Russian exports demand have become the biggest for the Russian economy, given its direct impact on the country's income and currency depreciation. This crisis may have worse consequences for the Russian economy due to the fact that the country is currently under the pressure from sanctions and counter-sanctions, and the dynamics of GDP has been negative since the beginning of 2020.The consequences of the current internal shock and external pressure may appear after 2020. They can put more pressure on the domestic economy than the 2008 global economic crisis and the Russian economic crisis of 2014–2015.

The work reveals a wide range of monetary and fiscal measures to support aggregate domestic demand in the Russian economy. Most of them helped to cope with the identified three shocks caused by COVID-19. The rate cut to historic lows was supposed to support lending and aggregate demand, including in the most vulnerable sectors of the Russian economy, affected by the drop in oil prices and the devaluation of the Russian currency. The significant easing of monetary policy is due to a set of factors, including a slowdown in inflation and a decline in inflationary expectations.

However, this measure did not lead to significant results due to the depreciation of the

[15] World Bank (2020). Recession and Growth under the Shadow of a Pandemic. Russia Economic Report. 6 July 2020: 43rd Issue of the Russia Economic Report. URL: https://www.worldbank.org/en/country/russia/publication/rer (accessed on 12.10.2020).

[16] Central Bank of the Russian Federation (2020). Bank of Russia. Statement by the Governor of the Bank of Russia E. Nabiullina at a press conference. URL: https://cbr.ru/press/event/?Id=6656 (accessed on 12.10.2020).

Russian currency by more than 20% against the US dollar and more expensive imports for businesses and households. This measure was not effective enough due to the freezing of economic activity. When most economic activity is prohibited, lower interest rates cannot stimulate growth in the short term.

Efforts to maintain liquidity in the economy became more visible as economic activity was largely frozen and many financial institutions experienced problems.

The article also mentions the role of fiscal policy. COVID-19 has increased country-specific risks and risk premium in many countries. Fiscal measures also contributed to risk mitigation. In general, fiscal and monetary policy measures were aimed at supporting domestic aggregate demand.

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Scenario Modelling for Reproducing Investment Potential of Institutional Sectors in the Regions of the Siberian Federal District

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ABSTRACT

The authors analyze the trends and patterns for reproducing investment potential of institutional sectors. This is relevant for the economic and financial security of territorial systems. **The aim** of the study is to design a scenario model for reproducing investment potential of institutional sectors at the regional level. This model suggests systems of predictive scenarios for the reproduction and choosing the optimal one to achieve positive dynamics of the socio-economic development of the regions. When designing the scenario model, the authors used statistical **methods** for data collecting and processing, regression analysis with the least squares method and ARIMA forecasting. The authors developed an algorithm of scenario modelling for reproducing investment potential of institutional sectors in regional systems. The authors designed a balance model for financial flows between them for various investment instruments. They analysed the regularities of reproducing their investment potential. The paper presents an econometric analysis of financial flows among the sectors considering the impact factors, and the basic scenarios of reproducing their investment potential. The work reveals a stable trend of the outflow of investment resources in institutional sectors accumulated by the banking sector abroad during periods of economic downturns and the development of financial and economic crises. The study suggests a model allowing to determine the most likely forecast scenarios for reproducing investment potential of institutional sectors: inertial, extremely negative (pessimistic) and the most favorable (optimistic). The authors conclude that an increase in volatility in financial markets, a weakening of the domestic currency, and an increase in negative trends in economic development significantly increase the likelihood of a pessimistic scenario. To prevent this, the Central Bank of the Russian Federation, must change its policy of regulating the financial and economic activities of the banking sector: to limit the speculative activities of credit institutions that facilitate the withdrawal of financial resources from the domestic economy, to support investment programs for developing of enterprises of the real sector. The prospect for further research is building a system of mechanisms for transiting to the implementation of the optimal scenario of reproducing investment potential of institutional sectors, ensuring the restoration and progressive socio-economic development of territorial systems.

Keywords: reproducing investment potential; institutional sectors; balance model; banking sector of the economy; scenario modelling; forecast scenarios

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INTRODUCTION

Investment resources play a crucial role in the socio-economic development of territorial systems at various levels. They make up the financial basis for modernization and technological renewal of production processes, expansion and diversification of their economic activities. Researches reveal the importance of attracting investment to develop the real sector of the economy: S. Yu. Glaz'ev [1], S. D. Bodrunov, R. S. Grinberg, D. E. Sorokin [2], T. V. Uskova [3], S. Chung, H. Singh, K. Lee [4], J. B. J. Bushee [5], Y. Yafeh, O. Yosha [6], A. Costeiu, F. Neagu [7] and many others.

Today, the real sector enterprises have no possibility of technological renewal due to the limited availability of their own financial resources and the lack of credit. Investments attracted by financial institutions are directed primarily to low-tech industries related to the extraction of mineral resources. High-tech industries that are in badly need of investment resources cannot attract them.

Investment resources play a crucial role not only in the activities of the real sector enterprises. Investments attracted to the public administration sector make it possible to implement large infrastructure projects in the field of transport, logistics, energy, housing and communal services, health care, ecology, and implement strategically important programs for the socio-economic development of territories at the municipal, regional and macroeconomic levels.

Researchers N. V. Zubarevich [8], Zh. A. Zakharova [9], V. I. Yakunin, A. R. Bakhtizin, S. S. Sulakshin [10], A. K. Morozkina [11], L. V. Tokun [12], T. Sula [13], L. Deidda, B. Fattouh [14], T. Jokipii, P. Monnin, [15], J. MacGregor [16], S. N. Silvestrov, N. V. Kuznetsov, V. V. Ponkratov, D. A. Smirnov, N. E. Kotova [17] and many others wrote about the significant role of investment resources in the implementation of state-important projects for the socio-economic development of territorial systems. Investments in the infrastructure of territorial systems and the social sphere allow creating favorable conditions for life, providing households with the necessary material benefits and high-quality services by modern standards. Today, many regions do not have sufficient investment resources for large-scale, capital-intensive infrastructure projects, as well as strategic programs for socio-economic development, and enterprises do not have the resources to modernize production processes and switch to innovative development. With limited financial resources of enterprises of various types of economic activity and budgetary funds, it is important to attract bank investments to combat technological backwardness, implement modernization and switch to innovative development of industrial enterprises and, in general, progressive socio-economic development of territories. Studying development problems of the investment potential of various economic sectors (government, financial and non-financial corporations, households and foreign institutions operating in Russia), its flow specifics between them and in space, between different regional systems, modelling the most probable forecast scenarios for reproducing investment potential in the growing economic crisis become especially relevant. Scenario design of reproduction processes of the investment potential of institutional sectors linked to each other is necessary to find optimal mechanisms for solving problems that impede attracting investments in the real sector of the economy.

DESIGN ALGORITHM FOR A USE CASE MODEL OF REPRODUCING THE INVESTMENT POTENTIAL OF INSTITUTIONAL SECTORS

Reproducing the investment potential of the institutional sectors of the economy has recently become an urgent problem due to the problem of attracting investments from financial institutions, the active outflow of

their capital from the domestic economy and speculative financial policy pursued by the banking sector of the economy.

The institutional sectors of the economy of any territorial system include:

- financial corporations (credit institutions, insurance organizations, non-state pension funds, investment companies);
- non-financial corporations (enterprises of various types of economic activity);
- public administration sector (government agencies);
- households;
- foreign institutions sector — rest of the world.

Reproducing investment potential of institutional sectors is renewing their investment resources, covering the stages of accumulation, use and attraction of additional resources, which result in the opportunities for the sectors of investment activity. S. V. Boslovyak [18] had this understanding of the essence of reproducing the investment potential of economic entities. He looked at the process of reproducing investment potential as to "a continuous process of renewal and additional attraction of financial flows of investments in order to provide the enterprise with sufficient financial resources for investment activity" [18, p. 93]. E. I. Strogonova [19] and I. V. Vyakina [20] demonstrated a similar approach.

We used a scenario approach for a systematic study and forecasting of the processes of reproducing the investment potential of various economic sectors. This approach involves developing not only basic, most probable forecast scenarios, but also a whole system of alternative ones by introducing "controlled variables" and methods of economic and mathematical modelling. "Controlled variables" in scenario modelling allow pre-forming a set of mechanisms to prevent adverse scenarios. The initial stage of this approach is to study the processes of reproducing the investment potential of the sectors, the flow patterns of investment resources between them for various financial instruments within the regional system. We used a matrix approach developed and presented in [21] for the most accurate and comprehensive study. This approach involves the formation of a model for reproducing the investment potential of the sectors as a result of systematization of the primary reporting data of credit institutions by form No. 101, the distribution of financial transactions by the active and passive parts of the balance sheet of institutional sectors, which characterize the development and use of investment potential. Developing this model assumes to use the basic principle of the methodology for developing the System of National Accounts ("double entry") and its structure of the financial account. In contrast to the SNA methodology or Social Accounting Matrix (SAM), this approach assumes a more complete and detailed display of financial flows between sectors at the regional level. Apart from traditional financial instruments typical for these methodological approaches (lending, investments in monetary gold, foreign exchange, debt and equity securities, transactions with deposits), this approach also allows displaying in the model investment flows for financial derivatives, transactions with fixed assets and other material assets, payments of taxes and duties, payroll, payment of receivables and payables and settlements with suppliers and contractors. Used in developing the equilibrium model of reproducing the investment potential of the sectors, the principle of "double entry" allows us to study the specifics of developing this potential by some sectors and use by others. Financial flows between these sectors are balanced due to displaying the financial flows in the generated model. This balance characterizes the results of reproducing the investment potential for each sector. The negative value of the balance by sectors in the model allows to conclude that they have no free investment resources, as

well as to determine the financial instruments for their use. The positive final value of the balance will allow determining additional investment opportunities for the development of sectors. Designed in this way, the model reveals the specifics of reproducing the investment potential of institutional sectors linked to each other, and allows assessing their investment opportunities and the threats to their economic development as a result of financial flows.

Scenario design of reproduction processes of the investment potential of institutional sectors linked to each other is necessary to find optimal mechanisms for solving problems that impede attracting investments in the real sector of the economy.

The next stage in building a scenario model is modelling the financial flows between sectors, considering the affecting factors by regression analysis. This stage implies building a functional relationships system in the investment flows between sectors for all financial instruments of their investment activities based on the data of the projected model of reproducing the investment potential of the sectors for the period from 1998 to 2019. The second block of the regression model reveals the specifics of the influence of various environmental factors on reproducing the investment potential of the sectors. This analysis is necessary for introducing "controlled variables" into the scenario model. As such factors, we suggest studying the changes in quotations of precious metals, foreign currency, the key rate of the Central Bank of the Russian Federation, the interest rate on loans and deposits of individuals, legal entities, the stock market volatility index, the corporate bond index, the RTS and MICEX index, as well as the dynamics of GRP constituent entities of the Russian Federation included in the federal district, the balanced financial result of the activities of enterprises in the regions, the cost of their fixed assets, the consumer price index in the region, etc. ARIMA-modeling of changes in these "controlled variables" will allow for an inertial forecast scenario for their changes in the future and the corresponding scenario of reproducing the investment potential of the sectors, and the standard deviations of changes in "controlled variables" — for the optimistic and pessimistic forecast scenarios. Introducing "controlled variables" in scenario modeling allows for a full-fledged implementation of the scenario approach, whose main task is to develop a system of alternative scenarios for the timely development of optimal management decisions.

The approaches to scenario modelling presented in the scientific literature is usually due to the need to design only basic, most probable predictive scenarios and ignore the importance of alternative scenarios. Their design is a key feature of the proposed approach to scenario modelling of reproducing the investment potential of institutional sectors in regional systems.

REGULARITIES OF REPRODUCING INVESTMENT POTENTIAL OF SECTORS IN THE REGIONS OF THE SIBERIAN FEDERAL DISTRICT

Built in all regions of the Siberian Federal District, for the period from 1999 to 2018, the models made it possible to establish negative patterns in designing and use of the investment potential of various sectors, the threat of loss of their financial stability due to the outflow of investment resources abroad to periods of economic recession and development of crisis phenomena. The reproduction model of investment potential of institutional sectors of the Novosibirsk region in 1999 (*Table 1*) revealed the

outflow of funds abroad as investments in foreign currency (3.4 million roubles).

The banking sector of the region (44.6 million roubles) and the Central Bank of the Russian Federation (26.9 million roubles) were especially active in investing in foreign currency. In order to save their capital, households, enterprises of the real sector of the economy (non-financial corporations) and government agencies actively placed funds on deposits not only of Russian banks (187.4 million roubles), but also foreign ones (120.2 million roubles). Capital outflow abroad was also in the form of investments in debt securities of foreign issuers (0.4 million roubles). The total outflow of investment resources abroad amounted to 107.1 million roubles.

The attracted foreign investment in shares of enterprises in the real sector of the economy was extremely insignificant (only 9 million roubles), which is 11.7 times lower than the funds allocated by the Central Bank of the Russian Federation. To solve the financial problems of enterprise development, which worsened in 1998, the banking sector of the region allocated loans in the amount of 89.1 million roubles. Despite this support, as well as the resources obtained as a result of the sale of fixed assets and property by enterprises (79.9 million roubles), the financial state of this sector in 1999 was critical, their investment potential decreased by 27.8 million roubles (*Table 1*).

Households were in the same condition, their investment potential decreased by 96.1 million roubles. Almost no new loans were issued to households; moreover, the banking sector had a debt to households on the payment of interest on deposits (0.5 million roubles).

Wage arrears of enterprises also increased (by 7 million roubles). The only sector with a positive balance in reproducing investment potential in 1999 and the resources to carry out investment activities was the public administration sector. Its investment potential was a result of loans issued by banks (22.6 million roubles) and investments in debt securities (84 million roubles).

The investment potential of the other sectors declined sharply, and they had a big shortage of financial resources. The funds from these sectors accumulated by credit institutions in the region were withdrawn from the domestic economy in a significant amount at that time (107.1 million roubles). The noted patterns took place during the economic recession of 2003 and the financial, the economic crisis of 2008–2009 and the economic downturn of 2014–2018.

The reproduction model of investment potential of institutional sectors of the Republic of Buryatia (*Table 2*) demonstrates transferring a significant amount of investment resources to the accounts of foreign financial institutions (552.9 million roubles) in the form of foreign currency (800.6 million roubles) and investments in debt securities of foreign issuers (6.4 million roubles).

Besides the household sector, the public administration sector was traditionally the most financially vulnerable. In 2014, the investments in government securities slashed (by 226.4 million roubles), as well as shares of government institutions (by 545.4 million roubles) and the investment potential of the general government sector decreased by 815 million roubles. The only sector whose investment potential grew in 2014 was the sector of non-financial corporations (enterprises of various types of economic activity). Its funds were not on deposits of foreign financial institutions. The funds withdrawn from deposits of credit institutions in the amount of 3323.7 million roubles were not invested by enterprises. On the one hand, this allowed them to provide additional investment opportunities for diversifying production activities, and technological modernization. On the other hand, there

were threats of devaluation of these funds in the context of the growing economic crisis. Withdrawing funds from deposits by non-financial corporations became a trend in almost all regions of the Siberian Federal District in 2014. Funds withdrawn from deposits of credit institutions (2,224.2 million roubles) had a negative impact on the financial stability of the banking sector. The debt of all institutional sectors to the banking sector increased significantly (by 198.5 million roubles). To stabilize their financial situation, the Central Bank of the Russian Federation allocated a short-term loan in the amount of 1,243.4 million roubles, and also returned part of the reserves of credit institutions (829.1 million roubles).

During economic recessions (1999, 2003, 2008–2009, 2014–2018), the Bank of Russia provided financial support to the credit sector of the economy (*Table 3*). In 2007 (a year before the economic crisis), 2,082.6 million roubles were allocated to reorganize the banking sector in the Siberian Federal District, 1,132.4 million roubles — in 2008, 3983.7 million — roubles in 2011 (a year before the second wave of the economic crisis), and 3456.4 million roubles — in 2014.

Most of these funds were used to cover losses of credit institutions coming from the growth of overdue debts on issued loans, and on operations with risky financial instruments. The strongest deficit of financial resources in the banking sector took place during economic downturns and before them. At this time, there was a lack of investment resources for the development of the public administration sector. This problem was most acute in 2008, when the investment potential of this sector decreased by a record 13,235.5 million roubles.

In the growing economic crisis, the investment potential of the household sector was actively decreasing: by 6975.6 million roubles in 2008, by 18,892.8 million roubles in 2009, by 7292 million roubles in 2012, by 18,685.2 million roubles in 2015. Within the periods of economic recovery, reverse processes took place in the movement of investment resources between institutional sectors (*Table 4*).

The reproduction model of investment potential of institutional sectors of the Krasnoyarsk Territory in 2007, and, in particular, the negative balance of "the rest of the world", indicates a reduction in the outflow of investment resources abroad, and the attraction of foreign investment to the domestic economy. Foreign investments were attracted in debt securities of enterprises of the real sector of the economy (136.3 million roubles), government agencies and budgets of various levels (69.9 million roubles). The total foreign investments in securities amounted to 252 million roubles. Foreign investments were also attracted in the shares of non-financial corporations (24 million roubles). During the economic recessions and the economic crisis, lending to institutional sectors was limited, while during the economic recovery, lending increased. In 2007, both households and enterprises of the real sector of the economy of the Krasnoyarsk Territory were issued additional loans for 1,820 million roubles. Long-term loans from foreign financial institutions (664.3 million roubles) were also allocated to institutional sectors. There was a positive balance on deposits opened by the financial corporations sector. This sector did not experience the outflow of funds, as during the economic downturns. The reproduction model of the investment potential of institutional sectors in the region showed that the banking sector had sufficient resources for development, and did not face big financial problems. This conclusion confirms the balanced positive value for the sector of financial corporations and, in particular, for the Central Bank of the Russian Federation. This value was negative during the economic downturns, as the Bank of Russia pursued the policy of financial support for credit institutions.

Table 1

Reproduction model of investment potential of institutional sectors of the Novosibirsk region in 1999, million roubles

	Financial corporations			Government control	Non-financial corporations	Households	The rest of the world
	Central Bank	Banks	Other financial organizations				
1. Investments in gold	0.08	–0.27	0.06	0.06	0.06	0	0
2. Cash	–26.9	–44.6	–5.5	–0.3	–0.3	74.2	3.4
3. Deposits:	103.5	187.4	6.3	–46.9	–216.1	–154.4	120.2
– from 30 days to 1 year	0	90.6	4.8	2.0	1.8	–96.1	–3.1
– from 1 to 3 years	0	0.4	–0.2	0	–0.2	0	0
– over 3 years	0	3.6	0	0	0	–3.6	0
– on demand	103.5	92.8	1.7	–48.9	–217.6	–54.7	123.2
4. Debt securities:	3.1	–75.0	–14.4	84.0	2.2	–0.4	0.4
– for up to 1 year	2.9	4.4	–10.3	0	2.9	0	0
– on demand	0.2	–79.4	–4.1	84.0	–0.7	–0.4	0.4
5. Loans granted:	0	–134.5	23.8	22.6	89.1	–0.9	0
– for up to 30 days	0	–13.5	12.2	–6.9	11.7	–3.5	0
– for up to 1 year	0	–65.4	11.6	5.5	45.2	3.0	0
– from 1 to 3 years	0	–47.7	0	27.2	19.8	0.8	0
– over 3 years	0	–4.1	0	0	4.1	0	0
– on demand	0	–3.9	0	–3.2	8.2	–1.1	0
6. Derivative financial instruments	0	8.3	–8.3	0	0	0	0
7. Investments in shares	–105.6	151.3	–7.5	–8.0	–14.1	–7.1	–9.0
8. Debt	0.1	21.6	–1.2	0.1	–12.0	–0.5	–8.0
9. Tax payments	0	6.0	0	–6.0	0	0	0
10. Payroll	0	6.7	0	0.3	0	–7.0	0
11. Settlements with suppliers	0	–43.4	0	0	43.4	0	0
12. Investments in fixed assets	0	–83.4	0	3.5	79.9	0	0
TOTAL	–25.8	0	–6.7	49.2	–27.8	–96.1	107.1

Source: compiled by the authors based on the turnover sheet of accounting of credit institutions of the Novosibirsk region, form No. 101. URL: https://cbr.ru/banking_sector/credit/colist/?find=&reg=57&nsitype=&status= (accessed on 24.10.2020).

Table 2

Reproduction model of investment potential of institutional sectors of the Republic of Buryatia in 2014, million roubles

	Financial corporations			Government control	Non-financial corporations	Households	The rest of the world
	Central Bank	Banks	Other financial organizations				
1. Investments in gold	69.7	92.3	17.8	–22.9	–22.9	–92.6	–41.5
2. Cash currency	0	–850.6	76.3	0.2	0.2	–26.8	800.6
3. Deposits:	–829.1	–2224.2	–99.7	–31.1	3323.7	–134.0	–5.6
– up to 30 days	0	0.1	0	0	0	–0.1	0
– from 30 days to 1 year	0	–1559.1	–1.8	0	1863.7	–299.8	–3.0
– from 1 to 3 years	0	–128.0	–4.0	0	1.5	131.4	–0.9
– over 3 years	0	433.1	0	0	–2.5	–430.6	0
– on demand	–829.1	–970.2	–93.9	–31.1	1460.9	465.0	–1.7
4. Debt securities:	6.4	1031.2	–374.5	–226.4	–216.1	–227.1	6.4
– for sale	3.9	–22.9	3.9	3.9	3.9	3.4	3.9
– for up to 1 year	0	733.6	–733.6	0	0	0	0
– from 1 to 3 years	0	0	0	0	0	0	0
– on demand	2.6	320.5	355.2	–230.3	–220.0	–230.5	2.6
5. Loans granted:	–1243.4	509.3	–215.1	8.1	1001.6	–60.4	–0.1
– for up to 30 days	0	250.0	–250.0	0	0	0	0
– for up to 1 year	–1243.4	1401.6	–169.5	0	265.6	–254.3	–0.1
– from 1 to 3 years	0	–998.0	8.3	5.0	640.5	344.2	0
– over 3 years	0	–183.1	0.9	3.1	52.5	126.5	0
– on demand	0	38.7	195.1	0	43.0	–276.8	0
6. Derivative financial instruments	0	61.7	–61.7	0	0	0	0
7. Investments in shares	–2.3	2473.7	–929.8	–545.4	–544.3	–241.4	–210.4
8. Debt	3.4	–198.5	1.7	3.4	59.9	126.7	3.4
9. Tax payments	0	0.9	0	–0.9	0	0	0
10. Payroll	0	2.6	0	0	0	–2.6	0
11. Settlements with suppliers	0	–816.3	0	0	816.3	0	0
12. Investments in fixed assets	0	–82.2	0	0	82.2	0	0
TOTAL	–1995.2	0.0	–1585.1	–815.0	4500.6	–658.2	552.9

Source: compiled by the authors based on the turnover sheet of accounting of credit institutions of the Novosibirsk region, form No. 101. URL: https://cbr.ru/banking_sector/credit/colist/?find=&reg=57&nsitype=&status= (accessed on 24.10.2020).

Table 3

Reproduction of investment potential sectors in the Siberian Federal District, million roubles

	Financial corporations		Government control	Non-financial corporations	Households	The rest of the world	Σ
	Central Bank	Banks					
1999	–6.8	20.3	61.9	–76.7	–104.0	105.3	0
2000	827.9	134.4	132.7	63.9	–1123.8	–35.0	0
2001	27.9	–585.8	–14.8	1204.7	–528.0	–104.1	0
2002	383.2	–435.1	52.5	1803.4	–1795.9	–8.0	0
2003	1377.9	676.9	860.5	977.8	–3931.0	37.9	0
2004	1101.3	1151.5	–2458.7	2031.7	–1968.0	142.1	0
2005	–913.1	–3311.7	2093.0	7022.4	–4604.5	–286.0	0
2006	8027.7	2049.8	–836.5	–11202.5	1848.3	113.2	0
2007	–2082.6	–1563.8	364.2	1688.1	1876.8	–282.7	0
2008	–1132.4	–11913.7	–13235.5	38534.3	–6975.6	–5277.1	0
2009	6694.8	12590.3	–2396.3	8273.1	–18892.8	–6269.1	0
2010	–593.5	13350.8	6677.7	–20988.7	–2076.3	3630.0	0
2011	–3983.7	2489.6	990.7	2804.5	–1787.6	–513.6	0
2012	8595.6	–4258.2	–4294.2	9660.8	–7292.0	–2412.0	0
2013	4475.2	–16091.7	828.4	2976.1	7597.8	214.2	0
2014	–3456.4	–12048.9	–4455.2	20387.7	731.1	–1158.3	0
2015	12663.9	10614.4	–5051.1	8305.0	–18685.2	–7847.0	0
2016	5959.5	–22967.8	–2561.0	21164.0	–298.0	–1296.8	0
2017	16862.1	–4886.9	6375.6	–14146.0	–5848.2	1643.4	0
2018	5685.8	–14535.9	–3281.3	23078.1	–3906.8	–7039.9	0

Source: compiled by the authors based on the turnover sheet of accounting of credit institutions of the Novosibirsk region, form No. 101. URL: https://cbr.ru/banking_sector/credit/colist/?find=&reg=57&nsitype=&status= (accessed on 24.10.2020).

Table 4

Reproduction model of investment potential of institutional sectors of of the Krasnoyarsk Territory in 2007, million roubles

	Financial corporations			Government control	Non-financial corporations	Households	The rest of the world
	Central Bank	Banks	Other financial organizations				
1. Investments in gold	–4.0	14.3	–3.9	–3.5	–3.5	–0.2	0.8
2. Cash currency	0	–300.6	–47.7	15.2	–3.2	323.5	12.9
3. Deposits:	1859.7	2044.0	–58.6	1153.0	–2897.1	–2431.8	330.7
– up to 30 days	1505.0	–3242.7	–60.0	1500.0	–25.7	0	323.4
– from 30 days to 1 year	0	681.1	–29.6	10.8	–309.7	–350.8	–1.7
– from 1 to 3 years	0	1239.7	–79.2	19.7	–26.2	–1154.8	0.7
– over 3 years	0	318.0	–30.1	–15.4	–117.6	–154.9	–0.1
– demand deposits	354.7	3047.9	140.4	–362.1	–2417.9	–771.3	8.4
4. Debt securities:	136.4	167.4	–264.0	69.9	136.3	6.0	–252.0
– available for sale	0	0	0	0	0	0	0
– for up to 1 year	115.9	–241.2	9.4	0	115.9	0	0
– from 1 to 3 years	0	254.1	–254.1	0	0	0	0
– on demand	20.5	154.5	–19.3	69.9	20.5	6.0	–252.0
5. Loans granted:	0	–2493.2	–463.2	–20.0	1820.5	1820.2	–664.3
– for up to 30 days	0	472.4	–516.9	–10.9	159.4	3.9	–107.8
– for up to 1 year	0	–544.5	–522.5	14.3	923.1	167.0	–37.5
– from 1 to 3 years	0	–1270.4	212.4	–23.5	504.2	577.4	0
– over 3 years	0	–1096.3	363.8	0	228.8	1022.8	–519.1
– on demand	0	–54.4	0	0	5.0	49.2	0.2
6. Derivative financial instruments	0	0.8	–0.8	0	0	0.0	0
7. Investments in shares	–331.2	1028.2	–379.4	–304.3	49.8	–39.2	–24.0
8. Debt	1.0	–145.9	32.5	1.0	22.4	87.8	1.0
9. Tax payments	0	2.9	0	–2.9	0	0	0
10. Payroll	0	2.2	0	–2.7	0	0.5	0
11. Settlements with suppliers	0	–20.0	–2.2	0	19.6	0	2.6
12. Investments in fixed assets	0	–300.1	0	0.3	299.8	0	0
TOTAL	1661.9	0	–1187.2	906.1	–555.4	–233.2	–592.3

Source: compiled by the authors based on the turnover sheet of accounting of credit institutions of the Novosibirsk region, form No. 01. URL: https://cbr.ru/banking_sector/credit/colist/?find=&reg=63&nsitype=&status= (accessed on 24.10.2020).

Scenario regression models of reproducing investment potential of institutional sectors in the Siberian Federal district

Investment in gold	Financial corporations		Government control	Non-financial corporations	Households	The rest of the world
	Central Bank	Other financial organizations				
1. Investments in monetary gold	CBis = −0.414*BS	OFOis = −0.191*BS	GCis = −0.35*BS	NFCis = −0.35*BS		RWis = 0.236*BS
	CBps = −0.785*BS	OFOps = −0.352*BS	GCps = −0.424*BS	NFCps = −0.424*BS		RWps = −0.041*BS
	CBos = −0.042*BS	OFOos = −0.03*BS	GCos = −0.277*BS	NFCos = −0.277*BS		RWos = 0.513*BS
2. Investments in foreign currency		OFOis = −293374.51−0.474*BS			His = 273681−0.388*BS	RWis = −0.136*BS
		OFOps = −573029.86−0.655*BS			Hps = 3505.5−0.563*BS	RWps = −0.254*BS
		OFOos = −13719.17−0.292*BS			OFOos = 543856.5−0.212*BS	RWos = −0.017*BS
3. Placed deposits				NFCis = −0.273*BS	His = −2271650.9−0.512*BS	RWis = −0.066*BS
				NFCps = −0.408*BS	Hps = −3777744.7−0.627*BS	RWps = −0.135*BS
				NFCos = −0.138*BS	Hos = −765557.2−0.397*BS	RWos = 0.003*BS
4. Investments in debt securities		OFOis = −0.507*BS		NFCis = −0.131*BS	His = −0.016*BS	RWis = −0.124*BS
		OFOos = −0.679*BS		NFCos = −0.206*BS	Hos = −0.028*BS	RWos = −0.226*BS
		OFOps = −0.335*BS		NFCps = −0.056*BS	Hps = −0.004*BS	RWps = −0.021*BS
5. Loans issued		OFOis = −0.326*BS	GCis = 429896.4+0.031*BS	NFCis = −0.348*BS	His = −0.349*BS	
		OFOps = −0.565*BS	GCps = 35749.5−0.0004*BS	NFCps = −0.502*BS	Hps = −0.51*BS	
		OFOos = −0.087*BS	GCos = 824043.3+0.062*BS	NFCos = −0.194*BS	Hos = −0.187*BS	
6. Investing in Stocks		OFOis = −0.231*BS	GCis = −0.211*BS	NFCis = −0.236*BS	His = −0.175*BS	RWis = −0.176*BS
		OFOps = −0.248*BS	GCps = −0.228*BS	NFCps = −0.255*BS	Hps = −0.189*BS	RWps = −0.190*BS
		OFOos = −0.214*BS	GCos = −0.196*BS	NFCos = −0.216*BS	Hos = −0.161*BS	RWos = −0.161*BS
7. Debit / Credit. indebtedness		OFOis = −0.072*BS		NFCis = −0.759*BS	His = −0.133*BS	RWis = −0.003*BS
		OFOps = −0.128*BS		NFCps = −0.873*BS	Hps = −0.275*BS	RWps = −0.059*BS
		OFOos = −0.016*BS		NFCos = −0.644*BS	Hos = −0.009*BS	RWos = −0.009*BS
8. Payments of wages			GCis = −0.133*BS		His = −0.867*BS	
			GCos = −0.159*BS		Hos = −0.894*BS	
			GCps = −0.106*BS		Hps = −0.840*BS	
9. Settlements with suppliers		OFOis = 0.002*BS		NFCis = −1.003*BS		
		OFOps = 0.003*BS		NFCps = −0.999*BS		
		OFOos = 0.0002*BS		NFCos = −1.006*BS		
10. Investments in fixed assets				NFCis = −0.667*BS	His = −0.323*BS	
				NFCps = −0.853*BS	Hps = −0.612*BS	
				NFCos = −0.481*BS	Hos = −0.033*BS	

Source: compiled by the authors.

SCENARIO MODELS OF REPRODUCING INVESTMENT POTENTIAL OF INSTITUTIONAL SECTORS IN THE SIBERIAN FEDERAL DISTRICT

We used regression analysis to confirm the identified patterns and develop predictive scenarios for transforming the reproduction model of the investment potential of the sectors. As a result, three scenario models were designed for each financial instrument of the investment activity of the sectors: inertial, optimistic and pessimistic (*Table 5*). The models were tested for the statistical significance of the parameters: the relationship between the variables, the significance of the determination coefficient (Fisher's statistics and F-significance), regression coefficients (according to Student's statistics, P-values, standard errors), autocorrelation between the residuals and the feasibility of other OLS premises. The inertial model was built by the regression coefficients obtained due to the regression analysis. To form the extremely negative (pessimistic) and the most favorable (optimistic) reproduction models of the investment potential of the sectors, we used the lower and upper boundaries of value distribution of the found regression coefficients. Since the banking sector is the key element in the balance reproduction model of the investment potential of institutional sectors, which accumulates and distributes resources from other sectors, we considered banks and credit institutions (BS) as the main regressors when constructing scenario models for each investment instrument. Further research and forecasting of financial flows between the banking and institutional sectors for each investment instrument made it possible to develop the most likely scenarios to transform the reproduction model of the investment potential of the sectors. We used ARIMA-modelling to form an inertial forecast of investment dynamics for various financial instruments.

This tool is optimal for designing inertial scenarios as it allows predicting the change of the studied indicators, considering the persistence of the current trends in the future. For pessimistic and optimistic scenarios on investment instruments and institutional sectors, we used the indicators of standard deviations from the values typical for the inertial scenario:

$$BSps = BS_{is} - \sqrt{\frac{\sum\left(BS - \overline{\overline{BS}}\right)^2}{n}} BSos = \\ = BS_{is} + \sqrt{\frac{\sum\left(BS - \overline{\overline{BS}}\right)^2}{n}}, \quad (1)$$

where BS is the investments by banks with a specific institutional sector by a particular financial instrument;

$\overline{BS}$ is the average value of investments of banks by a financial instrument;

BS_{is} is the inertial scenario of investments of banks by a financial instrument;

BS_{ps} is the pessimistic scenario of investments of banks by a financial instrument;

BS_{os} is the optimistic scenario of investments of banks by a financial instrument;

n is the number of observations (study period), years.

These indicators helped to determine the corridor of deviations in the values of investment flows between the banking and other sectors for various financial instruments, which determine two extreme scenarios of the predicted transformation of the reproduction model of their investment potential. ARIMA-modelling of investments of institutional sectors by financial instruments from 1999 to 2018 and the developed scenario models (*Table 5*) allowed us to design an inertial scenario for reproducing the investment potential of the sectors. This scenario assumes that current trends will continue by 2021, in particular: the growth of foreign investment in debt securities of enterprises of the real sector and in budgets of various levels by 198.4 million roubles, an annual inflow of

Table 6

Scenarios of reproducing investment potential of sectors in the Siberian Federal District by 2021, million roubles*

Million roubles		Financial corporations			Govern-mentcontrol	Non-financial corporations	House-holds	The rest of the world
		Central Bank	Banks	Other financial organi-zations				
1. Investments in monetary gold	IS	18.6	−45.0	8.6	15.8	15.8	−3.1	−10.6
	PS	−79.0	100.6	−35.4	−42.6	−42.6	103.2	−4.1
	OS	8.0	−190.6	5.7	52.8	52.8	169.0	−97.8
2. Investments in foreign currency	IS	21.7	−1000.0	180.6	0	0	661.7	136.0
	PS	−646.1	−2575.5	1113.9	0	0	1453.5	654.2
	OS	−805.8	575.5	−181.8	0	0	421.9	−9.8
3. Placed deposits	IS	1973.7	2000.0	0	0	−546.0	−3295.7	−132.0
	PS	1947.2	−10768.2	0	0	4393.4	2973.9	1453.7
	OS	−6145.9	14768.2	0	0	−2038.0	−6628.5	44.3
4. Investments in debt securities	IS	0	1600.0	−811.2	−355.2	−209.6	−25.6	−198.4
	PS	0	−1059.8	719.6	−147.3	218.3	29.7	239.5
	OS	0	4259.8	−1427.0	−2487.7	−238.6	−17.0	−89.5
5. Loans issued	IS	−365.9	−8000.0	2608.0	181.9	2784.0	2792.0	0
	PS	2295.8	4038.0	−2281.4	34.1	−2027.1	−2059.4	0
	OS	11078.5	−20038.0	1743.3	−418.3	3887.4	3747.1	0
6. Derivative financial instruments	IS	0	−500.0	500.0	0	0	0	0
	PS	0	−1504.1	1504.1	0	0	0	0
	OS	0	504.1	−504.1	0	0	0	0
7. Investing in stocks	IS	908.8	31339.3	−7239.4	−6612.6	−7396.1	−5484.4	−5515.7
	PS	1825.8	16598.6	−4116.4	−3784.5	−4232.6	−3137.1	−3153.7
	OS	−2396.2	46080.1	−9861.1	−9031.7	−9953.3	−7418.9	−7418.9
8. Accounts receivable / payable	IS	0	643.7	−46.3	−21.2	−488.6	−85.6	−1.9
	PS	0	−672.9	86.1	−225.4	587.4	185.0	39.7
	OS	0	1960.3	−31.4	−631.2	−1262.4	−17.6	−17.6

* *Note*: IS — inertial scenario, OS — optimistic scenario, and PS — pessimistic scenario.

Table 6 (continued)

Million roubles		Financial corporations			Government-control	Non-financial corporations	House-holds	The rest of the world
		Central Bank	Banks	Other financial organi-zations				
9. Payments for taxes and duties	IS	0	–147.8	0	147.8	0	0	0
	PS	0	143.2	0	–143.2	0	0	0
	OS	0	–438.7	0	438.7	0	0	0
10. Payroll calculations	IS	0	61.9	0	–8.2	0	–53.7	0
	PS	0	161.7	0	–25.7	0	–136.0	0
	OS	0	–37.9	0	4.0	0	33.9	0
11. Settlements with suppliers	IS	0	–26 580.5	–53.2	0	26 660.2	0	–26.6
	PS	0	–40 085.9	–120.3	0	40 045.8	0	160.3
	OS	0	–13 075.1	–2.6	0	13 153.5	0	–75.8
12. Investments in fixed assets	IS	0	–102.0	0	1.0	68.0	32.9	0
	PS	0	–776.9	0	–361.3	662.7	475.5	0
	OS	0	573.0	0	–278.5	–275.6	–18.9	0

Source: compiled by the authors.

foreign investment in shares in the amount of 5515.7 million roubles (*Table 6*).

According to this scenario, a significant increase in investments of other institutional sectors in equity securities (stocks), classified as high-risk financial instruments, is possible. With a decline in economic development indicators, growing economic crises and volatility in financial markets, the expected growth in investment in stocks threatens the investment potential of almost all institutional sectors. The projected *inertial scenario* made it possible to predict:

- possible inflow of foreign investment in monetary gold in the amount of 10.6 million roubles;
- return of funds placed by institutional sectors on deposits of foreign financial institutions (132 million roubles);
- an increase in lending to households (by 2,792 million roubles) and enterprises in the real sector (by 2,784 million roubles);
- reduction of household investments in foreign currency (by 661.7 million roubles) and their growth in the sector of financial corporations (by 1,000 million roubles), etc.

Table 6 presents the inertial scenario of reproducing the investment potential of institutional sectors as moderately optimistic, since it assumes an inflow of foreign investments in debt and equity securities, a partial return of funds placed on deposits of foreign financial institutions. On the other hand, this scenario creates threats of loss of financial stability of institutional sectors due to increased investment in high-risk instruments.

The negative, *pessimistic* transformation scenario of reproducing the investment potential of institutional sectors presupposes the intensification of speculative investment activity in the sectors:

- growth in investments of financial corporations in foreign currency (654.2 million roubles) and its sale by the household sector (1,453.5 million roubles) as a result of the weakening and increased volatility of the domestic currency exchange rate;
- closing of bank deposits by enterprises of the real sector of the economy (4393.4 million roubles) and households (2973.9 million roubles) and their partial placement on deposits of foreign financial institutions (1,453.7 million roubles);
- sale of Russian securities by enterprises of the real sector (218.3 million roubles) and households (29.7 million roubles) and investments in debt securities of foreign issuers (239.5 million roubles);
- reduction of the inflow of foreign investments into shares of state and financial institutions, enterprises of the real sector;
- a significant reduction in lending to households and non-financial corporations (the volume of loans repaid by households will exceed the volume of loans issued by 2,059.4 million roubles, and enterprises of the real sector — by 2,027.1 million roubles);
- significant growth in investments of financial institutions in high-risk derivative financial instruments such as futures and options (by 1504.1 million roubles).

Implementing a negative, pessimistic scenario will lead to an increase in the debt of institutional sectors to financial institutions (enterprises of the real sector by 587.4 million roubles, households by 185 million roubles), to debts of financial corporations in taxes and fees to the public administration sector (143.2 million roubles), an increase in the debt of financial institutions on payment of wages (by 136 million roubles) and social insurance contributions (by 25.7 million roubles).

The pessimistic scenario in *Table 6* assumes the development of negative trends in reproducing the investment potential of institutional sectors, noted by us during the economic recessions and the economic crisis (in 1998–1999, 2003–2004, 2008–2009, and 2014–2018). If this scenario is implemented by 2021, a significant reduction in the investment potential of financial corporations (by 34,187.4 million roubles), government institutions (by 4,695.9 million roubles), households (by 111.7 million roubles) is possible and its transfer to the accounts of foreign financial institutions.

The only sector with a positive balance in reproducing investment potential in 1999 and the resources to carry out investment activities was the public administration sector. Its investment potential was a result of loans issued by banks (22.6 million roubles) and investments in debt securities (84 million roubles).

The investment activity by the banking sector and financial institutions on withdrawing the accumulated financial resources of institutional sectors during the economic crises was supported by the Central Bank of the Russian Federation. Debt securities and shares of foreign issuers, foreign currency and deposits in foreign banks were recognized by the regulator as a more reliable financial instrument. That is why, during the growing economic crisis, the outflow of investment resources from institutional sectors to the accounts of foreign financial institutions (the "rest of the world" sector) increased many times.

Today, in the context of increasing volatility in financial markets, weakening of the domestic currency, strengthening nega-

tive trends in economic development, the likelihood of a pessimistic transformation scenario of reproducing the investment potential of institutional sectors increases significantly.

CONCLUSIONS

Today, the progressive development of institutional sectors mostly depends on their investment potential, its formation and use, and the specifics of its spatial movement. Their reproduction is a burning issue. For the most accurate and comprehensive study of reproducing the investment potential of institutional sectors, we proposed a matrix approach. This approach implies designing an equilibrium model of reproducing the investment potential of these sectors based on systematizing the primary data of the turnover balance sheet of credit institutions and the "double entry" methodology of the System of National Accounts.

The scenario model design algorithm contributes to developing methodological foundations of scenario modelling to reproduce the investment potential of sectors at the regional level. This allows studying the formation and use of the investment potential of institutional sectors linked to each other, increases the accuracy of the study of its reproduction through the primary reporting data of credit institutions; compared to the methodology of the System of National Accounts and Matrices of financial flows, allows to cover all possible investment instruments for financial flows to reproduce the investment potential of sectors. In contrast to traditional approaches, due to the regression analysis and ARIMA-modeling, the scenario model design algorithm allows for the full-fledged realization of the scenario approach. Namely, to introduce the "controlled variables" that allow generating a whole system of possible predictive scenarios. This enables to establish the features of investment flows between sectors for various financial instruments, the patterns of reproducing the investment potential of institutional sectors during the economic downturns and crisis, as well as during the economic recovery.

We built three basic forecast scenarios for reproducing the investment potential of institutional sectors:

- the inertial scenario, preserving current trends in the formation and use of investment flows;
- an unfavorable, pessimistic scenario, assuming an intensification of speculative investment activity in the sectors (an increase in investments in foreign currency, debt securities of foreign issuers, in high-risk derivative financial instruments such as futures and options, placement of funds on deposits of foreign financial institutions, a decrease in the inflow of foreign investments in shares of government and financial institutions, enterprises of the real sector of the economy, a significant reduction in lending to households and non-financial corporations, etc.);
- an optimistic scenario for reproducing the investment potential of institutional sectors, observed during the economic recovery, namely: an inflow of additional investments, including foreign ones in equity and debt securities of enterprises in the real sector, government institutions, an increase in the volume of long-term lending to institutional sectors, a decrease in investment in high-risk instruments leading to an outflow of financial resources abroad.

The study showed that today most regions experience a shortage of investment resources for the progressive development of enterprises in the real sector of the economy, and the volume of attracted foreign investment is decreasing. The volatility growth in financial markets, weakening domestic currency, and strengthening negative trends in the economic development significantly increase the likelihood of a pessimistic transformation scenario of reproducing the investment potential of insti-

tutional sectors. To prevent its implementation, we consider it necessary to change the policy by the Central Bank of the Russian Federation in the field of regulating the financial and economic activities of the banking sector, namely: limiting the speculative activities of credit institutions that contribute to the withdrawal of financial resources from the domestic economy, and supporting investment programs for the development of enterprises in the real sector, the most important strategic projects and programs implemented by the public administration sector.

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Naumov I. V. — statement of the problem, development of the concept of the article, critical analysis of the literature, development of a methodological approach to the design of a scenario model for reproduction of the investment potential of institutional sectors, construction of a model for reproduction of their investment potential in the constituent entities of the Russian Federation included in the Siberian Federal District, description of the results and formation of research conclusions.
Trynov A. V. — collection of statistical data on the turnover sheet of accounting of credit institutions of the Altai Territory, Irkutsk Kemerovo, Novosibirsk regions for the period from 1998 to 2018, tabular and graphical presentation of the results.
Safonov A. O. — collection of statistical data on the turnover sheet of accounting of credit institutions of the Krasnoyarsk Territory, Omsk, Tomsk regions, the republics of Altai, Tyva, Khakassia for the period from 1998 to 2018, tabular and graphical presentation of the results.

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Analysis of Possibilities to Automate Detection of Unscrupulous Microfinance Organizations Based on Machine Learning Methods

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ABSTRACT

Microfinance is a way to fight poverty, and therefore is of high social significance. The microfinance sector in Russia is progressing. However, the engagement of microfinance organizations in illegal financial transactions associated with fraud, illegal creditors, money laundering, significantly limits their potential and has negative impact on their development. The **aim** of the paper is to study the possibilities to automate detection of unscrupulous microfinance organizations based on machine learning methods in order to promptly identify and suppress illegal activities by regulatory authorities. The author cites common fraudulent schemes involving microfinance organizations, including a scheme for cashing out maternity capital, a fraudulent lending scheme against real estate. The author carried out a comparative analysis of the results obtained by classification **methods** – the logistic regression method, decision trees (algorithms of two-class decision forest, Adaboost), support vector machine (algorithm of two-class support vector machine), neural network methods (algorithm of two-class neural network), Bayesian networks (algorithm of two-class Bayes network). The two-class support vector machine provided the most accurate results. The author analysed the **data** on microfinance institutions published by the Bank of Russia, the MFOs themselves, and *banki.ru*. The author **concludes** that the research results can be of further use by the Bank of Russia and Rosfinmonitoring to automate detection of unscrupulous microfinance organizations.

Keywords: microfinance organizations; financial monitoring; machine learning methods; classification algorithms

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INTRODUCTION

Microfinance organizations are financial companies that offer small loans to unbanked or low income populations. MFOs provide microloans, insurance services, deposits and other services. These organizations are widespread in Russia, Asia, Europe, Africa and many other countries.

A. S. Sorokin and V. A. Shilov note that microfinance is a way to fight poverty, and therefore is of high social significance [1]. The microfinance sector in Russia is progressing, which is presented in the studies by E. B. Makarova [2], N. B. Balasheva [3], V. A. Tsvetkov [4] and other authors [5–7].

The article by Yu. S. Yevlakhova [8] proves that the engagement of microfinance organizations in illegal financial transactions associated with fraud, illegal creditors, money laundering, significantly limits their potential and has negative impact on their development.

Rosfinmonitoring Public Report "National Assessment of the Risks of Money Laundering. Main conclusions" also indicates the high risk of using MFOs in money laundering schemes.[1]

The MFOs vulnerability is partly due to the relatively easy registration of these organizations, as well as their specifics, in particular, the ability to legally raise funds from legal entities, redistributing them between individuals.

The Bank of Russia, together with law enforcement agencies, the General Prosecutor's Office and the Federal Financial Monitoring Service, is consistently clearing the financial sector of unscrupulous organizations.

The high probability of client default is the main risk inherent in the work of microfinance organizations. The key to their success is to issue as much funds as possible with a minimum default and the lowest costs.

The two main money laundering schemes involving MFOs are as follows:

- an attempt on assets that belong to financial organizations and are included in their main activities;
- an attempt on assets that belong to investors and are attracted by financial organizations in order to steal them in the future.

The main vulnerabilities to money laundering involving MFOs are legal and financial ignorance of citizens, as well as an insufficient amount of resources necessary for effective fight against fraudsters among the majority of microfinance *market participants*.

The MFO owners and management may commit crimes related to attempts on assets that belong to investors and are attracted by financial organizations. Asset withdrawals can be disguised as standard procedures for issuing loans and raising funds.

The first stage of asset withdrawals is often falsified reporting, with either reduced the real attracted resources or increased microloans in order to formally comply with the established standards and not be excluded from the register.

ANALYSIS OF FRAUDULENT SCHEMES INVOLVING MFOS

S. E. Volkov and I. N. Loskutov [9] show some fraudulent schemes involving microfinance organizations:

Intermediary services. A future MFO client is imposed intermediary services that supposedly guarantee for borrowed funds. For this service, the intermediary company charges a commission of up to 50% of the loan amount. The intermediary company can conclude an agreement with the client, stating that the client is obliged to pay a one-time registration fee of 5% to 20% of the loan amount. Fraudsters may demand to

[1] Rosfinmonitoring. National assessment of the risks of money laundering. Main conclusions. 2017–2018. Rosfinmonitoring Public Report. 2018. URL: http://www.fedsfm.ru/content/files/documents/2018/%D0%BE%D1%86%D0%B5%D0%BD%D0%BA%D0%B0%20%D1%80%D0%B8%D1%81%D0%BA%D0%BE%D0%B2%20%D0%BE%D0%B4_5.pdf (accessed on 22.07.2020).

pay for checking the client's credit history, notary services, pay a membership fee in a credit cooperative, etc. This "intermediation" does not actually guarantee the client borrowed funds by a microfinance organization, and refunds are not provided.

Credit ladder. Supposedly to confirm his/her solvency, the client is given small amounts of borrowed funds at a high interest rate, after the next loan is repaid, the amount of the next one is increased, and the interest is reduced, and so on until the desired amount is reached. However, after the client pays the penultimate loan, the fraudster disappears. The victim ends up paying high interest rates without receiving the desired loan amount.

Activities of illegal lenders when providing microloans online. Applying for a microloan online on MFO websites, one must fill out a questionnaire that can be used by fraudsters to collect personal data. A potential borrower registers on this website and fills out a questionnaire with personal data. The victim sends an application and receives a message with a refusal of the loan and a proposal to reapply. The contact details of the registered person are used by fraudsters to apply for a loan in real microfinance companies that issue money online [9].

Now let us consider other common fraudulent and money laundering schemes involving microfinance organizations.

Cashing out maternity capital. Based on expert estimates, hundreds of companies may be involved in schemes for providing shadow services for cashing out maternity capital. They find troubled families that have received a birth certificate and provide them with services for cashing these funds.

Citizens are issued with a fake home purchase, usually unsuitable for living or from their own relatives (*Fig. 1*). Then, a loan for this transaction is issued in a microfinance organization and repaid with a certificate. Families receive part of their maternity capital in cash, and the intermediary lenders get the rest.

Fraudulent lending against real estate. An individual needs a loan, but banks refuse him/her or offer a loan at a high rate. S/he contacts a microfinance organization that is funded by private investors or banks. The borrower receives the money, and among other documents s/he has to sign a mortgage on his apartment.

If a client violates the terms of the loan agreement, the lender takes the apartment under the mortgage. The microfinance organization sells the apartment to a figurehead (holder). When the scandal ends, the MFO resells it to a bona fide buyer.

ANALYSIS OF THE DYNAMICS OF REGISTRATION AND LIQUIDATION OF MFOS

If the Bank of Russia detects unscrupulous microfinance market participants involved in dubious transactions, it excludes them from the register. As of July 27, 2020, 1,618 microfinance organizations are registered in Russia.[2]

Moscow is the leader by the number of MFOs registered in the territory (*Table 1*). Top ten also includes the Novosibirsk region, St. Petersburg, Irkutsk region, etc.

In terms of 1 million people living in the region (according to Rosstat data as of January 1, 2020[3]), the Altai Republic, the Arkhangelsk and Kostroma regions, and others are the leaders (*Table 2*). Moscow is on the 21st place.

To consider the dynamics of excluding MFOs from the register and the formation of new MFOs by region, we will correlate the number of MFOs excluded from the register for the entire time and the number of existing ones. The leaders of the rating are the Chechen Republic (more than 36 MFOs

[2] Bank of Russia. URL: https://www.cbr.ru/microfinance/registry/ (accessed on 27.07.2020).

[3] Rosstat. URL: http://www.statdata.ru/largest_regions_russia (accessed on 27.07.2020).

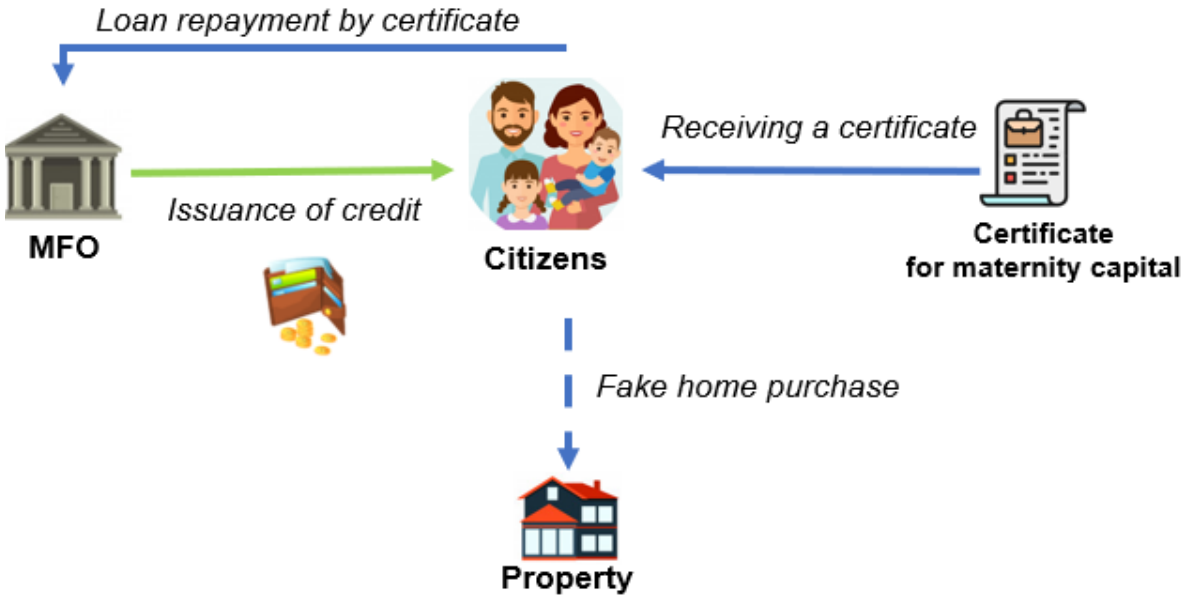

Fig. 1. **Maternity capital cashing scheme through MFOs**
Source: compiled by the author.

excluded from the register against one operating), the Yamalo-Nenets Autonomous District, Yaroslavl region, the Republic of Dagestan, etc. Moscow is on the 12th place (almost 8 excluded MFOs against one operating) (*Table 3*).

We will now consider the MFO average **operating time** before they are excluded from the Register (*Table 4*).

The MFO lowest operating time before exclusion from the register is in the Republic of Ingushetia — 14 months. In the Chechen Republic, this period is slightly longer — 15 months. There are more than 36 MFOs excluded from the register per one operating. Microfinance organizations in this region are very unstable.

The MFO greatest average operating time before exclusion from the register in the Kabardino-Balkarian Republic is 3.5 years. This period is about three years in the Sakhalin and Kaliningrad regions (*Table 5*).

Against the background of small values of the ratio of the number of MFOs excluded from the register to the number of operating organizations, these regions, as well as

Table 1

Top-10 regions by number of MFOs

Region	Number of MFOs
Moscow	226
Novosibirsk region	61
St. Petersburg	59
Irkutsk region	53
Arhangelsk region	44
Krasnoyarsk region	44
Rostov region	44
Samara Region	43
Krasnodar region	42
Republic of Bashkortostan	42

Source: compiled by the author based on data from the Bank of Russia.

Table 2

Top-10 regions by number of MFOs per 1 million people

No.	Region	Number of MFOs	Population	Number of MFOs per 1 million people
1	Altai Republic	9	220181	40.88
2	Arhangelsk region	44	1136535	38.71
3	Kostroma region	22	633385	34.73
4	Republic of Sakha (Yakutia)	28	971996	28.81
5	Republic of North Ossetia — Alania	19	696837	27.27
6	Jewish Autonomous Region	4	158305	25.27
7	Republic of Khakassia	13	534262	24.33
8	Tomsk region	26	1079271	24.09
9	Amur region	19	790044	24.05
10	Udmurtia	36	1500955	23.98
...				
21	Moscow	226	12615279	17.91

Source: compiled by the author based on data from the Bank of Russia.

Table 3

Top 10 regions by the number of MFOs excluded from the register to the existing ones

No.	Region	Number of MFOs excluded from the register	Number of MFOs	The ratio of the excluded MFOs to the existing MFOs
1	Chechen Republic	145	4	36.25
2	Yamalo-Nenets Autonomous District	16	1	16.00
3	Yaroslavl region	79	6	13.17
4	Republic of Dagestan	51	4	12.75
5	Pskov region	12	1	12.00
6	Saratov region	70	7	10.00
7	Volgograd region	99	10	9.90
8	Republic of Tatarstan	335	36	9.31
9	Omsk region	123	14	8.79
10	Kabardino-Balkar Republic	25	3	8.33
...				
12	Moscow	1734	226	7.67

Source: compiled by the author based on data from the Bank of Russia.

Table 4

Top 10 regions with the lowest average operating time

Region	Average work duration of an MFO (months)	Number of MFOs excluded from the register	Number of MFOs	The ratio of the excluded MFOs to the existing MFOs
Republic of Ingushetia	14	3	1	3.00
Chechen Republic	15	145	4	36.25
Pskov region	20	12	1	12.00
Altai Republic	21	28	9	3.11
Saratov region	21	70	7	10.00
Republic of Karelia	22	17	5	3.40
Kaluga region	22	20	8	2.50
Moscow	22	1734	226	7.67
Kurgan region	23	24	5	4.80
Tver region	23	29	5	5.80

Source: compiled by the author based on data from the Bank of Russia.

the Primorsky Krai and the Astrakhan region, preserve high stability of the microfinance sector.

DATA AND METHODS

The decision of the Bank of Russia to exclude an MFO from the register may indicate its involvement in shadow financial schemes. Automating the detection of unscrupulous microfinance organizations based on machine learning methods will allow regulatory authorities to promptly identify and suppress illegal activities, thereby contributing to the stability of the microfinance sector.

We will now examine the likelihood of excluding MFOs from the register. For this, we downloaded the data from the official website of the Bank of Russia.[4] We also collected MFO reports that must have been published on their websites. The information about organizations and the reports is supplemented by a rating by *banki.ru* based on the feedback from MFOs clients.

The following indicators were downloaded for each organization:

- company name;
- registration date;
- date of exclusion from the register;
- period of activity in months;
- region;
- city;
- activity profile;

[4] Bank of Russia. URL: https://www.cbr.ru/microfinance/registry/ (accessed on 27.07.2020).

Table 5

Top 10 regions with the greatest average operating time

Region	Average work duration of an MFO (months)	Number of MFOs excluded from the register	Number of MFOs	The ratio of the excluded MFOs to the existing MFOs
Kabardino-Balkar Republic	42	25	3	8.33
Sakhalin region	35	29	10	2.90
Kaliningrad region	35	44	11	4.00
Tula region	34	56	10	5.60
Karachay-Cherkess Republic	34	3	2	1.50
Leningrad region	33	28	7	4.00
Primorsky Krai	33	114	35	3.26
Republic of Kalmykia	33	6	3	2.00
Astrakhan region	33	55	11	5.00
Republic of North Ossetia — Alania	32	20	19	1.05

Source: compiled by the author based on data from the Bank of Russia.

- rating;
- authorized capital as of the end of the year;
- long-term financial obligations;
- book value of net assets as of the end of the year;
- book value of assets;
- net interest income;
- net profit;
- year of the submitted reports;
- how many years ago the last reporting was submitted;
- number of founders — individuals and legal entities;
- location of founders, managers and MFOs in different regions;
- information about the legal entities-founders in offshores.

Information on these indicators was collected by year for the period from 01.01.2015 to 09.05.2020. The final sample included 100 microfinance organizations, of which 50 were excluded from the MFO register for the specified period.

Logical variable "In the register" has been introduced as an MFO sustainability indicator. Its two states are defined as follows:

0 is the organization excluded from the register;

1 is the organization in the register.

Consequently, the final list of indicators consists of 100 organizations, 19 indicators (listed above) collected over 64 months, and the resulting column "In the register", which contains the information about the MFOs excluded from the register.

Identifying unscrupulous participants in the microfinance market can be viewed as a binary classification task. We will consider traditional methods and modern algorithms that solve classification problems in the field of financial monitoring.

Logistic regression

Logistic regression is a well-studied and widely used method in statistics. In modern studies highlighted in publications [10–12], logistic regression is used in combination with other methods or for comparison [13, 14].

Decision trees

Decision tress are advantageous for solving classification problems:

- efficient in computing and using computer memory, which makes them suitable for working with large amounts of data;
- the choice of functions is integrated into the learning and classification processes;
- are nonparametric models, which allows processing data with different distributions.

The disadvantages of these algorithms include the fact that the results may be variable and non-reproductive when the sample is changed.

To eliminate the disadvantages, the decision tree ensembles are used. The ensembles are based on a general principle that allows you to get the best results by combining several related models. Typically, ensemble models are more accurate than individual decision trees.

There are many different ways to ensemble decision trees. The *two-class decision forest* and the *Adaboost* algorithm are the most efficient for solving financial monitoring problems.

Using combined methods for solving practical problems is common. [15–17] prove this fact.

Vector Machine method

The algorithm was proposed in 1963 by Vladimir Vapnik and Aleksei Chervonenkis. The *Two-class Support Vector Machine* creates a binary classification model by a support vector machine. A two-class support vector machine is a supervised learning algorithm that trains on labeled data.

Neural networks

A lot of different models are based on neural networks. To solve financial monitoring

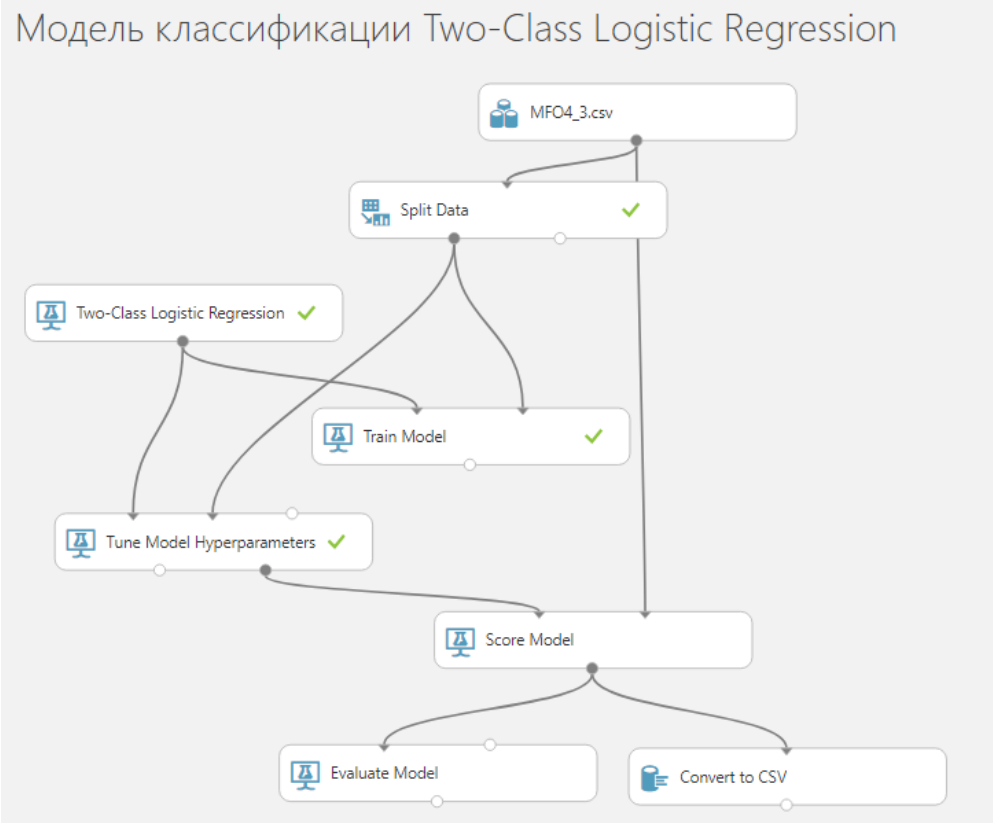

Fig. 2. **Two-Class Logistic Regression Classification Model**

Source: compiled by the author.

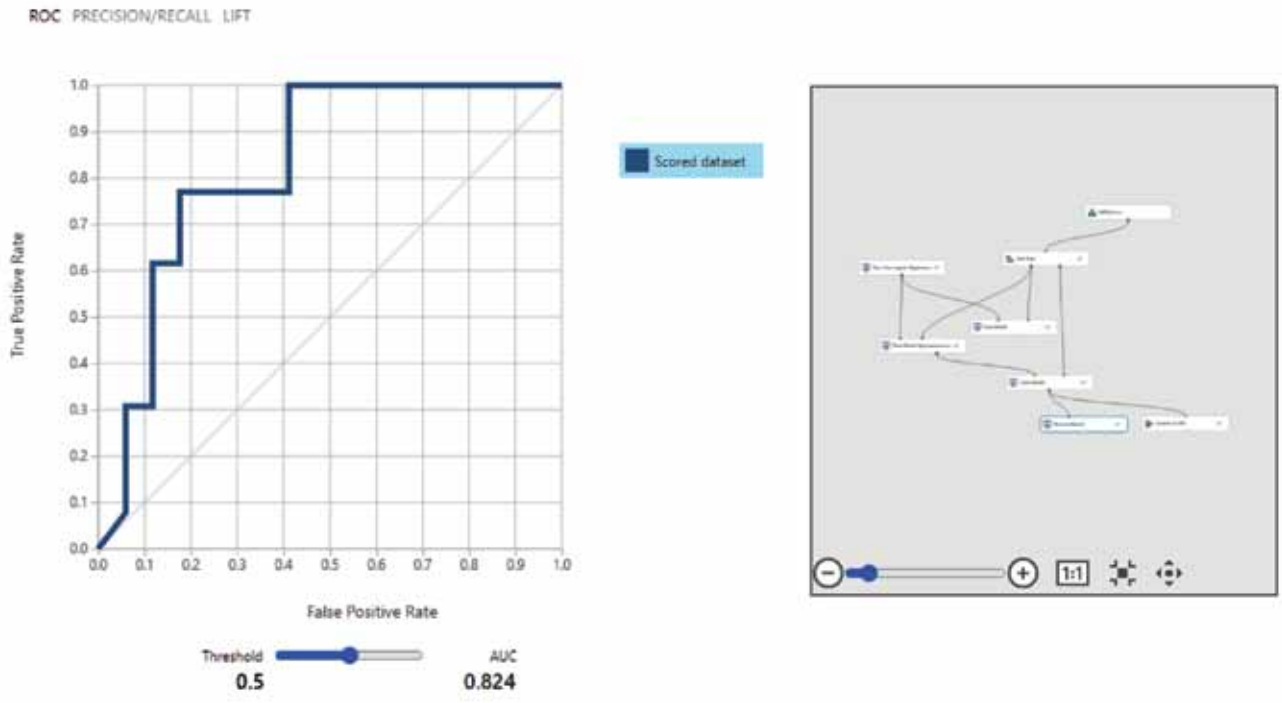

Fig. 3. **ROC Curve and Accuracy Ratings for the Loregression Model**

Source: compiled by the author.

Table 6

AUC indicators for classification algorithms

	Classification model					
	Two-Class Logistic Regression	**Two-Class Decision Forest**	**Two-Class Boosted Decision Tree**	**Two-Class Neural Network**	**Two-Class Support Vector Machine**	**Two-Class Bayes Point Machine**
AUC ratio	0.824	0.796	0.688	0.833	0.873	0.855

Source: compiled by the author.

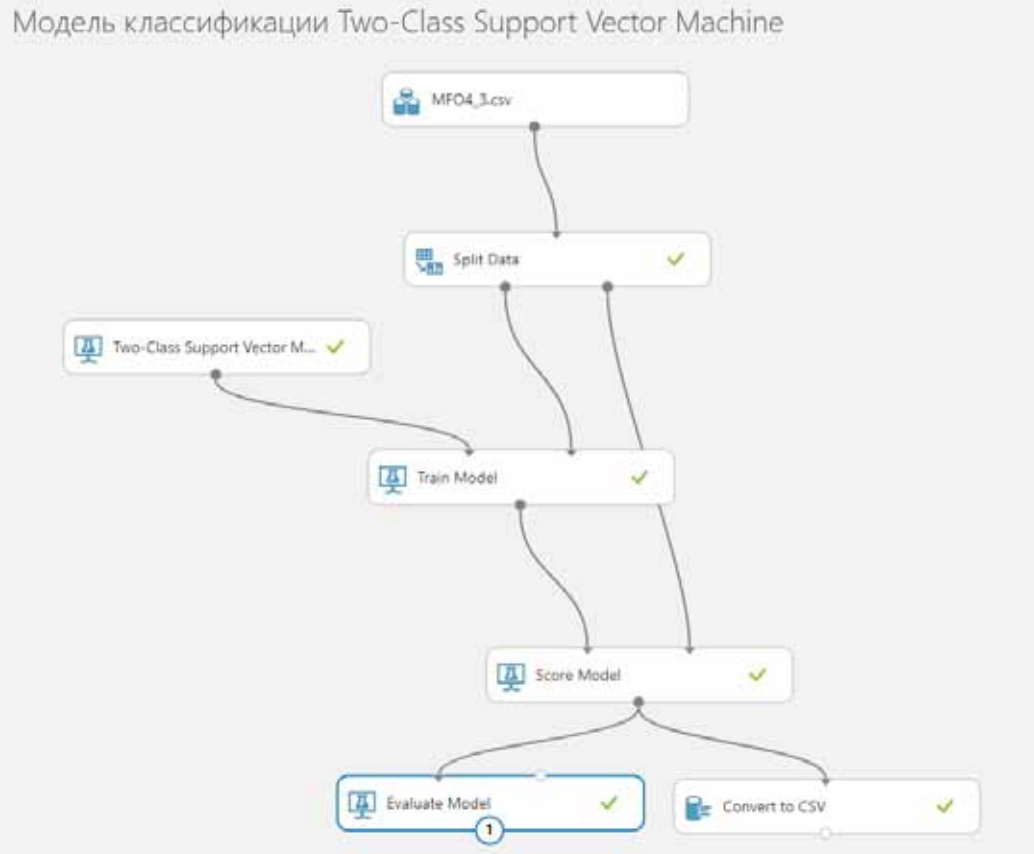

Fig. 4. **Two-Class Support Vector Machine Classification Model**

Source: compiled by the author.

problems, we will consider the two-class neural network algorithm.

Classification using neural networks is a supervised learning method and therefore requires a tagged dataset that includes a column of tags. The *Two-class neural network* algorithm is used to predict binary outcomes, such as whether a patient has a specific disease, whether a machine can fail within a certain period of time, or whether a particular financial monitoring object is deviant.

Bayes networks

Bayesian networks are mainly used for solving diagnostic problems. For example, they are often used in medicine, credit scoring [18–20], and other tasks requiring risk assessment.

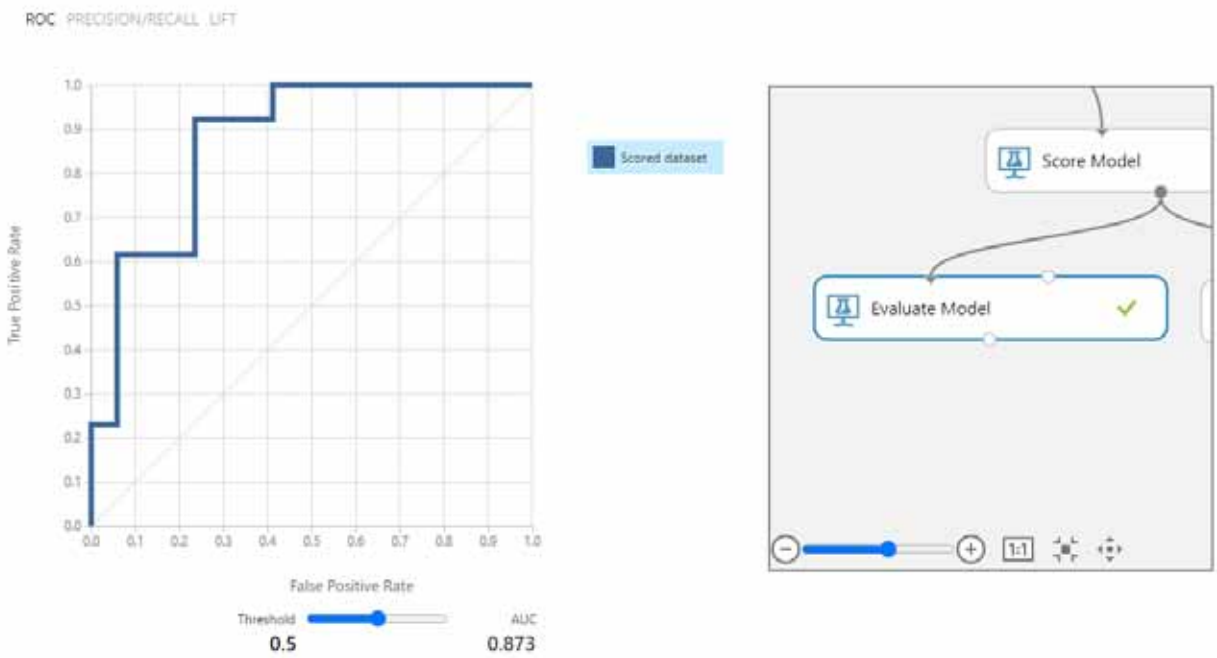

Fig. 5. **ROC curve and accuracy ratios for support vector machine**

Source: compiled by the author.

The *Two-class Bayes Point Machine* algorithm uses a Bayesian approach to linear classification, it effectively approximates the theoretically optimal Bayesian mean for linear classifiers (in terms of generalization efficiency) by choosing one "middle" classifier, the Bayes point. Being a Bayesian classification model, this algorithm cannot be over-trained.

CLASSIFICATION RESULTS

We will demonstrate the classification of MFOs based on prepared data using the *Two-Class Logistic Regression* algorithm. *Fig. 2* shows the machine learning diagram.

From the considered classification algorithms the most accurate results were shown by the *Two-Class Support Vector Machine* algorithm, the AUC ratio was 0.873 (*Fig. 4, 5*).

CONCLUSIONS

The microfinance sector in Russia is progressing and therefore is of high social significance. Short-term loans can be really helpful for citizens to quickly restore the financial balance.

However, there is a high risk of microfinance organizations to be involved in illegal financial transactions, fraud and money laundering.

Automating detection of unscrupulous microfinance organizations based on machine learning methods will allow for promptly identifying and suppressing illegal activities by regulatory authorities.

Comparative analysis of processing data on the MFOs activities by classification methods — logistic regression, decision trees (two-class decision forest algorithms, *Adaboost*), support vector machine (two-class support vector machine algorithm), neural network methods (two-class neural network algorithm), Bayesian networks (algorithm two-class Bayes network) — showed that the two-class support vector machine demonstrates the most accurate results. The research results may be of use to the Bank of Russia and Rosfinmonitoring to automate detecting unscrupulous microfinance organizations.

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Cyberattack Risk Assessment in Electronic Banking Technologies (the Case of Software Implementation)

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ABSTRACT

The authors investigate the risks of computer attacks on automated banking systems. **The relevance** of the study is due to the need to revise the approaches to risk assessment based on the technical components of banking business processes and the consequences of cyber-attacks aimed at banking automated systems in credit institutions. **The aim** of the study is to describe the developed methods for assessing cyber risks in a commercial bank and provide an option for assessing the risks of information security violations in electronic banking technologies. **The methodology** of the article includes the analysis of domestic and foreign literature on the research topic, the theoretical and probabilistic method of calculation, computer programming and graphic interpretation of information. The authors analysed the operational risk of a commercial bank to develop components of the operational risk management system in the context of developing electronic banking technologies. They designed a computer program to quantify risk probabilities of cyberattacks on electronic banking technologies (by means of Borland Delphi). The work presents a formalised probabilistic model for determining the most vulnerable segment of risk management techniques used by information security structures. **The conclusion** is that it is possible to develop a software package based on a mathematical model that reduces the number of checks of risk factors by several times. **The research results** may be of further use for the development of risk divisions in credit institutions using electronic banking technologies.

Keywords: the risk of cyberattacks; electronic banking technologies; information security; risk assessment; probabilistic model; computer program; typical banking risks

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INTRODUCTION

Scientific and technological progress contributes to the transition of traditional banking services to remote ones and the expansion of risk profiles. According to a number of experts (B. King [1] and C. Skinner [2]), in the 2020s some countries will completely give up cash (Sweden, China, Canada).

The monotown Neryungri (Yakutia) became the first case of smart card technology in Russia, which demonstrated the potential of cashless payments of the future. The restructuring of the USSR caused cash problems. The city-forming enterprise JSC Yakutugol (today a subsidiary of PJSC Mechel) used high-quality equipment from Japan as salaries to workers (barter). In 1995, by means of the city's main bank "Neryungribank" (now "Coalmetbank"), it put the salaries of all employees to plastic cards "Zolotaya korona" [3].

The Centre of Financial Technologies in Novosibirsk outstripped time and its product became convenient for all professions and segments of the population, including pensioners.[1] One of the authors of this article (A.A. Berdyugin) witnessed these innovations, since he was born and lived in Neryungri from 1988 to 2010 before he moved to Moscow. The gradual abandonment of cash is a consequence of the active introduction of electronic banking technologies (EBT)[2] in the banking business [4] and provides an opportunity (opposite to the risk) for cybercriminals.

Along with the EBT obvious advantages, profiles of typical banking risks have significantly expanded, including operational risk (OpR). A world leading developer of the methodology for assessing banking risks, the Basel Committee on Banking Supervision has issued several documents on improving banking supervision. It recommends that credit institutions create a reserve for operational risk, which includes a reserve for cyber risk (see Basel II, III and Basel IV).[3]

According to the Committee, commercial banks have to reserve funds for OpR, considering active development and use of information technologies (fintech or techfin [1, 2]).

OpR means the risk of direct and indirect losses as a result of:

- low efficiency or erroneous internal business processes of a commercial bank;
- actions of the staff and third parties;
- violations and shortcomings in the operation of information, technological and other systems;
- external events.

OpR includes legal risks, but excludes strategic and reputational risks. It also includes various risks depending on the types of processes:

- the risk of insufficient information security;
- the risk associated with deficiencies in the construction of information systems in a particular organization;
- the project risk as a consequence of OpR;
- the risk of violation of control procedures, which may include compliance risk or risk of internal control deficiencies;
- the risk of errors in the processes of development, verification, adaptation, acceptance of methods and quantitative models for assessing assets and risks (model risk as a consequence of OpR);
- the risk associated with erroneous actions of the personnel.

[1] The art of survival: what helped CFT overcome all financial crises. URL: https://www.rbc.ru/magazine/2016/12/582c40a29a7947079b45fdce (accessed on 26.05.2020).

[2] EBT are based on PC-banking (management of bank accounts and cards from a computer via the Internet and a Web browser online) and mobile banking (SMS-banking, as well as management of bank accounts and cards via a special application from smartphones, tablets and smart watches). EBT also include ATMs and self-service banking terminals.

[3] The content of these documents, as well as various articles by leading experts in the field of banking supervision, are here www.bis.org.

Fig. 1. **Building an operational risk management system in the context of electronic banking technologies**

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

In general, OpR control system in the context of EBT may look as follows (*Fig. 1*) [5]. We will adapt the generally accepted term "risk of information security breach" and consider OpR in the fuel and energy balance.

Definition 1. By risk of cyberattacks (RCa) we understand a quantitative expression of a likely increase in typical banking risks influenced by insider and hacker threats, in case of disruptions to the automated banking system, as well as expression of the magnitude of negative consequences (financial costs, reduced reputation, loss of liquidity) caused by the threat. The concept of RCa in EBT was used by the authors in [3, 6, 7].

The key is the software package that ensures the functioning of the operational risk management system in EBT. The EBT susceptible to cyberattacks can be classified by way of providing financial remote services:

- PC-banking;
- Telephone/SMS banking;
- Terminal banking;
- Mobile banking.

Testing for penetration into the protected perimeter of commercial banks, carried out by experts from Positive Technologies, showed that seven out of eight organizations have a local network not protected from penetration from the global network. The security of the corporate infrastructure of most considered credit and financial institutions from internal cyberattacks was assessed by the company as extremely low.[4] Commercial banks reimbursed their clients only 15% (935 million roubles, or every sev-

[4] Penetration testing in organizations of the credit and financial sector. URL: https://www.ptsecurity.com/ru-ru/research/analytics/pentest-finance-2020/ (accessed on 27.06.2020).

enth stolen rouble), and explained this by a high proportion of social engineering: clients themselves disclose confidential information.[5]

Thus, cyberattacks cause significant damage to banks and become the reason for typical banking risks (credit, operational, legal, reputational, strategic risks and liquidity risk), whose characteristics are provided in the letter of the Bank of Russia No. 70-T "On typical banking risks").

SOFTWARE IMPLEMENTATION OF ASSESSMENT METHOD OF RCa IN EBT

According to the Federal Law of the Russian Federation No. 184-FZ "On Technical Regulation", risk is the likelihood of damage to the life or health of citizens, property of individuals or legal entities, state or municipal property, the environment, life or health of animals and plants, considering the severity of this damage [6]. *Table 1* shows a comparative characteristic of cyberattack risk assessment tools.

Domestic software for risk assessment is presented only by "GRIF 2006", not supported by the manufacturer. Therefore, we automate the method of quantitative assessment of RCa management in EBT, described in [3, 6], in the high-level language Borland Delphi (*Fig. 2* shows the user-friendly interface and a ready-made example) using [9–11].

1. First, the risk analyst selects a demand from the drop-down list and assesses it by four radio buttons ([3, 6] provide approximate requirements for the RCa control system), thereby setting the initial data:

```
…
Cells[1, Row]:=
IntToStr(RadioGroup.ItemIndex +
1);
…
```

2. After the cells are filled with demands and are assessed on a 4-point scale, we determine the quantitative value of the probability of an unfavorable outcome when implementing RCa by pressing "Probability of RCa" button:

```
procedure TRiskForm.
ProbabilityButtonClick(Sender:
TObject);
var
 znam, j: Integer;
begin
 znam:= 0;
 for j:= 1 to ConditionOfBank-
 StringGrid.rowCount do
  if ConditionOfBankStringGrid.
  Cells[1, j] <> '' then
 begin
  znam:= znam + StrToInt(Condi
  tionOfBankStringGrid.Cells[1,
  j]); // Cells[Col, Row]
  ProbabilityLabel.Caption:=
  FloatToStr(SimpleRoundTo(100 *
  j / znam,—2)) + '%';
  RadioGroup.ItemIndex:= -1;
  // to remove the radio buttons
 end;
end;
```

Meeting the requirement (positive answer) reduces the probability of RCa and vice versa.

3. For further work, requirements and calculations can be saved into a Microsoft Excel report by clicking on the appropriate button:

```
…
 with ConditionOfBankStringGrid
 do
 begin
  for i:= 0 to ColCount — 1 do
   for j:= 0 to RowCount — 1 do
   Excel.Sheets[1]. Cells [j + 1,
   i + 1]:= Cells [i, j]; // "To
   link" Excel and Delphi
 end;
  Excel.Sheets[1]. Cells [1, 7]:=
 'Result: '; {Write down the
  percentage of RCa}
```

[5] Report of the Bank of Russia "Review of transactions performed without the consent of clients of financial institutions in 2019". URL: http://www.cbr.ru/Content/Document/File/103609/Review_of_transactions_2019.pdf (accessed on 28.06.2020).

Table 1

Comparative characteristics of cyberattack risk assessment tools

Product	CRAMM (Central Computer Telecommunications Agency, UK)	RiskWatch, Riskwatch International (USA)	GRIF 2006, Digital Security Office (Russia)	Microsoft Security Assessment Tool
Support:	Provided	Provided	Absent	Provided
User friendly:	Requires special training and high qualifications of an auditor	Requires special training and high qualifications of an auditor	The program interface is focused on IT managers and executives. Requires specialized knowledge of information security	The program interface is focused on IT managers and executives. Requires specialized knowledge of information security
Cost:	License cost from 2 thousand to 5 thousand dollars per one workplace	License cost from 10 thousand dollars per one workplace	License cost from 1 thousand dollars per one workplace	Free
Entry data:	– Resources; – value of resources; – threats; – system vulnerabilities; – selection of adequate measures	– Type of information system; – basic safety requirements; – resources; – losses; – threats; – vulnerabilities; – protective measures; – value of resources; – frequency of threats; – selection of countermeasures	– Resources; – network hardware; – types of information; – group of users; – protection; – threats; – vulnerabilities; – selection of countermeasures	Formed based on user responses
Options / content of the report:	– Risk analysis report; – general report on risk analysis; – detailed report on risk analysis	– Brief summary; – report on the cost of protected resources and expected losses from the implementation of threats; – report on threats and countermeasures; – business loss report; – security audit report	– Inventory of resources; – risks by types of information; – resource risks; – the ratio of damage from RCa and resource; – selected countermeasures; – expert recommendations	– Detailed guidance; – recommendations for reducing RCa; – links to industry guidelines; – banking risk profile; – deep protection index
Quantitative or qualitative method:	Qualitative assessment	Quantitative assessment	Qualitative and quantitative assessment	Qualitative assessment
Availability of a network solution:	Absent	Absent	Corporate version	Absent

Source: compiled based on the works of the authors [8].

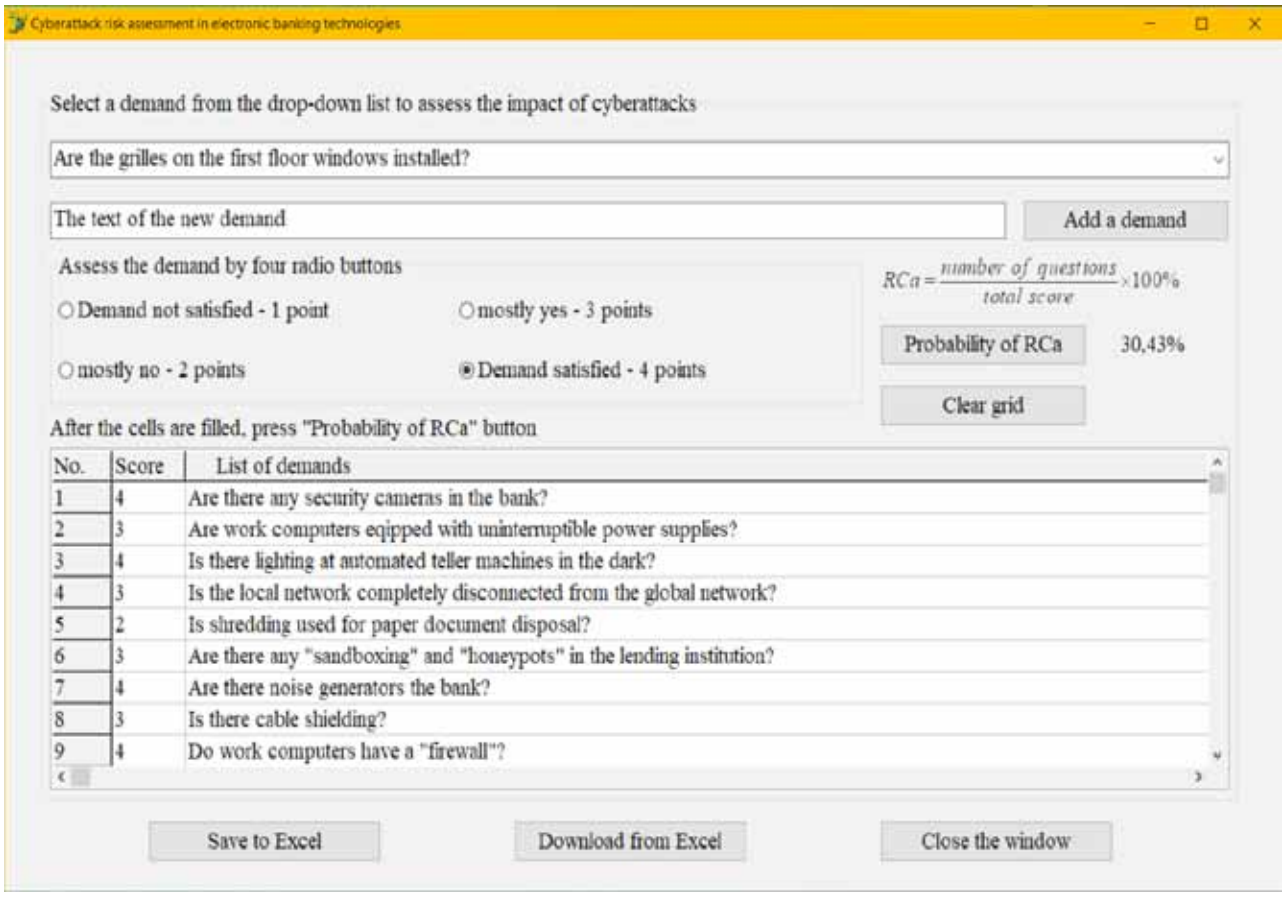

Fig. 2. **Example of using the program that assesses the risks of cyberattacks**

Source: developed by the authors in the high-level language Borland Delphi.

```
Excel.Sheets[1]. Cells [1, 8]:=
ProbabilityLabel.Caption;
Excel.DisplayAlerts:= False;
// Switch off Excel notifica-
tions
if SaveDialog.Execute then
// If you started the save win-
dow, then
try
 Excel.ActiveWorkbook.
 SaveAs(SaveDialog.FileName);
 ShowMessage ('Saved to file: '
 + #10 + SaveDialog.FileName);
except
 ShowMessage ('The file can-
 not be saved, it is open for
 writing or read-only.'
 + #10 + ' Try to save the file
 under a different name.');
end;
```

...

4. The existing list of requirements and assessments can be downloaded from the Excel database:

...

```
Excel:= CreateOleObject ('Excel.
Application');
Excel.Workbooks.Open(OpenDialog.
FileName);
with ConditionOfBankStringGrid
do
begin
 for i:= 2 to Excel.ActiveSheet.
 UsedRange.Rows.Count do
 for j:= 1 to ColCount do
 begin
  {Make the number of rows of
  StringGrid equal to the num-
  ber …}
  RowCount:= Excel.ActiveSheet.
  UsedRange.Rows.Count; {…
  filled Excel rows}
```

```
    Cells [j-1, i-1]:= Excel.
    Sheets[1]. Cells [i, j];
    {Load from Excel to Delphi}
  end;
end;
```

…

The list of demands was developed by the authors empirically and is based on the analysis of the relevant literature. The revision is possible when exploiting the program.

5. The program works when the corresponding modules are connected:

```
uses
…
  Math {connect the module for
  mathematical functions},
  ComObj {connect the module for
  Microsoft COM objects};
…
var
  RiskForm: TRiskForm;
  Excel: OleVariant; {Declaring
  object OleVariant with a Micro-
  soft Excel name}
…
```

Note. The program provides that the probability of the risk realization was not zero, since there is no absolute protection. A distinctive feature of the Borland Delphi is the need to disable Delphi's reaction to exceptions (try — except — end): in the system menu Tools → Debugger Options → Language Exceptions → disable Stop on Delphi Exceptions.[6]

Regular application of the program for ensuring the cybersecurity of a commercial bank will allow monitoring the effectiveness of measures aimed at leveling the negative consequences of implementing RCa in the context of EBT. The final assessment of the likelihood of RCa presents an idea of the corporate infrastructure security of a credit institution. In the introduction, we describe the security of most banks as extremely low (see above the results of Positive Technologies on penetration testing). Using this program to assess RCa in the context of EBT will allow for effective management of the overall risk management system in a credit institution.

DEVELOPING A PROBABILISTIC MODEL TO ASSESS RCa IN EBT

Stealing large sums of electronic money includes not only stealing the numbers and PIN-codes of bank cards or passwords to access bank accounts, but also developing a mechanism to withdraw stolen money to "safe" accounts (the so-called money laundering). This is done in various ways: through a sequence of electronic transfers in the victim's EBT to the accounts of the attacker through figureheads or by purchasing goods in online stores with later resale at reduced prices [12–14].

Testing for penetration into the protected perimeter of commercial banks, carried out by experts from Positive Technologies, showed that seven out of eight organizations have a local network not protected from penetration from the global network.

For a more detailed analysis, we have developed a method where the number of checks of risk factors[7] contributing to theft and withdrawal of funds, with total number n of negative factors, can be reduced several times as follows:

1. Estimated money losses are grouped according to k factors of RCa $(k < n)$.

[6] Codecall Programming Forum. Community Forum Software by IP.Board. URL: http://forum.codecall.net (accessed on 10.07.2020).

[7] By risk factors we understand a quantitative expression of the fulfillment of the demands from the previous section.

2. Possible losses falling within the range of insignificant or acceptable risks imply the end of the cycle.

3. Possible losses falling within the range of critical or catastrophic risks require an individual consideration of each n factor. Then, for k factors of RCa $k+1$ check is required.

Proof. We will build a probabilistic model to assess RCa in EBT that can become the basis for the methods developed in [15]. Let the probability of critical or catastrophic losses be equal to p and be the same for each of n factors. Losses from implementing RCa in EBT are independent for each factor. The elements of the probabilistic model constitute a sequence of Bernoulli distributions for n tests with probability p.

Definition 2. Bernoulli distribution models a random arbitrary experiment with a known probability of success or failure. Random variable ς has Bernoulli distribution with probability $p\left(0\le p\le 1\right)$ if its values are equal to 0 or 1 with probabilities $P\left(\varsigma=0\right)=1-p$ and $P\left(\varsigma=1\right)=p$ accordingly.

If n is divided by k, then n/k will be tested. X_j is the number of checks performed in group j, $j=1,2,\ldots,n/k$. Then

$$X_j=\begin{cases}1, \text{ with probability } P\left(X_j\right)=\left(1-p\right)^k,\\ \text{all } k \text{ factors within standard}\\ k+1, \text{ with probability } P\left(X_j\right)=1-\left(1-p\right)^k,\\ \text{with negative factors.}\end{cases}$$

Here $\left(1-p\right)^k$ is the product (combination) of events opposite to critical or catastrophic losses. Let $Z=X_1+X_2+\ldots+X_{n/k}$ be the total number of checks. Let us estimate $k_0=k_0\left(p\right)$ group size for the given value of p (the value of p can be estimated by the detection frequency of negative factors in previous tests). This $k_0=k_0\left(p\right)$ group size should minimize the value of mathematical expectation $M\left(Z\right)$. According to the definition of mathematical expectation $M\left(\xi\right)=\sum_k x_k p_k$, we have:

$$M\left(X_j\right)=1\cdot\left(1-p\right)^k+\left(k+1\right)\cdot\left[1-\left(1-p\right)^k\right]=$$
$$=k+1-k\cdot\left(1-p\right)^k.$$

According to the definition of mathematical expectation $M\left(\xi+\eta\right)=M\left(\xi\right)+M\left(\eta\right)$, we have:

$$M\left(Z\right)=M\left(X_1\right)+M\left(X_2\right)+\ldots+M\left(X_{n/k}\right)=$$
$$=\frac{n}{k}\cdot M\left(X_j\right)=n\cdot\left[1+1/k-\left(1-p\right)^k\right].$$

Further research will allow us to develop a software package for automating the identification of risk factors, which will reduce the number of checks by several times.

To determine $k_0=k_0\left(p\right)$ group size we can assume that $H\left(x\right)=1+1/x-\left(1-p\right)^x$ at $x>0$. For p values that are close to 0, function $H\left(x\right)$ will reach the minimum at x_0, which is the minimum extremum of equation $H'\left(x\right)=0$, i.e.

$$\left[1+1/x-\left(1-p\right)^x\right]'=1/x^2+\left(1-p\right)^x\cdot\ln\left(1-p\right).$$

The resulting equation relative to x is clearly not solvable. According to Newton's binomial theorem, for small p we have $\left(1-p\right)^x\approx 1-px$. Replacing

$$H\left(x\right)=1+1/x-\left(1-p\right)^x$$

with $\tilde{H}\left(x\right)=1+1/x-1+px=1/x+px$, we find the minimum point of function

$$\left(1/x+px\right)'=0\Leftrightarrow -1/x^2+p=0,$$

where $\tilde{x}_0=1/\sqrt{p}$.

Wherein $\tilde{H}(\tilde{x}_0)=\sqrt{p}+p/\sqrt{p}=2\sqrt{p}$. Let the minimum probability of critical or catastrophic losses be 1%. Then for $p=0.01$ we have:

$$\tilde{x}_0=1/\sqrt{0.01}=10,\quad \tilde{H}(\tilde{x}_0)=2\sqrt{0.01}=1/5,$$

$$M(Z)\approx n\cdot\tilde{H}(\tilde{x}_0)=n/5.$$

Expected number of loss checks $M(Z)=n/5$ (fivefold reduction). The model proposed to identify negative risk factors makes it possible to reduce by 5 times the time spent on checking monetary losses from RCa implementation. This significantly increases the effectiveness of measures to identify the most vulnerable segment that are used by information security structures of RCa management technicians.

CONCLUSIONS

Further research will allow us to develop a software package for automating the identification of risk factors, which will reduce the number of checks by several times.

EBT introduction contributes to a significant reduction in operating expenses for credit institutions. At the same time, the bank's work in cyberspace is associated with additional sources of typical banking risks.

The paper proposes a simple method for assessing RCa, which, if necessary, can be constantly expanded by including additional control parameters and the development of new models. It can be used permanently by specialists of risk departments. The results of the RCa assessment may increase the efficiency of decisions taken by credit institutions to ensure cybersecurity in EBT.

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Solving Fiscal Problems through Monetary Policy Mechanisms: Case of Armenia

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ABSTRACT

The problem of fiscal dominance tends to be most pronounced in emerging markets. The research **subject** is the monetary policy of the Central Bank of the Republic of Armenia and its participation in solving fiscal problems. The **aim** of the article is to analyze and assess fiscal dominance in the macroeconomic regulation of Armenia. The **methodological basis** of the study is a review of theoretical and practical models of fiscal dominance known in the scientific literature, as well as applying the most optimal models to the Armenian economy. The authors conclude that the tasks of fiscal policy are the priority of macroeconomic management, and monetary policy aims to solve fiscal problems.

Keywords: monetary regulation; monetary policy; inflation; fiscal policy; fiscal dominance

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INTRODUCTION

The strategic goal of macroeconomic regulation is to achieve sustainable economic growth rate in terms of stable prices and national currency, low unemployment together with free capital flow. Thus, all of the above indicators characterizing macroeconomic stability are closely interrelated.

As a rule, the choice of priorities for macroeconomic regulation in the economy is adaptive. In particular, this approach is inherent in developing countries or countries with economies in transition, since the conditions of uncertainty and lack of macroeconomic stability are often chronic. At the same time, this approach does not provide a strategic direction for the development of the economy and largely hinders the achievement of sustainable economic growth.

A key challenge faced by developing societies is the high public debt and inability to pay off debt in the near future, which is very closely related to slow economic growth. In such conditions, macroeconomic policy tends to solve the fiscal problems associated with public debt and high public deficit by all possible means, including monetary mechanisms. For this reason, developing countries choose to opt for fiscal dominance in their macroeconomic policies. Armenia is a good example.

LITERATURE REVIEW: THEORETICAL PREMISES OF FISCAL DOMINANCE IN MACROECONOMIC POLICIES

Fiscal dominance takes place in the economy when all macroeconomic decisions are based on the priorities of fiscal policy. This means that with a conflict of interest between monetary and fiscal policies, the choice is made in favor of fiscal problems, and monetary instruments are inevitable to solve problems with public debt and budget deficits. One of the most famous theories of fiscal dominance in macroeconomic regulation is "The Fiscal Theory of the Price Level", first described by E. Leiper (1991), K. Sims (1994), M. Woodford (1994, 1995) [1–4].

The author of earlier studies M. Bassetto (2008) [5] prioritizes the role of public debt and fiscal policy in the pricing process in the economy, while monetary policy plays an indirect role. The author relied on data from the crisis and post-crisis periods, which clearly proved that monetary mechanisms are overshadowed by economic shocks. However, ten years later, M. Bassetto and W. Cui in their work "The Fiscal Theory of the Price Level in a World of Low Interest Rates" (2017) [6] showed that the fiscal theory of the price level is not a good balancing tool in a context when interest rates are not outstripping long-term growth. Taylor's equation (1993) [7] also sup-

ports this idea (*Equation 1*), based on the sensitivity of the interest rate level to changes in the price level and to the difference between real and potential GDP.

Equation 1

$$R = P + 0.5(Y - Y^*)/Y^* + 0.5(P - 0.02) + 0.02,$$

where R is the nominal interest rate, P is the prior period inflation, Y is the real GDP, Y^* is the potential GDP, and 0.02 is the most optimal inflation target according to Taylor — 2%.

The work by W.H. Buiter (2002) [8] is one of the critics of FTPL. As a counterargument, it suggests the thesis that this approach carries many contradictions and violations of the laws of economic theories, in particular, in achieving a balance only in the face of budget restrictions.

Many researchers attempted to build mathematical and econometric models to reveal fiscal dominance. In particular, the study by H. Bohn (1998) [9] (*Equation 2*):

Equation 2

$$PB_t = a + b * D_{t-1} + e_t,$$

where PB_t is the primary balance scaled by GDP for the current period, D_{t-1} is the public debt scaled by GDP of the previous period, a and b are the model parameters, and e_t is the errors.

This equation is based on the thesis that if the coefficient b is significant and positive, it indicates monetary dominance. However, FTPL proponents, who argued that positive rating b could also indicate fiscal dominance in certain circumstances, as it reflects government fiscal sustainability, criticized this theory.

Many studies measured fiscal dominance in sample countries. For example, Carlos de Resende (2007) [10] tried to estimate fiscal dominance and monetary independence by examining OECD countries as well as a group of developing countries that are part of the IMF group. The research by the author showed that fiscal dominance is inherent in many developing countries, while in developed countries monetary authorities are highly independent. The author singles out the institutional environment and its development as a reason for such dynamics.

From the experience of several European developing economies, I. Milenkovich (2018) [11] conducted an empirical analysis using the econometric VAR model. He found that, first, a prerequisite for inflationary expectations in these countries is fiscal management (which might be a valid argument for applying FTPL). Second, in these countries fiscal policy, rather than monetary policy, prevails. Based on the analysis of the quarterly data of the primary balance sheet and the consolidated gross public debt of five developing countries in Europe (Hungary, Romania, Bulgaria, Serbia and Macedonia), the author built two regression models (*Equation 3*) that describe fiscal or monetary dominance in the economy.

Equation 3

$$X_t = \sum_{j=1}^{k+d_{\max}} \alpha_j X_{t-j} + \sum_{j=1}^{k+d_{\max}} \beta_j Y_{t-j} + \varepsilon_t,$$

$$Y_t = \sum_{j=1}^{k+d_{\max}} \gamma_j X_{t-j} + \sum_{j=1}^{k+d_{\max}} \delta_j Y_{t-j} + \eta_t,$$

where Xt is the government budget deficit, Yt is the consolidated gross debt, $\alpha_j, \beta_j, \gamma_j$ *and* δ_j are model parameters, k is the optimal number of lags in the initial VAR model, d_{max} is the maximum sequence integration in the system, and ε_t and η_t are the errors of the first and second regressions respectively.

The key finding of the study was that the causal relationship between government debt and budget deficits reduces the ability of monetary authorities to effectively determine policies to achieve their own goals, and as a result, they lose autonomy in regulating the economy.

K. Sanusi and A. Akinlo (2015) [12] proposed their own approach to defining fiscal dominance in macroeconomic policy. Their research refers to the work by M. Fratianni and F. Spinelli (2001) [13], based on the assumption that the causal relationship between the budget deficit and the increase in the monetary base in the economy is direct. The focus of the research by K. Sanusi and A. Akinlo was to identify the fiscal dominance in Nigeria. The VAR model is as follows (*Equation 4*):

Equation 4

$$\begin{bmatrix} Y_t & X_t \end{bmatrix} = \begin{bmatrix} a_{10} & a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} Y_{t-1} & X_{t-1} \end{bmatrix} + \begin{bmatrix} e_{yt} & e_{xt} \end{bmatrix},$$

where Y_t is the budget deficit of the current period, X_t is the growth of money base, the first term and the first part of the second term are parameters of the regression model, and the last term is errors.

The study failed to prove the existence of fiscal dominance in Nigeria, because other mechanisms of fiscal dominance were used there.

The link between government spending and inflation is presented in the book by H. Khan, M. Marimuthu and F.-W. Lai (2020) [14]. It describes several stages of financing the budget deficit. Their research is based on the formula linking inflation and budget deficit described in the study by K. Ali and M. Khalid [15]. The relationship between inflation and budget deficits is as follows (*Equation 5*):

Equation 5

$$CPI_t = \alpha_0 + \beta_1 FD_t + \beta_2 GDP_t + \beta_3 M2_t + \varepsilon_t,$$

where *CPI* is the Consumer Price Index, *FD* is the Fiscal Deficit, *GDP* is the Gross Domestic Product, M2 is the money supply.

Since the model does consider the methods of financing the government deficit, the authors modified it as follows (*Equation 6*):

Equation 6

$$CPI_t = \alpha_0 + \beta_1 DB_t + \beta_2 EB_t + \beta_3 PS_t + \beta_4 M2_t + \beta_5 GDP_t + \varepsilon_t,$$

where *DB* is domestic borrowings, *EB* is external borrowings.

The third phase reveals the categories of internal and external borrowings (*Equation 7*):

Equation 7

$$CPI_t = \alpha_0 + \beta_1 CBB_t + \beta_2 BIB_t + \beta_4 M2_t + \beta_5 GDP_t + \beta_6 PS_t + \beta_7 MLT_t + \beta_8 STL_t + \varepsilon_t,$$

where *CBB* is Central Bank borrowings, *BIB* is bank borrowings, *PS* is political instability, *MLT* is medium and long term borrowings, *STL* is short term borrowings.

In their work, M. Mehrara, M.B. Soufiani and S. Rezael (2016) [16] consider government spending within expansionary and restrictive monetary regimes. They find that in the case of the former, an increase in government spending is not inflationary and may even contribute to economic development, but it is inflationary in the latter. Both may cause price changes, but the first regime can minimize the negative effects of inflationary pressures. The authors' findings are not entirely consistent with FTPL, as the latter suggests the impact of inflationary pressures on government spending. However, the opposite is also true, when prices are kept at a certain level in order to maintain optimal costs from the government budget.

We believe that this approach can be identified through the model described in the work by H. Khan, M. Marimuta and F.-W. Lai (2020) [14]. First, the following simple econometric model is as follows (*Equation 8*):

Equation 8

$$CPI_t = \alpha_0 + \beta_1 FD_t + \beta_2 GDP_t + \beta_3 M2_t + \xi_t.$$

The equation describes the direct relationship between inflation and the state budget deficit of the country without considering the internal and external sources of financing the budget deficit. The model with these parameters is as follows (*Equation 9*):

Equation 9

$$CPI_t = \alpha_0 + \beta_1 CBB_t + \beta_2 BIB_t + \beta_4 M2_t + \beta_5 GDP_t + \beta_6 PS_t + \beta_7 MLT_t + \beta_8 STL_t + \varepsilon_t.$$

The authors concluded that in the short term, government borrowing will not have a negative impact on the inflationary background in the economy, while in the long term, this impact will be significant.

Thus, the literature suggests three key mechanisms of fiscal dominance.

The first mechanism is to solve the problem of the budget deficit by increasing the money supply, contrary to the principles of monetary regulation. Thus, fiscal policy dominates macroeconomic management.

The second mechanism is based on the close relationship between domestic prices and government spending. In the case of fiscal dominance, the government prefers to keep prices at a certain level to reduce budget spending. At the same time, the target may damage economic growth. This approach is most pronounced in developing countries prone to inflation, where prices are chosen as the best target for the government budget, rather than for sustainable economic growth. The third mechanism is monetary regulation and its close link to the external debt. If the external liabilities cannot be met in the short term, countries often use monetary policy to maintain constant external debt. Fiscal dominance is also pronounced here.

In the real world, countries are not limited to one of the above mechanisms for solving fiscal problems through monetary policy mechanisms, but tend to use all these mechanisms of fiscal dominance. In this regard, we will further consider all three mechanisms of fiscal dominance using the case of the Armenian economy.

FISCAL DOMINANCE: CASE OF ARMENIA

In this study, we have assessed fiscal dominance in the macroeconomic regulation of Armenia, using the above monetary mechanisms for solving fiscal problems. The considered cases are as follows.

Fiscal dominance: monetizing government deficits

Budget deficits are common in most developing countries. Moreover, countries often use monetary instruments to deal with the default on government deficits. Monetizing the government deficit actually indicates the priority of fiscal policy in macroeconomic management. The deficit balance (*Fig. 1*) characterizes the state budget of the Republic of Armenia. Chronic state budget deficits have been observed over the past thirty years.

Since the monetization of the state deficit depends more on the structure and growth of the money supply, the structure of the money supply and the monetary base in Armenia was considered as indicators of the money supply.

Figure 2 shows that the growth of money supply over the last 10 year has been driven largely by the growth of term and foreign currency deposits. At the same time, the growth of cash turnover is almost non-existent, due to the decline of consumption in the economy, as well as the decrease in household income. There was a slight increase in demand deposits. Foreign currency deposits account for a large share in the overall structure of the money supply, which reflects the high dollarization of the country's money supply. The monetary base structure also indicates no significant growth in the money supply of the economy. The growth of the monetary base is due to the growth of correspondent accounts in national and foreign currency in the banking system.

The next step is to define a model that would determine the monetization of the state budget deficit in the Armenian economy. The model is as follows.

- *Methodology: Characteristics of the government deficit monetization model*

In the case of fiscal dominance, the government can use mechanisms for monetizing the state budget deficit, which will definitely affect the independence of the monetary authorities in macroeconomic management.

We went for the model by M. Fratianni and F. Spinelli [13] to describe the existence of fiscal dominance by monetizing the state budget deficit. The model is a step-by-step determination of fiscal dominance in the country's macroeconomic management.

First, it is necessary to assess the quantitative impact of the monetary component of the state budget. We start the calculations with the methodology for accounting for money supply growth.

To solve this problem, the authors initially use the money-supply formula and its derivatives (*Equation 10*):

Equation 10

$$M_t = m_t MB_t,$$
$$m_t = (1 + k_t)/(k_t + rr_t + re_t),$$
$$k_t = BP_t/D_t,$$
$$rr_t = BR_t/D_t,$$
$$re_t = BE_t/D_t,$$

where M_t is the money supply, m_t is the money multiplier, MB_t is the money base, rr_t is the reserve ration, re_t — deposit rate, BR_t is the reserve requirement, BE_t is the excess reserves, BR_t is the cash, D_t is the deposits.

These formulas do not describe the growth of monetary base, so *Equation* (10) was transformed into the following: (*Equation 11*):

Equation 11

$$\ln m_t - \ln m_{t-1} = c(k) + c(rr) + c(re) + c(com1),$$
$$c(k) = \ln(1 + k_t) - \ln(1 + k_{t-1}) - \ln(k_t + rr_{t-1} + re_{t-1}) + + \ln(k_{t-1} + rr_{t-1} + re_{t-1}),$$
$$c(rr) = -\ln(k_{t-1} + rr_t + re_{t-1}) + \ln(k_{t-1} + rr_{t-1} + re_{t-1}),$$
$$c(re) = -\ln(k_{t-1} + rr_{t-1} + re_t) + \ln(k_{t-1} + rr_{t-1} + re_{t-1}),$$
$$c(com1) = \ln m_t - \ln m_{t-1} - [c(k) + c(rr) + c(re)].$$

Then, it was transformed into *Equation 12*:

Equation 12

$$\ln MB_t - \ln MB_{t-1} = c(MBTR) + c(MBOT) + c(BF) + + c(com2),$$
$$c(MBTR) = \ln(MBTR_t + MBOT_{t-1} + BF_{t-1}) - \ln(MBTR_{t-1} + + MBOT_{t-1} + BF_{t-1}),$$
$$c(MBOT) = \ln(MBTR_{t-1} + MBOT_t + BF_{t-1}) - \ln(MBTR_{t-1} + + MBOT_{t-1} + BF_{t-1}),$$
$$c(BF) = \ln(MBTR_{t-1} + MBOT_{t-1} + BF_t) - \ln(MBTR_{t-1} + + MBOT_{t-1} + BF_{t-1}),$$
$$c(com2) = \ln MB_t - \ln MB_{t-1} - [c(MBTR) + c(MBOT) + + c(BF)],$$

where *MBTR* is the government bonds, *MBOT* is the non-governmental bonds, *BF* is the foreign component of securities, *com*1 an indicator that integrates the determinants of multiples, and *com*2 is an indica-

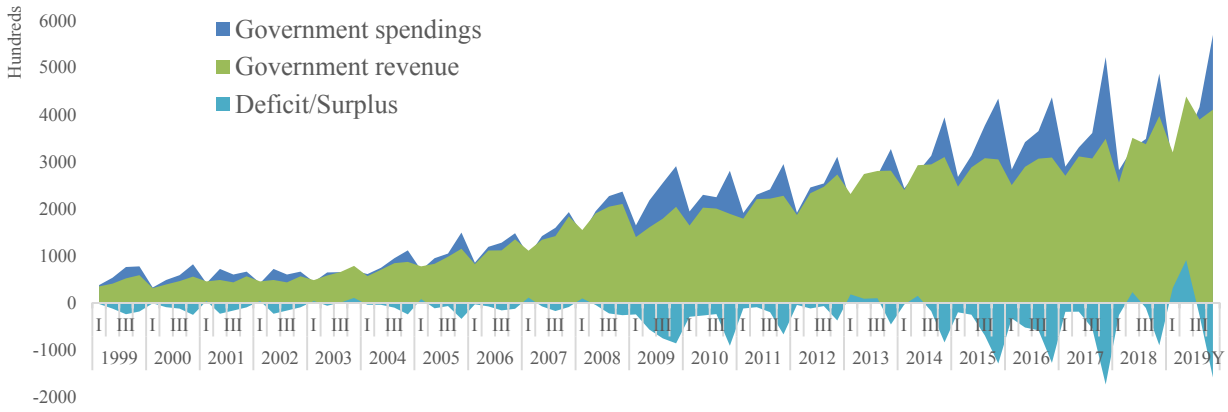

Fig. 1. **Government spending, revenue and deficit/surplus, quarterly, in billion AMD**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

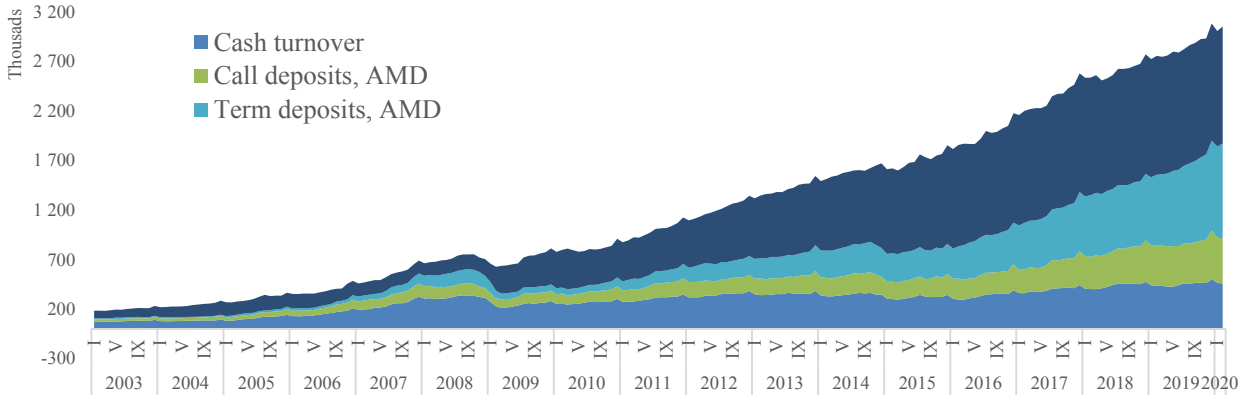

Fig. 2. **Monthly money supply, billion AMD**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020).

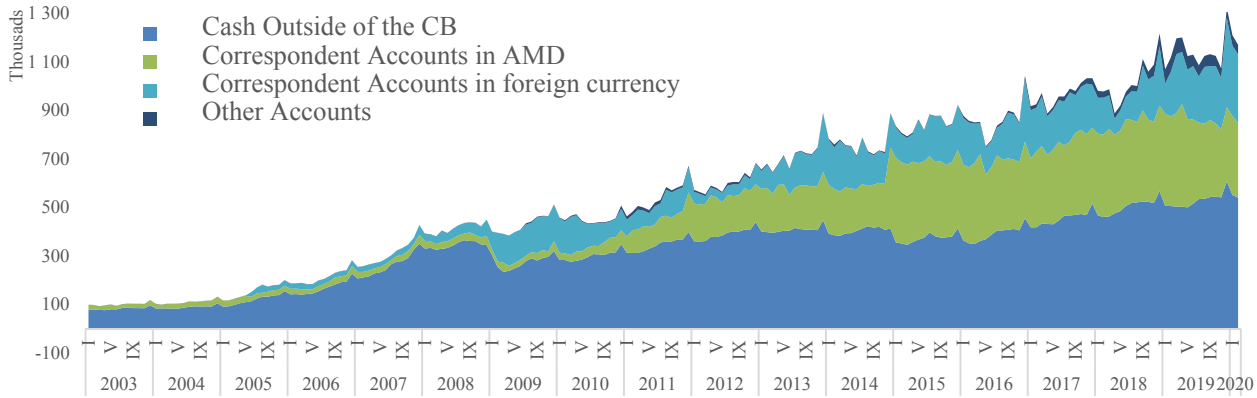

Fig. 3. **Monthly money base, billion AMD**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020).

tor that integrates the determinants of the monetary base.

The first set of equations passed to the second one using *Equation 13*:

Equation 13

$$MB = MBTR + MBOT + BF.$$

With these equations, the authors identified the contribution of each indicator into the monetary growth.

Then goes the analysis of the impact of the budget deficit on the growth of the earlier component of the monetary base. It helps assess how the deficit has been solved through the monetization of the economy and to

identify the elements of fiscal dominance. To this end, the authors analyzed the impact of the budget on the state component of the money supply. They suggested that a positive relationship between indicators could be a prerequisite for fiscal dominance, while the absence of this relationship indicates that it does not exist.

The following type of regression analysis was used:

Equation 14

$$DMBTR = a_0 + a_1 DMBTR_{t-1} + \ldots + a_n DMBTR_{t-n} + b_0 DEFY_t + \ldots + b_n DEFY_{t-n} + cDEFY(CRE) + dDEFY(MAAS) + u_t,$$

where $DMBTR = (MBTR_t - MBTR_{t-1})/Y_{t-1}$, $DEFY = DEF/Y_{t-1}$,

Y is the net national income, CRE is the dummy variable (1 in the period 1981–1992, 0 in other cases), MAAS is the dummy variable (1 in the period 1993–1997, 0 in other cases).[1]

Finally, the authors assessed the relationship between the general monetary base growth and the budget deficit. It makes it possible to determine whether fiscal policy should be given priority in the country's macroeconomic management. To this end, the authors tested the relationship between the relative change in the total monetary base and the budget deficit by regression analysis of the type in *Equation (15)*. The model is as follows:

Equation 15

$$DMB = e_0 + f_1 DMB_{t-1} + \ldots + f_n DMB_{t-n} + g_0 DEFY + \ldots + g_n DEFY_{t-n} + hDEFY\,(CRE) + nDEFY(MAAS) + qDY + + si_{diff} + vCAB + z\,r_{diff} + \varepsilon,$$

where $DMB = (MB_t - MB_{t-1})/Y_{t-1}$, i_{diff} is the difference between the return on assets and the cost of borrowing from the Central Bank, r_{diff} is the difference between Italian and foreign interest rates, ε is the errors.

The researchers conclude that the monetization of the budget deficit decreases over time and may even be reversible, which indicates that solving fiscal problems by monetizing the state budget leads to an excessive increase in the money supply in the economy and, as a consequence, to additional inflationary pressure.

- *Testing the model of budget deficit monetization in the economy of Armenia*

The model described above is adapted to the specifics of the Armenian economy, considering the key features and factors between the budget deficit and the money supply. To build the model of the Armenian economy, we used the monetary base, the volume of government securities on the market and the state budget deficit (from the first quarter of 2008 to the fourth quarter of 2019). The percentage of foreign participation in the securities market was excluded from the indicators in the original model, since the capitalization of the stock market in Armenia is about 2% of GDP and is not significant in terms of money supply.

The data were cleared of seasonality, logarized, and the differences between the current and previous values were calculated. The data distribution was normalized. The data were tested for normality using the Shapiro-Wilk and Shapiro-Francia tests. The distribution of all data is normal (*Appendix, Table 1*), and the time series is stationary (*Appendix, Table 2*).

We built a VAR model (*Table 1*) to find the correlation between the growth of the monetary base and the growth of government securities. Before that, we tested its order criterion and chose the first order (*Appendix, Table 3*). There is a one lag correlation between government securities, meaning that an increase in government securities over one time period affects the monetary base and, therefore, the amount of money in circulation in Armenia.

The model was tested using the Granger causality test, where the null hypothesis is that a lagging variable (in this case, one lag) does not cause the dependent variable to change. *Table 2* presents the test result. The test result showed that the null hypothesis is accepted with a probability of 4.3% for the model with the monetary base as the dependent variable. This means that the null hypothesis is denied. In other words, changes in the monetary base are inversely affected by changes in the number of government securities.

The next step was to assess the impact of changes in the state budget deficit on changes in the volume of government securities. We calculated the order criterion for the model and chose lag-4 (*Appendix, Table 4*). We built the VAR model with these three variables. *Table 3* presents the result.

Table 3 shows that the changes in government deficits have no impact on the volume of government securities. The Granger causality test also proves this point (*Table 4*).

The last step was to identify the link between the monetary base and state budget deficit. For this purpose, the order of the VAR model (*Appendix, Table 5*) was analyzed and the fourth order was chosen. *Table 5* presents the

[1] CRE and MAAS are specific variables for the Italian economy.

Table 1

VAR analysis of the impact of changes in the state component of the monetary base and the monetary base

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
mb						
mb						
L1.	.1333205	.1417833	0.94	0.347	-.1445696	.4112107
govtb						
L1.	-.0115482	.0057165	-2.02	0.043	-.0227522	-.0003441
_cons	.0200455	.0062981	3.18	0.001	.0077014	.0323896
govtb						
mb						
L1.	-.3932807	2.717911	-0.14	0.885	-5.720289	4.933727
govtb						
L1.	-.6759048	.1095816	-6.17	0.000	-.8906808	-.4611287
_cons	.1597744	.1207317	1.32	0.186	-.0768553	.3964042

Note: mb is the money base, *govtb* is the government securities.

Source: calculated by the authors.

result. The relationship between the budget deficit and the monetary base was not found at the 5% significance level. However, at the 10% significance level, the budget deficit has a positive effect on the monetary base. This means that if the deficit grows in the next quarter, the monetary base will increase, and hence the money supply.

Granger causality test showed no connection between monetary base and deficit (*Table 6*).

The study also examined the effect of external and internal shocks on individual regressions and the responses to these impulses of the remaining regressions by the impulse response function (*Fig. 4*) and the orthogonal impulse response function (*Fig. 5*). Since the shocks identified by the impulse response function are intrinsic, it can be argued that these shocks are due to a sharp increase or decrease in the variable itself, which may be caused by unforeseen circumstances (the COVID-19 pandemic and the associated sharp increase in government spending). In this case, impulses for change will be based on the size of the government expenditure variable, and the response will be reflected on other variables.

The orthogonalized impulse-response function shows the external shock of the given factor. These are shocks, for example, related to innovation or technological progress, introduced in this area.

Figure 5 shows that the amount of government securities is the biggest for regression shocks.

In addition, *Fig. 6* shows the changes in government internal debt, which suggests that an increase in the ab-

Table 2

Granger causality test of the state component of the monetarv base and monetarv base

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
mb	govtb	4.081	1	0.043
mb	ALL	4.081	1	0.043
govtb	mb	.02094	1	0.885
govtb	ALL	.02094	1	0.885

Source: calculated by the authors.

Table 3

VAR analysis of state budget deficit and government securities

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
govtb						
govtb						
L1.	-.6140958	.1523082	-4.03	0.000	-.9126144	-.3155773
L2.	.1673323	.1786786	0.94	0.349	-.1828713	.5175358
L3.	.0167982	.1789218	0.09	0.925	-.333882	.3674785
L4.	-.1394247	.1520903	-0.92	0.359	-.4375319	.1586824
def						
L1.	-.2240432	.4535043	-0.50	0.620	-1.113695	.6640088
L2.	-.5644248	.4627076	-1.22	0.223	-1.471315	.3424654
L3.	-.5454681	.4871452	-1.12	0.263	-1.500255	.4093189
L4.	-.3900071	.4814185	-0.81	0.418	-1.33357	.5535558
_cons	.1408481	.1080592	1.30	0.192	-.070944	.3526402
def						
govtb						
L1.	-.0323687	.0446701	-0.72	0.469	-.1195205	.0551831
L2.	-.0251058	.0524042	-0.48	0.632	-.1278162	.0776046
L3.	.0316681	.0524756	0.60	0.546	-.0711821	.1345183
L4.	-.0033308	.0446086	-0.07	0.940	-.090762	.0841003
def						
L1.	-.4208134	.1330072	-3.16	0.002	-.6815028	-.160124
L2.	-.4593744	.1357064	-3.39	0.001	-.7253541	-.1933946
L3.	-.4133504	.1428737	-2.89	0.004	-.6933857	-.1333151
L4.	.5436343	.1411941	3.85	0.000	.2668989	.8203697
_cons	.0065590	.0316924	0.21	0.836	-.0555562	.0686759

Note: govtb is the government securities, *def* is the budget deficit.

Source: calculated by the authors.

solute values of government internal debt is not equal to an increase in the share of internal debt in GDP. This indicates that the total public debt is currently increasing mainly due to external borrowing.

In such a way:

1) there is a negative relationship between government securities and the monetary base, and hence the money supply;

2) there is no correlation between the government budget deficit and government securities;

3) there is a weak, but positive relationship between the fiscal deficit and the monetary base.

Thus, the mechanism for addressing fiscal deficit is rarely resolved through monetization mechanisms.

Fiscal dominance: government expenditure and inflation

The assessment of fiscal dominance through price control with a view to reducing the growth of public expenditure should begin with an analysis of monetary regulation in Armenia within the framework of inflation targeting. Since 2006, Armenia has officially adopted an inflation-targeting regime within monetary regulation. Base inflation was wet as a target and initially changed several times in value. The Central Bank of the Republic of Armenia has definitely set the inflation target of 4±1.5% since the end of 2007, which is still in force today.

Table 4

Granger causality test of the government securities and budget deficit

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
govtb	def	2.4961	4	0.645
govtb	ALL	2.4961	4	0.645
def	govtb	1.8384	4	0.765
def	ALL	1.8384	4	0.765

Source: calculated by the authors.

However, as a result of monetary regulation throughout the inflation targeting period, the Central Bank of Armenia rarely managed to achieve the set target (*Fig. 7*). Despite the fact that in most cases the monetary authorities failed to achieve the set goal, the Central Bank of Armenia never tried to change the target nominal anchor of monetary policy [19].

Neither core inflation nor the cumulative value of the price level falls within the definition of a central bank. The Armenian economy has been deflationary over the past four years, indicating rather tight monetary regulation, as well as a slowdown in economic growth due to a significant decrease in consumption in the economy.

However, the inflation rate set by the Central Bank is significant for the government spending, since the latter requires mandatory annual indexation of price changes. From this perspective, keeping the prices as low as pos-

Table 5

VAR analysis of the impact of the state budget deficit on the state securities

		Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
mb							
	mb						
	L1.	-.0702561	.1417934	-0.50	0.620	-.3481661	.2076539
	L2.	-.0596247	.1335285	-0.45	0.655	-.3213357	.2020864
	L3.	-.3599978	.1307913	-2.75	0.006	-.616344	-.1036516
	L4.	-.3640742	.1413079	-2.58	0.010	-.6410327	-.0871158
	def						
	L1.	.0391473	.0217276	1.80	0.072	-.0034379	.0817326
	L2.	.0359355	.021998	1.63	0.102	-.0071798	.0790507
	L3.	.0361583	.0235236	1.54	0.124	-.0099472	.0822638
	L4.	.0259636	.0230099	1.13	0.259	-.019135	.0710622
	_cons	.0439094	.008331	5.27	0.000	.0275808	.0602379
def							
	mb						
	L1.	1.021696	.8711134	1.17	0.241	-.6856545	2.729047
	L2.	-.4052407	.8203375	-0.49	0.621	-2.013073	1.202591
	L3.	.5030956	.8035211	0.63	0.531	-1.071777	2.077968
	L4.	.520096	.8681307	0.60	0.549	-1.181409	2.221601
	def						
	L1.	-.4347283	.1334842	-3.26	0.001	-.6963525	-.1731041
	L2.	-.4918619	.1351454	-3.64	0.000	-.756742	-.2269818
	L3.	-.4173965	.1445184	-2.89	0.004	-.7006474	-.1341457
	L4.	.5293657	.1413622	3.74	0.000	.2523008	.8064306
	_cons	-.0349252	.051182	-0.68	0.495	-.13524	.0653896

Note: mb is the monetary base, def is the deficit. *Source:* calculated by the authors.

sible allows monetary regulation to solve fiscal problems.

As mentioned above, the state budget of Armenia is characterized by chronic budget deficits (*Fig. 1*). Let's consider these indicators for GDP (*Fig. 8*). The share of expenditures of the state budget of the Republic of Armenia in relation to the gross product has significantly increased since 2008. This is offset by an increase in the budget deficit due to the contraction of the economy as a whole as a result of fiscal revenues. Thus, the problem of increasing government revenues is quite obvious.

The reduction of budget expenditure is not an easy task, especially in developing economies. *Fig. 9* shows the structure of government spending in Armenia. As you can see, the largest share of spending falls on social spending, defense and the state apparatus. These sections are difficult to cut down.

As a result, macroeconomic regulation urgently requires control of public spending. In the absence of stronger institutions, it is forced to address the problem through monetary intervention.

- *Methodology: Characteristics of the relationship model between government spending and inflation*

To determine the relationship between government spending and inflation, we used the model described in the work by S. Olubokun, E. Ayooluwade and F.O. Fawehinmi (2016) [20]. *Equation 16* is a brief description of this model:

Table 6

Granger causality test of the monetary base and budget deficit

vargranger

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
mb	def	3.8699	4	0.424
mb	ALL	3.8699	4	0.424
def	mb	1.9073	4	0.753
def	ALL	1.9073	4	0.753

Source: calculated by the authors.

Equation 16

$$\alpha_t = \sum_{i=1}^{k} A_i \times \alpha_{t-1} + \mu_t,$$

where α_t is a column vector of observations of all variables in a model at t, $\mu_t = V_1 - V_5$ — are impulses, innovations and other shocks.

In particular, in the model presented in the above-mentioned paper variables Real GDP (RGDP), Total Government Expenditure (TGEP), Inflation (INFR), Money Supply (MSPL) and Exchange Rate (EXCH) (α_t= $RGDP_t$, $TGEP_t$, $INFR_t$, $EXCH_t$, $MSPL_t$) were used.

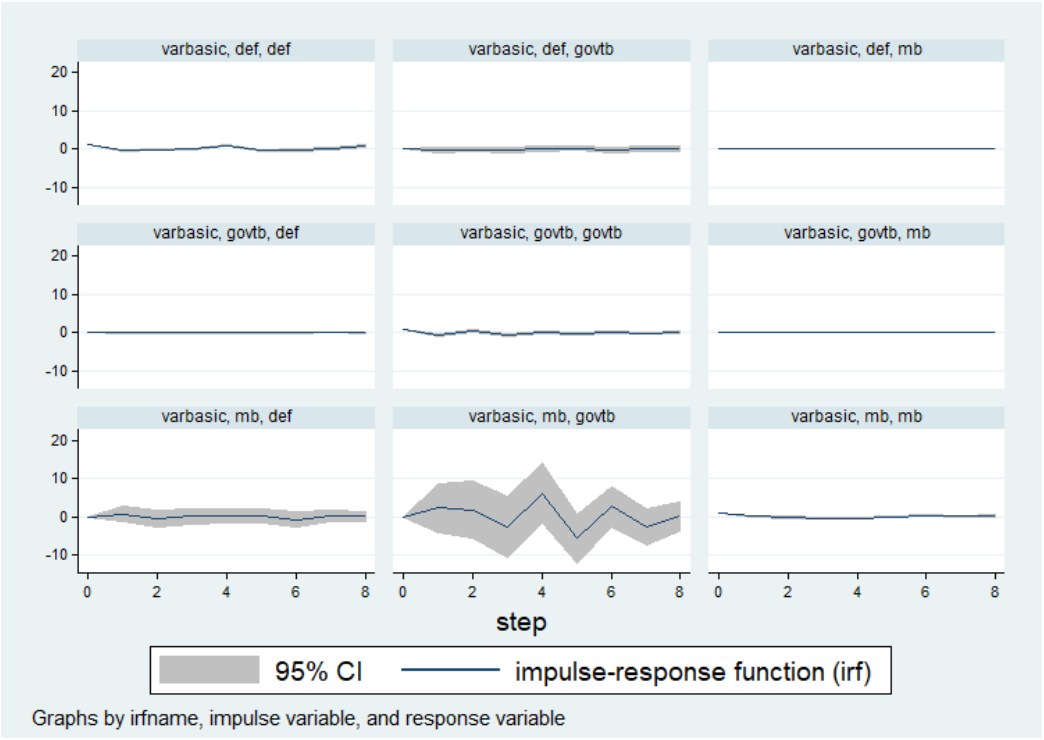

Fig. 4. **Impulse-response function for following variables: budget deficit, government securities, monetary base**

Source: calculated by the authors.

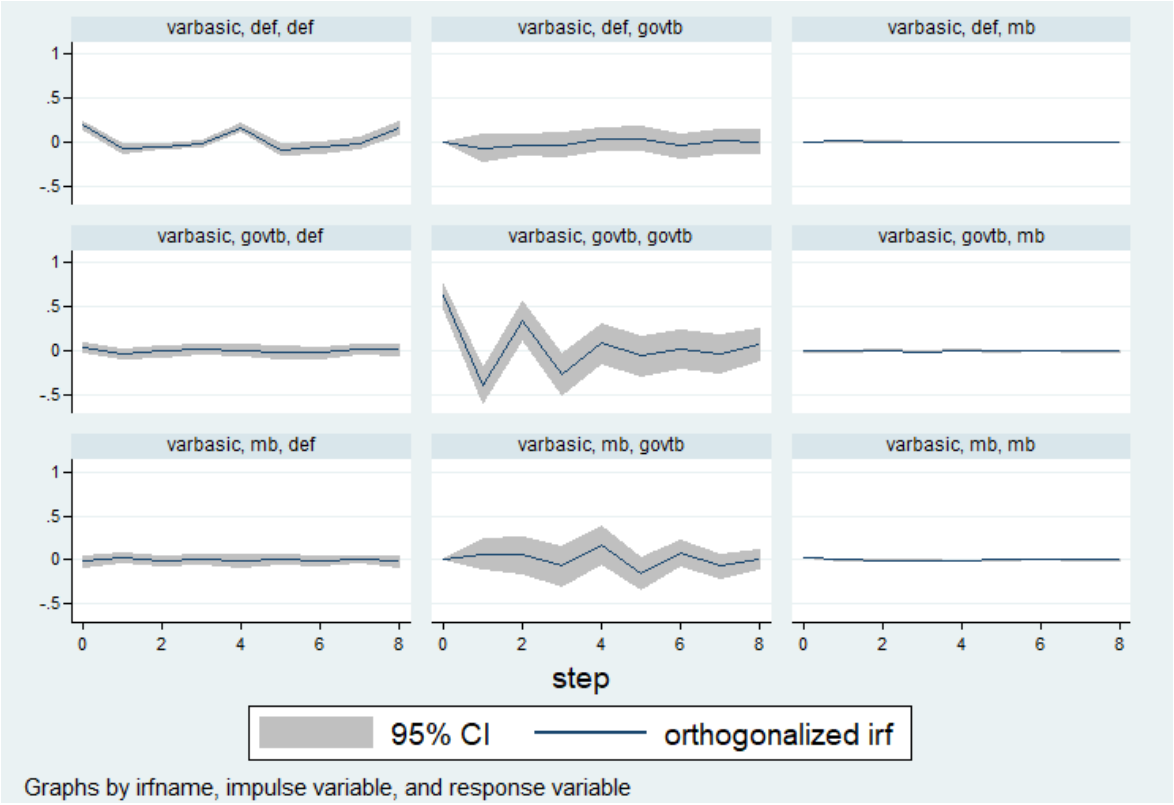

Fig. 5. **Orthogonalized impulse-response function for the following variables: budget deficit, government securities, monetary base**

Source: calculated by the authors.

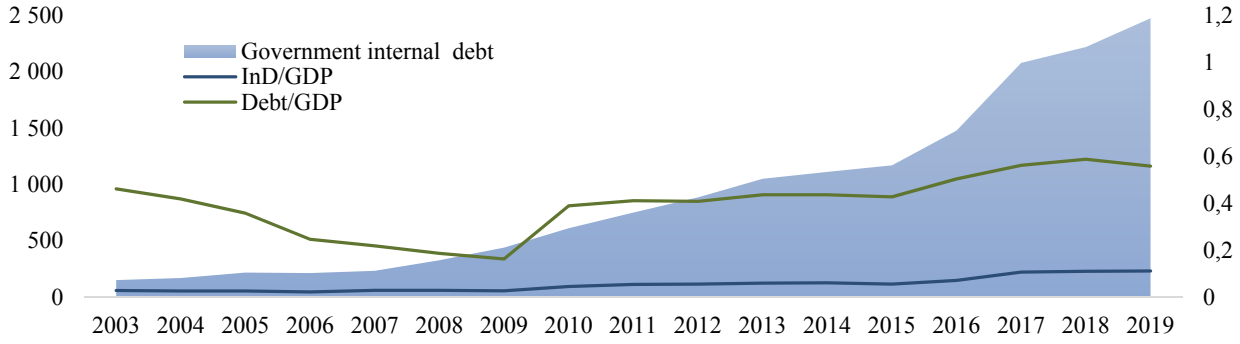

Fig. 6. **Government internal debt of the Republic of Armenia, billion AMD**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020) and also calculated by the authors.

Equation 17 is disclosed in *Equation 17*:

Equation 17

$$RGDP_t = \gamma_1 + \gamma_2 TGEP_{t-1} + \gamma_3 INFR_{t-1} + \gamma_4 EXCH_{t-1} + \\ + \gamma_5 MSPL_{t-1} + \gamma_6 RGDP_{t-1} + V_1,$$

$$TGEP_t = \theta_1 + \theta_2 TGEP_{t-1} + \theta_3 INFR_{t-1} + \theta_4 EXCH_{t-1} + \\ + \theta_5 MSPL_{t-1} + \theta_6 RGDP_{t-}1 + V_2,$$

$$INFR_t = \alpha_1 + \alpha_2 TGEP_{t-1} + \alpha_3 INFR_{t-1} + \alpha_4 EXCH_{t-1} + \\ + \alpha_5 MSPL_{t-1} + \alpha_6 RGDP_{t-1} + V_3,$$

$$EXCH_t = \beta_1 + \beta_2 TGEP_{t-1} + \beta_3 INFR_{t-1} + \beta_4 EXCH_{t-1} + \\ + \beta_5 MSPL_{t-1} + \beta_6 RGDP_{t-1} + V_4,$$

$$MSPL_t = \sigma_1 + \sigma_2 TGEP_{t-1} + \sigma_3 INFR_{t-1} + \sigma_4 EXCH_{t-1} + \\ + \sigma_5 MSPL_{t-1} + \sigma_6 RGDP_{t-1} + V_5,$$

where $\gamma_1 - \gamma_5$, $\theta_1 - \theta_5$, $\alpha_1 - \alpha_5$, $\beta_1 - \beta_5$ and $\sigma_1 - \sigma_5$ are the parameters to be estimated.

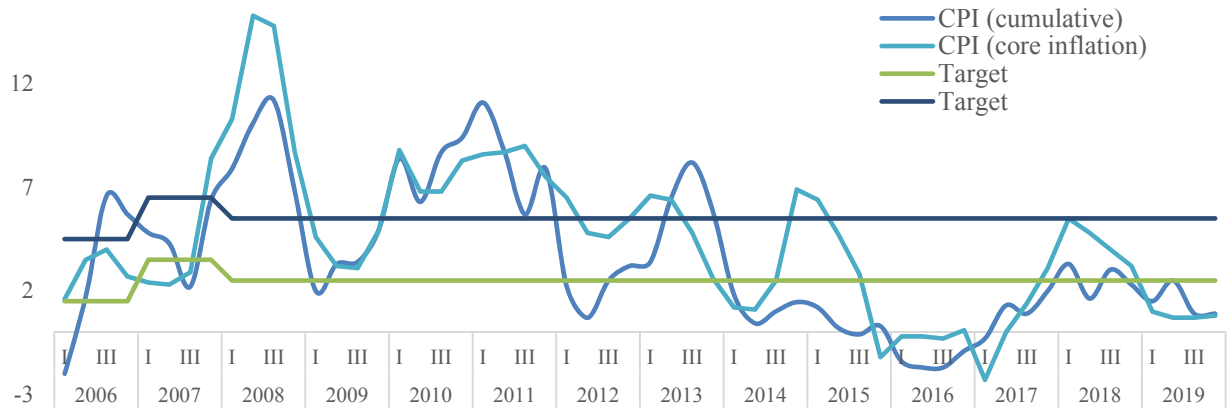

Fig. 7. **CPI and Central Bank of Armenia monetary policy target, quarterly, %**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020).

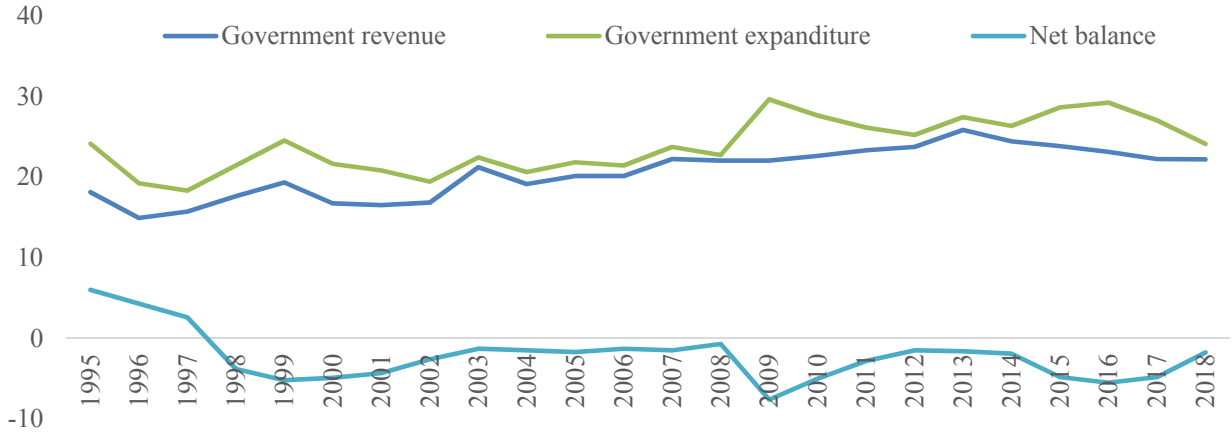

Fig. 8. **State budget of the Republic of Armenia, % of GDP**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

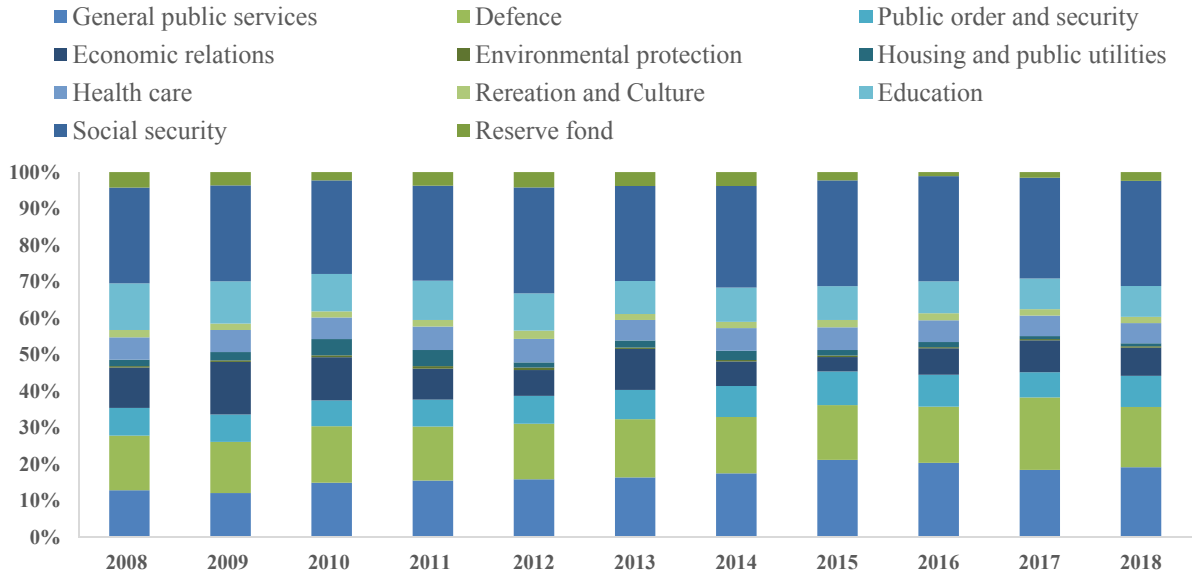

Fig. 9. **State budget expenditure structure of Armenia**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

The data were converted to stationary and normal distributions and a VAR model was built. The resulting model was considered by the authors both holistically and by individual regressions. Finally, the authors built a table of the impulse-response function, which made it possible to assess the influence of two separate indicators on each other.

• *Testing the model of connection between public expenditure and inflation for Armenia*

We used the following data to build the model for Armenian economy: quarterly data on the exchange rate (exr), government expenditure (exp), inflation in the form of CPI (inf), money supply (m2) and real GDP (rgdp) from the first quarter of 2003 to the third quarter of 2019. Then, we calculated the differences between logarithms of this data, and checked them for stationarity by means of Dickie-Fuller test (*Appendix, Table 6*). We normalized time series (*Appendix, Table 7*). We then calculated the order criterion for the model (*Appendix, Table 8*). Thus, the third order was concluded to be the best choice for the model. The model produced the following points:

• government expenditure is affected by government expenditure itself with lags of 1, 2 and 3, and is affected negatively, which is logical, because if in one quarter the authorities spend more money from the state budget, then in the next quarter they should cut their spending;

• the impact of exchange-rate volatility on government expenditure is also negative, if the dram to the dollar becomes more expensive, then government expenditure increases with the first lag;

• inflation is influenced positively by inflation itself, exchange rate volatility and changes in the money supply with the third lag;

• exchange rate volatility is affected positively, only by the exchange rate itself, with the first lag. The money supply is also affected by exchange-rate volatility with one lag, but negatively;

• real GDP is affected negatively, only by the real GDP itself through one lag (quarter).

The analysis of the impulse-response function (*Fig. 10*) and the orthogonalized impulse-response function (*Fig. 11*) showed that internal shocks are strongly responded by government expenditure (they respond to shock from government expenditure itself, exchange rates, inflation and money supply), real GDP (responds to shocks from exchange rate, inflation, money supply and real GDP itself), but the inflation response to changes in government expenditure is rather small. The response of the indicators to external shocks almost coincides with the response to internal shocks, except government expenditure, which responds more to changes in real GDP than to changes in prices. The most significant factors for real GDP were exchange rate volatility inflation and exogenous changes in GDP itself.

The analysis showed that inflation does not react to internal and external shocks, which means that it is not subject to market mechanisms, but the high concentration in the market of goods in Armenia, as well as the active intervention of the Central Bank of Armenia in the currency market, as detailed in our previous studies. The analysis also supports this point, evidently indicating that the exchange rate of the national currency did not respond to any internal or external shocks included in the regression analysis, which may be due to non-market mechanisms of exchange rate formation of the dram and active currency regulation by monetary authorities of Armenia.

Finally, when examining GDP growth, GDP deflator and CPI, it can be seen that GDP growth is in most cases higher than GDP deflator growth, which in fact does not reflect either inflationary GDP growth or low consumption growth, where supply exceeds demand (*Fig. 12*). This dynamics reflects the lack of economic efficiency.

The developed model points to the ineffectiveness of monetary regulation within inflation targeting in Armenia, since monetary regulation aims at the fiscal objective of controlling the growth of state budget expenditures along with price level instability.

Fiscal dominance: public debt and exchange rate

Finally, the most notorious stumbling block between fiscal and monetary policy is the problem of public debt. While in theory this problem is being addressed by the Central Bank lending money to the government, in practice many countries use exchange-rate mechanisms.

As mentioned above, Armenia is pursuing an inflation targeting policy that assumes a freely floating exchange rate of the national currency. According to the Law of RA "On Currency Regulation and Currency Control",[2] as well as the IMF[3] classification, Armenia is included in the group

[2] Cf The Law of RA on Currency Regulation and Currency Control. URL: http://www.parliament.am/legislation.php?sel=show&ID=2140&lang=eng (accessed on 05.05.2020).

[3] CF Annual Report on Exchange Arrangements and Exchange Restrictions 2018; International Monetary Fund. Monetary and

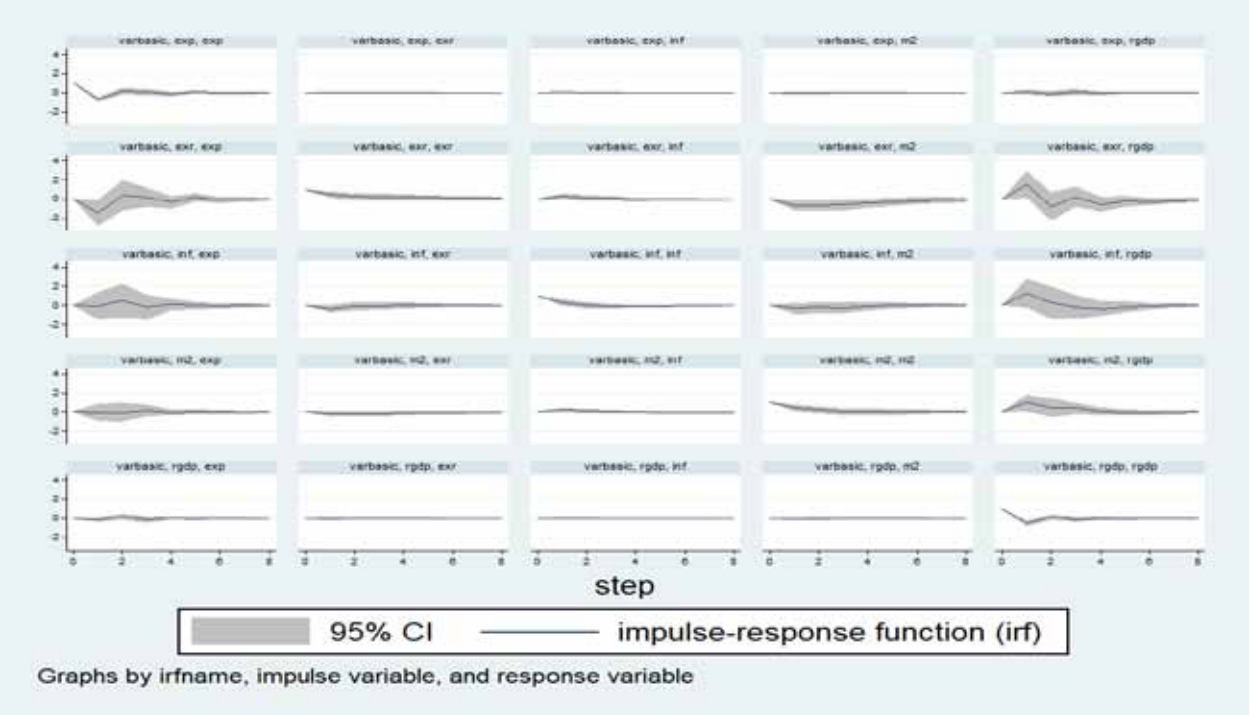

Fig. 10. **Impulse-response function for the following variables: government expenditure, exchange rate, inflation, money supply, real GDP**

Source: calculated by the authors.

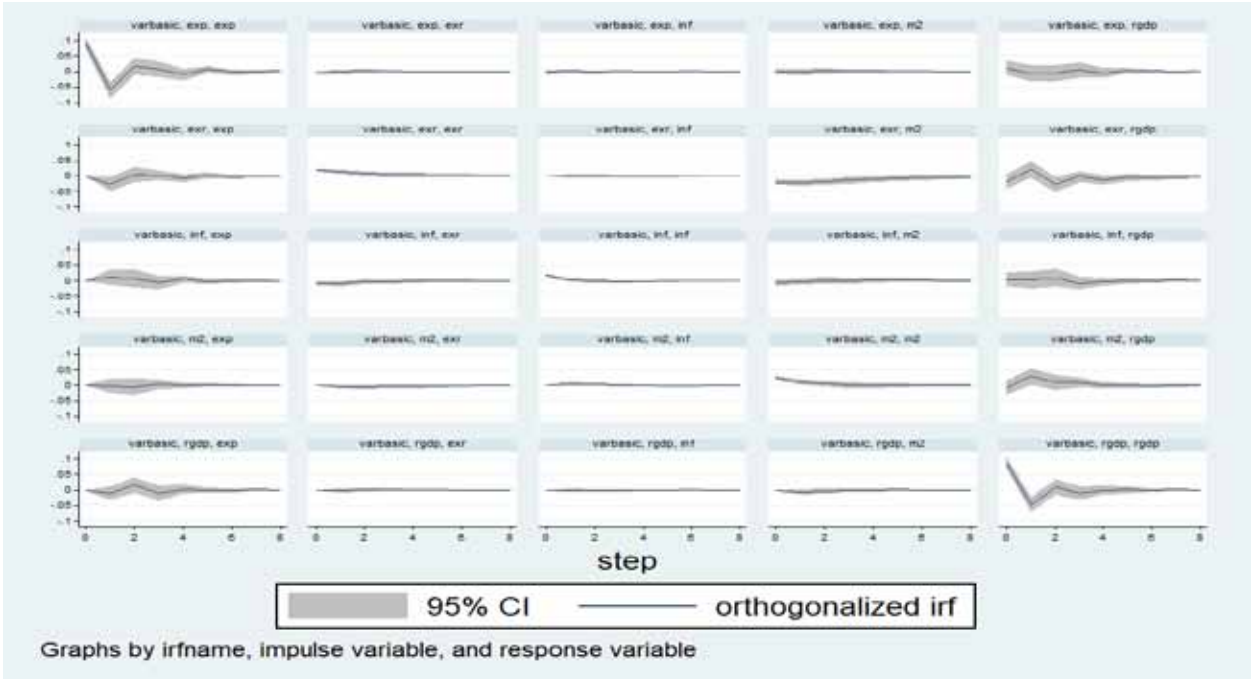

Fig. 11. **Orthogonalized impulse-response function for the following variables: government expenditure, exchange rate, inflation, money supply, real GDP**

Source: calculated by the authors.

Fig. 12. **Growth of GDP, CPI and GDP deflator, annual, in %**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020) and also calculated by the authors.

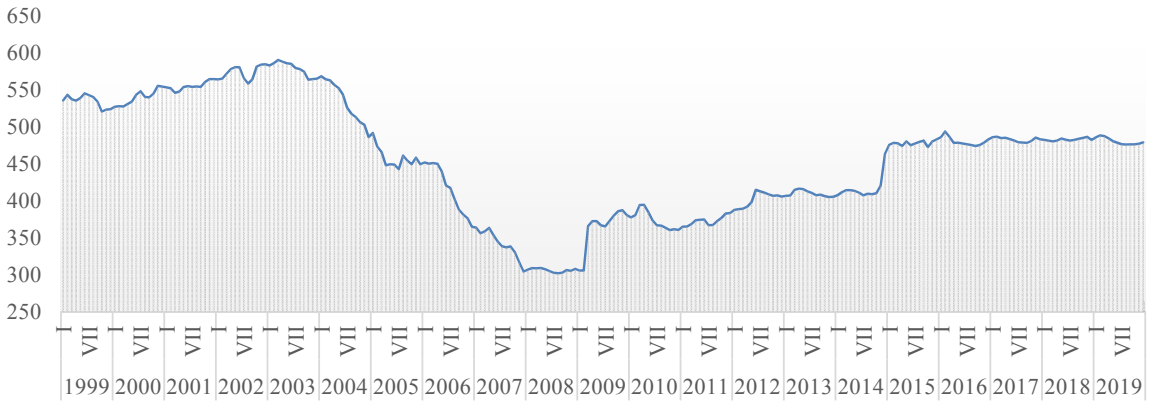

Fig. 13. **Dynamics of USD\AMD rate in Armenia, monthly**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020).

with a regulated free floating rate. In addition, the Law notes the possibility of the Central Bank's intervention in the foreign exchange market, in case it is necessary to achieve the goals of monetary regulation.

The assessment of foreign exchange regulation in Armenia testifies to the active intervention of the Central Bank in the foreign exchange market and in the formation of the dram exchange rate. *Figure 13* shows the dynamics of the exchange rate by month. Despite significant external and internal shocks for the economy, the AMD exchange rate has demonstrated stable volatility over the past few years [19]. Many of our researches prove that such stability has been and is currently ensured by efforts of monetary authorities [20]. The analysis of the formation factors of the exchange rate indicates a rather low participation of market factors in this process, while the role of monetary authorities is big [21, 22].

Maintaining the exchange rate at a certain point aims at several objectives. Among the most significant are the maintenance of prices and the resolution of the public debt problem.

As we can see in *Fig. 14*, Armenia's external debt amounts to almost $ 12 billion and is equivalent to above 85% of GDP. More than half of the debt is in the government sector.

As of 2018, the share of total government debt in GDP was 55.7%, including 44.5% of external debt and 11.2% of domestic debt (*Fig. 15*). According to the Fig., over the past 10 years, Armenia's total public debt has increased

Capital Markets Department, April, 2019. URL: https://www.imf.org/en/Publications/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions/Issues/2019/04/24/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions-2018–46162 (accessed on 12.05.2020).

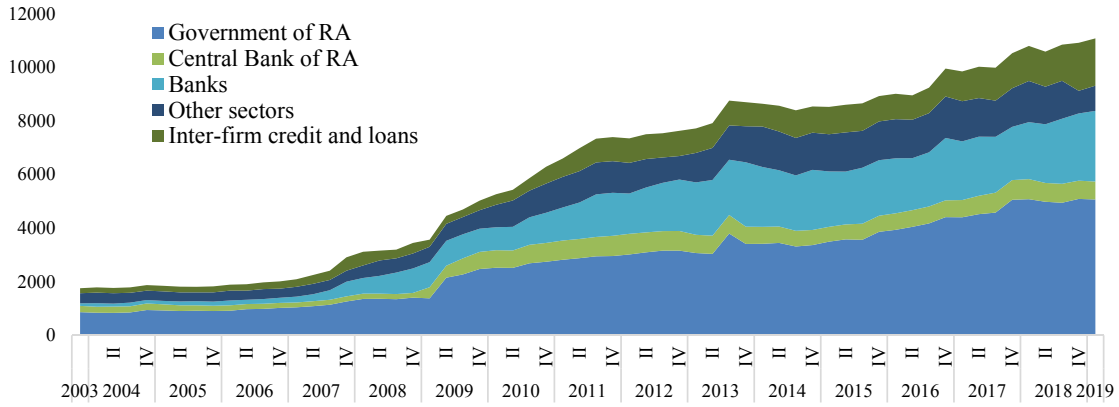

Fig. 14. **Gross external debt of RA, million USD**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

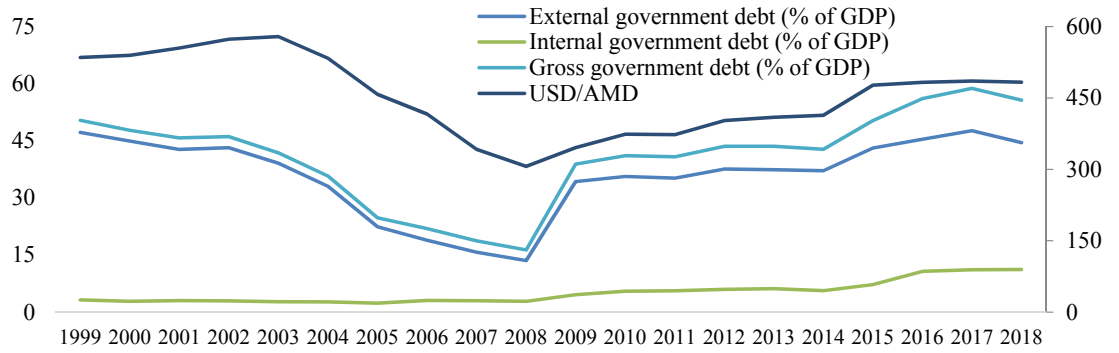

Fig. 15. **Government debt of RA (in % of GDP) and exchange rate of AMD**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

twice: after 2008 and 2014. Both periods were caused by external shocks, which had a negative impact on the macroeconomic situation in Armenia and demanded an increase in the country's external debt to offset the loss of economic growth. Since the end of 2014, the Armenian government has been actively raising domestic debt obligations.

The problem of Armenia's high government debt is obvious and certainly requires both regulation and solution. Monetary policy is actively involved in solving this problem now. If the Central Bank of Armenia stimulated the investment of the financial system in government securities by the Armenian government, using supervisory functions on the part of the internal debt, then, in our opinion, it is pursuing a policy of gimmicks on the external debt to maintain the exchange rate at a stable level, conceived to the detriment of the country's export positions and the competitiveness of the domestic product in foreign markets, including the EAEU market. In this regard, a model of the relationship between the public debt and the exchange rate of the national currency in order to identify this relationship in the Armenian economy is presented below.

- *Methodology: Characteristics of the model of the relationship between public debt and the exchange rate*

In order to identify the dependence of exchange rate volatility in a country's government debt, we propose the following model: a country with a similar structure and internal and external shock to the economy was selected as a benchmark. The choice was also based on the implementation of inflation targeting policies in the context of a regulated floating exchange rate. In addition, the country's trade route options as well as the structure of GDP were included in the country's selection criteria. Based on the above criteria, we chose the Hungarian economy to build the basic model, which applies inflation targeting in a floating exchange rate framework,[4] has no access to the

[4] Cf. Annual Report on Exchange Arrangements and Exchange Restrictions 2018; International Monetary Fund. Monetary and Capital Markets Department. April, 2019. URL: https://www.imf.org/en/Publications/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions/Issues/2019/04/24/

Table 7

Correlation between variables

```
. corr exr ml cpi exp imp gdp debt
(obs=86)
```

	exr	ml	cpi	exp	imp	gdp	debt
exr	1.0000						
ml	-0.0480	1.0000					
cpi	-0.1722	-0.2795	1.0000				
exp	0.2262	-0.0077	0.0594	1.0000			
imp	0.2586	-0.0375	0.0654	0.8410	1.0000		
gdp	0.1382	0.0509	-0.0398	0.2172	0.2775	1.0000	
debt	-0.6851	0.1393	0.0794	-0.0060	0.0019	-0.1565	1.0000

Table 8

Regression model with the dependent variable of exchange rate

```
. reg exr cpi imp debt
```

Source	SS	df	MS	Number of obs	=	86
				F(3, 82)	=	34.13
Model	.131414091	3	.043804697	Prob > F	=	0.0000
Residual	.105242774	82	.001283448	R-squared	=	0.5553
				Adj R-squared	=	0.5390
Total	.236656865	85	.002784198	Root MSE	=	.03583

exr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cpi	-.0073885	.0040153	-1.84	0.069	-.0153762	.0005991
imp	.3160456	.0867879	3.64	0.000	.1433969	.4886944
debt	-.5016812	.0549219	-9.13	0.000	-.6109383	-.3924241
_cons	.0071809	.0046241	1.55	0.124	-.0020178	.0163797

Table 9

Heteroskedasticity and omitted variables test

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of exr

         chi2(1)      =     0.15
         Prob > chi2  =   0.7007

. estat ovtest

Ramsey RESET test using powers of the fitted values of exr
       Ho:  model has no omitted variables
                  F(3, 79) =      1.02
                  Prob > F =      0.3886
```

sea and two major industries are metallurgy and textiles. Based on the analysis of monetary and exchange rate policy in Hungary, a model was built that describes the relationship between the country's public debt and the volatility of exchange rates of national units.

To build the currency volatility, we used quarterly data from the first quarter of 1998 to the third quarter of 2019 on the following indicators: GDP, M1 cash aggregate (cash + demand deposits), inflation (CPI), exchange rate, export and import, and government debt. The data have been seasonally cleared, differences between logarithms of current and previous periods have been calculated and then the data have been normalized (*Appendix, Table 9*).

First, we tested the correlation between variables to avoid the multicollinearity. The highest correlation is between imports and GDP, imports and exports, inflation and money supply (*Table 7*). Since the exchange rate is more closely correlated with imports than with export or GDP, we decided to keep imports, monetary inflation and inflation rate in the model along the same lines.

We built a regression model with the remaining variables (*Table 8*).

Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions-2018–46162 (accessed on 18.03.2020).

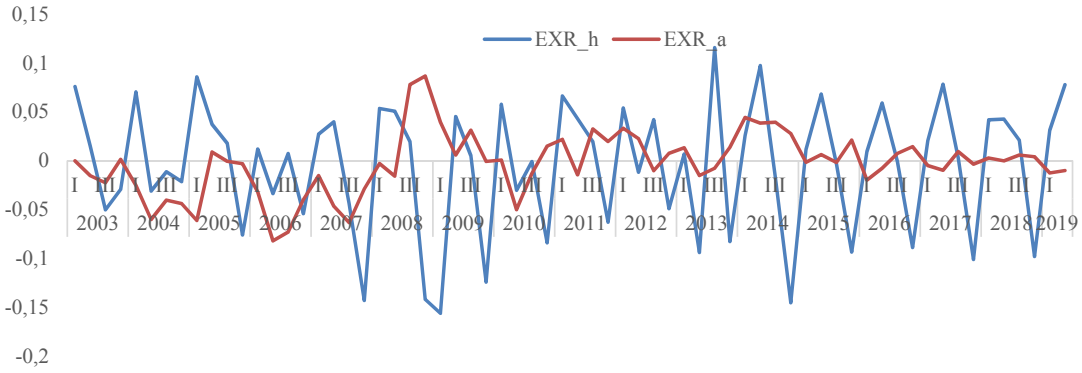

Fig. 16. **Volatility of real exchange rate of the dram and exchange rate of the dram on the model examined**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020) and also calculated by the authors.

The model is acceptable ($R^2 = 0.5552$), which means that exchange rate volatility is explained by data variables with probability more than 50%. To validate the model, we tested the model for heteroscedasticity (Breusch-Pagan test) and lack of significant variables (Ramsey test) in addition to lack of multicollinearity. The test results made us conclude that there is no heteroskedasticity and that there are no significant variables omitted (*Table 9*).

The model was adopted for testing in the Armenian economy.

- *Testing the model of connection between government debt and exchange rate for Armenia*

Exchange rate volatility equation for the Hungarian economy:

Equation 19

$$ExR = -0.0073885 * CPI + 0.3160456 * Imp - \\ - 0.5016812 * Debt.$$

Using *Equation 19*, we analyzed and assessed the impact of government debt on the exchange rate of the dram.

Figure 16 shows the analysis of the movement of the exchange rate using the formula and the real exchange rate. The data used in the model does not have a seasonality factor, and each variable is the difference between the current and the previous period of the logarithms (all variables except the CPI) of the variable values. The volatility of the dram exchange rate is also seasonally adjusted. We conclude that the exchange rate volatility of the Hungarian forint against the US dollar (Exr_h) is not similar to the exchange rate volatility of the dram against the US dollar (Exr_a). Thus, the Armenian exchange rate is not regulated by the same regime as the Hungarian exchange rate, even if both Armenia and Hungary have a floating exchange rate regime. Thus, the volatility of the dram is due to non-market factors, which indicates the intervention of the Central Bank of Armenia in the foreign exchange market of Armenia.

In addition to meeting the targets, non-market interference shows that monetary authorities also indirectly engage in fiscal regulation to keep external debt at a certain level.

CONCLUSION

Fiscal dominance in the Armenian economy is clearly present to some extent. For sure, monetary policy aims to achieve stable prices in the country. However, the target chosen greatly facilitates the adoption of regulatory instruments, and the intended target directly solves the problems of fiscal policy.

The developed models have proved that all three mechanisms of fiscal dominance are used in monetary regulation by the Central Bank of Armenia. The most pronounced are fiscal expenditure, as well as external government debt. Clearly, the priority of these objectives in macroeconomic regulation requires fiscal dominance. However, given the negative consequences for economic growth and well-being of the population in the long term, we believe that the chosen approach in the country's macroeconomic policy should be revised.

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APPENDIX

Table 1

Test of the data distributions

```
. swilk def govtb mb

                    Shapiro-Wilk W test for normal data

    Variable |   Obs        W          V          z       Prob>z
-------------+--------------------------------------------------
         def |    46    0.95378      2.036      1.509    0.06566
       govtb |    46    0.97535      1.086      0.175    0.43060
          mb |    46    0.95687      1.900      1.362    0.08661

. sfrancia def govtb mb

                  Shapiro-Francia W' test for normal data

    Variable |   Obs        W'         V'         z       Prob>z
-------------+--------------------------------------------------
         def |    46    0.95331      2.279      1.549    0.06067
       govtb |    46    0.98382      0.790     -0.443    0.67128
          mb |    46    0.96528      1.695      0.992    0.16058
```

Table 2

Test of stationarity

```
. dfuller def

Dickey-Fuller test for unit root                   Number of obs   =        45

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical     10% Critical
                 Statistic           Value             Value           Value
------------------------------------------------------------------------------
 Z(t)             -9.273             -3.614            -2.944          -2.606
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller govtb

Dickey-Fuller test for unit root                   Number of obs   =        45

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical     10% Critical
                 Statistic           Value             Value           Value
------------------------------------------------------------------------------
 Z(t)            -14.971             -3.614            -2.944          -2.606
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller mb

Dickey-Fuller test for unit root                   Number of obs   =        45

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical     10% Critical
                 Statistic           Value             Value           Value
------------------------------------------------------------------------------
 Z(t)             -5.821             -3.614            -2.944          -2.606
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

Table 3

Selection-order criteria test

```
. varsoc mb gov

Selection-order criteria
Sample:  2009q1 - 2019q2                        Number of obs      =        42

+---------------------------------------------------------------------------+
| lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC   |
|-----+---------------------------------------------------------------------|
|  0  |  20.454                        .001424  -.87876  -.84843  -.796013  |
|  1  | 37.6232  34.339    4  0.000   .000761* -1.50587* -1.41488* -1.25763* |
|  2  | 39.1357  3.0249    4  0.554   .000858  -1.38741  -1.23576  -.973682  |
|  3  | 44.3148  10.358*   4  0.035   .000814  -1.44356  -1.23126  -.864341  |
|  4  | 48.4244  8.2191    4  0.084   .000816  -1.44878  -1.17581  -.704065  |
+---------------------------------------------------------------------------+
Endogenous:  mb govtb
 Exogenous:  _cons
```

Table 4

Selection-order criteria test

. varsoc gov def

Selection-order criteria
Sample: 2009q1 - 2019q2 Number of obs = 42

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-82.9472				.195806	4.0451	4.07543	4.12785
1	-66.5337	32.827	4	0.000	.10847	3.45398	3.54497	3.70222
2	-61.4151	10.237	4	0.037	.103027	3.40072	3.55237	3.81445
3	-39.6354	43.56	4	0.000	.04436	2.55406	2.76637	3.13329
4	-31.9047	15.461*	4	0.004	.037409*	2.37641*	2.64938*	3.12113*

Table 5

Selection-order criteria test

. varsoc mb def

Selection-order criteria
Sample: 2009q1 - 2019q2 Number of obs = 42

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	52.1963				.000314	-2.3903	-2.35997	-2.30755
1	55.2431	6.0937	4	0.192	.000329	-2.34491	-2.25392	-2.09667
2	60.3691	10.252	4	0.036	.000312	-2.39853	-2.24688	-1.9848
3	85.427	50.116	4	0.000	.000115	-3.40129	-3.18898	-2.82206
4	95.5631	20.272*	4	0.000	.000086*	-3.69348*	-3.42052*	-2.94877*

Table 6

Testing variables for stationarity

. dfuller exp

Dickey-Fuller test for unit root Number of obs = 65

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-14.171	-3.559	-2.918	-2.594

MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller inf

Dickey-Fuller test for unit root Number of obs = 65

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-6.820	-3.559	-2.918	-2.594

MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller exr

Dickey-Fuller test for unit root Number of obs = 65

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.547	-3.559	-2.918	-2.594

MacKinnon approximate p-value for Z(t) = 0.0069

. dfuller m2

Dickey-Fuller test for unit root Number of obs = 65

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.448	-3.559	-2.918	-2.594

MacKinnon approximate p-value for Z(t) = 0.0094

. dfuller rgdp

Dickey-Fuller test for unit root Number of obs = 65

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-11.780	-3.559	-2.918	-2.594

MacKinnon approximate p-value for Z(t) = 0.0000

Table 7

Test of the data distribution

. swilk exp inf exr m2 rgdp

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
exp	66	0.98052	1.144	0.291	0.38566
inf	66	0.98633	0.802	-0.478	0.68368
exr	66	0.96917	1.809	1.285	0.09940
m2	66	0.96852	1.847	1.330	0.09174
rgdp	66	0.96579	2.007	1.510	0.06547

. sfrancia exp inf exr m2 rgdp

Shapiro-Francia W' test for normal data

Variable	Obs	W'	V'	z	Prob>z
exp	66	0.97334	1.731	1.056	0.14558
inf	66	0.99057	0.612	-0.944	0.82744
exr	66	0.96799	2.078	1.408	0.07962
m2	66	0.96735	2.120	1.446	0.07412
rgdp	66	0.97219	1.805	1.137	0.12784

Table 8

Selection-order criteria test

. varsoc exp inf exr m2 rgdp

Selection-order criteria
Sample: 2004q1 - 2019q2 Number of obs = 62

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	496.932				8.0e-14	-15.8688	-15.8014	-15.6972
1	563.724	133.59	25	0.000	2.3e-14*	-17.2169*	-16.8128*	-16.1876*
2	577.237	27.026	25	0.355	3.4e-14	-16.8464	-16.1055	-14.9594
3	593.031	31.588	25	0.170	4.7e-14	-16.5494	-15.4717	-13.8047
4	619.027	51.992*	25	0.001	5.0e-14	-16.5815	-15.1671	-12.9791

Endogenous: exp inf exr m2 rgdp
Exogenous: _cons

Table 9

Test of the data distribution

```
. swilk ml cpi exr exp imp gdp debt

                    Shapiro-Wilk W test for normal data
```

Variable	Obs	W	V	z	Prob>z
ml	86	0.97358	1.924	1.440	0.07491
cpi	86	0.98465	1.118	0.246	0.40294
exr	86	0.99031	0.706	-0.766	0.77816
exp	86	0.97602	1.747	1.227	0.10984
imp	86	0.98240	1.282	0.546	0.29242
gdp	86	0.97735	1.650	1.101	0.13535
debt	86	0.97960	1.486	0.871	0.19182

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Developing Credit Risk Assessment Methods to Make Loss Provisions for Potential Loans

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ABSTRACT

According to Bank of Russia Regulation No. 590-P dated June 28, 2017, Russian banks assess credit risk and make loss provisions for potential loans. Since 01.01.2018, credit institutions have been required to create loss provisions for expected losses in accordance with international standards (IFRS 9). This **novation** seems relevant due to the lack of a common risk assessment method and the importance of cost optimization on loan provisions. **The aim** of the study is to improve the credit risk assessment method for making loss provisions for potential loans. The author used the **methods** of system and logical analysis and synthesis, techniques of high financial calculations, the balance method, the method of financial ratios. When estimating the probability of borrowers' default, potential credit losses and loan provisions, the author applied actuarial, market, statistical and econometric methods. Based on a Russian bank's sample data for 2012–2019, the author developed a regression model that establishes the relationship between financial ratios and the default of corporate borrowers — agricultural producers, and checked the significance of the model's financial ratios. The author divided the borrowers into rating groups by score. The probability of default is the ratio of the number of defaults to the number of borrowers by group. The average default loss for each group depends on the collection / debt ratio in the bank under review. The score of a borrower brings them into a certain rating group, helps calculate the probability of a default and losses in case of default. The calculated expected losses may be of further use when determining loss provisions for potential loans. The author concludes that this method allows assessing risks and making a decision on lending to borrowers — agricultural producers. The expected credit loss approach will allow for more reasonable provisioning, which corresponds to other authors' findings. Applying this method in a particular bank requires considering the specifics of the composition and structure of the loan portfolio. It is necessary to analyze the impact of the expected credit loss method on the profitability of banks.

Keywords: financial condition; credit risk; actual losses; financial ratios; expected credit losses; loss provisions for potential loans

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INTRODUCTION

Lending to corporate borrowers is associated with credit risk factors that may lead to potential loan losses. To reduce the risk, banks create loss provisions for potential loans, loan and similar debt (the principal debt),[1] as well as provisions for potential losses (interest, commissions, penalties, state duty) in accordance with the Bank of Russia regulations.[2] Provisions are made in accordance with Russian requirements by the method of actually incurred losses. To determine provisions, the loan category with collateral is also considered, since this factor minimizes the created provisions.

Banks can assess risks and create provisions based on incurred losses in two ways: individually (for each specific loan) or on a portfolio of homogeneous loans. With an individual approach, provisions are created based on the loan quality. Loans are classified by quality according to the financial condition of the borrower and the quality of debt service. In case of portfolio provisioning, portfolios of homogeneous loans with similar characteristics of credit risk are created, which meet certain requirements and are isolated to make provisions.

According to IFRS 9, since 01.01.2018, simultaneously with creating provisions by Russian standards, commercial banks have been calculating provisions based on expected losses.[3] *Table 1* presents the main differences in approaches to creating provisions by the method of incurred losses and expected credit losses.

Under IFRS 9, provisions are created in three stages depending on changes in credit risk. *Stage 1* — Expected credit losses are calculated within 12 months after the reporting date. *Stage 2* — A significant increase in the credit risk of a financial asset, for example, a decrease in collateral value, more than 30 days of delay, unfavorable changes in business, etc. *Stage 3* — A financial asset becomes objectively impaired; there is a real credit loss due to events that negatively affect the receipt of future cash flows (overdue more than 90 days, probable bankruptcy, or default). For *Stages 2* and *3*, expected credit losses are recognized over the life of the financial instrument.

Expected credit losses at the reporting date are determined as follows:

1) for financial assets at *Stages 1* and *2* — as the present value of all expected not received funds or the difference between the cash flows owed to the bank under the agreement and the cash flows that the bank expects to receive, formulas (1), (2);

2) for financial assets at *Stage 3* — as the difference between the gross carrying amount of assets and the present value of estimated future cash flows, formula (3):

$$\text{Provision}_{\text{stage1}} = PD * LGD * EAD, \quad (1)$$

$$\text{Provision}_{\text{stage2}} = LGD * \sum PD_k * CF_k/(1+i)^k, \quad (2)$$

$$\text{Provision}_{\text{stage3}} = LGD_{\text{in default}} * EAD, \quad (3)$$

where *PD* is the probability of default (determined based on statistical models or available market data);

LGD is the loss given default (share of losses in the default amount): the indicator can be estimated by modeling expected cash flows, regression on historical data or based on market prices of non-problematic loans;

EAD is the exposure at default, debt at the reporting date subject to the risk of impairment (the default amount); calculated separately for each financial asset;

i is the effective interest rate;

[1] Bank of Russia Regulation No. 590-P, dated 28 June 2017, "On the Procedure for Credit Institutions to Make Loss Provisions for Loans, Loan and Similar Debts": [together with the "Procedure for Assessing Credit Risk of Portfolio (Portfolios) of Homogeneous Loans"]: (registered in the Ministry of Justice of Russia on 12 July 2017 No. 47384). URL: http://www.consultant.ru/document/cons_doc_LAW_220089/ (accessed on 10.10.2020).

[2] Bank of Russia Regulation No. 611-P, dated 23.10.2017, "On the Procedure for Creating Loss Provisions by Credit Institutions": (registered in the Ministry of Justice of Russia on 15 March 2018 No. 50381). URL: http://docs.cntd.ru/document/542611725(accessed on 10.10.2020).

[3] International Financial Reporting Standard (IFRS) 9 Financial Instruments principles (came into effect in the Russian Federation in accordance the Ministry of Finance Order No. 98n, dated 27 June, 2016). URL: http://www.consultant.ru/document/cons_doc_LAW_202060/(accessed on 10.10.2020).

CF_k is the cash flow generated by the financial instrument.

To calculate expected credit losses for each loan agreement, it is necessary to know the probability of default, the loss given default and the exposure at default.

Based on IFRS 9, the Bank of Russia, has developed recommendations for commercial banks for calculation of credit risk by internal ratings,[4] as well as on accounting for provisions.[5] Under the Basel Agreements and the Bank of Russia recommendations, commercial banks create their own methods for assessing credit risk and provisions [1].

M. M. Selezneva, D. V. Novoselov, V. A. Pozdyshev, O. V. Oboznaya and others note the positive result of the transition of Russian banks to a new model of creating provisions, which consists in a more accurate and advanced risk assessment [2–5]. V. Bityutskii, G. Penikas, E. Mikheeva and G. Holt predict the need to increase provisions for most banks [6–8]. O. Yu. Yakovlev and Yu. M. Porozova emphasize that the new approach does not allow banks to underestimate the amount of provisions to improve their financial condition in the reporting by overstating the financial position of borrowers [9, 10].

Famous Russian and foreign rating agencies Fitch Ratings, AKRA and others indicate that the approach based on expected credit losses causes an adjustment in the profitability of Russian banks, namely, its decrease.[6]

M. Vlasenko, A. Tkachev and other authors believe that creating the expected credit loss model should be based on the large amounts of information available to commercial banks [11, 12]. The main criterion for the model adequacy can be the compliance of its assessments with the bank requirements for borrowers.

The above emphasizes the importance of the cost optimization on provisions by the expected credit loss method, especially with no generally accepted method for calculating the probability of default and the loss given default. In this regard, it is relevant to study the method for calculating credit risks in accordance with the approach based on expected losses. The aim of the study is to improve the credit risk assessment method for making loss provisions for potential loans.

RESEARCH METHODS

We plan to assess the expected credit loss risk by the following algorithm:

1) segmentation of corporate borrowers by industry, business size and other parameters. An example of segmentation is dividing borrowers into two groups based on the industry and seasonality of activity: agribusiness enterprises and non- agribusiness enterprises. Moreover, each group should include potential bankrupts and non-bankrupts;

2) sampling enterprises from a specific segment within the framework of a regional or national market;

3) preparing initial data (financial ratios) for each enterprise from the sample (preferably for five annual dates preceding the date of the analysis);

4) calculating financial ratios, which are independent variables, in the following areas of

[4] Bank of Russia Ordinance No. 483-P, Dated 6 August 2015, 'On the Procedure for the IRB Calculation of Credit Risk". Bank of Russia Bulletin. 2015 No. 81 as amended on 01.12.2015.

[5] Bank of Russia Regulation No. 605-P, Dated 2 October 2017, "On the Procedure for Credit Institutions to Account Transactions to Place Funds under Loan Agreements, Transactions to Purchase Receivables from Third Parties Related to the Performance of Cash Liabilities, Transactions Related to Liabilities under Bank Guarantees Issued and Funds Provision" (as amended by the instructions of the Central Bank of the Russian Federation dated June 21, 2018 No. 4827-U, dated December 18, 2018 No. 5017-U).

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Table 1

Approaches to creating loss provisions

Approach	Actual Loss Model	Expected Credit Loss Model
Calculation of provisions	Difference between the carrying loan value and the fair value	Lost funds considering the probability of the borrower's default within one year
Probability of default (PD)	Determined indirectly by the loan category	Within one year or throughout the entire term of the financial instrument, depending on the risk
Default detection	Signs of impairment	The bank's internal policy on credit risk management, including the rebuttable assumption of a delay of 90 days
Loss given default (LGD)	Determined indirectly by the loan category	Basel estimates, subject to the exclusion of certain components
Exposure at default (EAD)	Determined indirectly by the loan category with collateral	Analysis for the entire life of a financial instrument
Expected Losses (EL)	Determined indirectly by the loan category with collateral	Losses within one year or throughout the entire life of a financial instrument in case of an increase in credit risk

Source: compiled by the author.

analysis: profitability, liquidity, solvency, and turnover. Assigning a specific weight to each coefficient by expert means, based on the influence on the financial condition and the probability of default;

5) determining non-financial indicators related to industry prospects, competition, seasonality, market position (usually about 20 indicators); assigning a specific weight to each indicator depending on the influence on the probability of default (we did not use non-financial indicators to assess the probability of default due to the lack of relevant information and the complexity of an objective assessment);

6) determining the maximum score for each financial coefficient based on the weight, formation of intervals of values, assigning points for each interval;

7) establishing a statistical relationship between the values of financial ratios and a borrower's default;

8) calculating points for each borrower, classifying borrowers into rating groups based on their financial condition and ability to repay their obligations to creditors on time;

9) establishing the correspondence between the score for each borrower from the sample and the fact of default for the past year;

10) calculating the probability of default for each rating group as the proportion of the group's borrowers who defaulted during the year;

11) calculating the level of losses on default of the obligations of the borrower (4):

$$LGD = 1 - \frac{\text{Amount of debt repayment under the agreement}}{\text{Creditagreement amount}} \times 100\%. \quad (4)$$

The ratio of the amount of debt repayment to the credit agreement amount can be calculated according to the banking statistics of transactions of assignment (sale) of rights (claims) under credit agreements [indicator "recovery rate" ("collection/debt")]. In this case, the agreement price for the assignment of rights of claims is made up based on the value of the collateral and non-tax property, as well as the income and property of the guarantors. The indicator of the amount of debt assigned under the credit agreement is taken from the financial statements. It is necessary to calculate the *LGD* indicator for each rating group separately;

12) calculating the expected losses of the lender as the product of the probability of default, the level of losses in case of default and the amount of the credit exposed at default. Creating provisions for loss provisions for potential loans, loan and similar debt based on the indicator of expected losses.

RESEARCH RESULTS

We chose the agribusiness enterprises business segment for the study. The sample included 57 agricultural enterprises of the Samara region that are borrowers of the bank (for 24 of them, a default was recorded as of 01.01.2020). The main debt of the enterprises in the sample amounts to 5,798 million roubles, or 42% of the bank's corporate portfolio.

The following financial ratios were selected as independent variables: financial independence ratio K1, equity ratio K2, current liquidity ratio K3, quick liquidity ratio K4, net profit margin K5, current assets turnover K6, and debt/EBITDA K7. The dependent variable is the probability of default, which equals to 1 if the borrower does not fulfill its obligations to the bank, and it equals to 0 if there are no overdue obligations. We calculated the above indicators for each enterprise as of 01.01.2020.

We calculated the weight of the financial ratios using the expert judgment method; the maximum possible score is 100; we accepted scoring intervals (*Table 2*).

We corrected the initial data to obtain an objective result. We took the financial independence ratio with a negative value of equity capital equal to zero. *Table 3* presents the results.

There is a close relationship between financial ratios and the probability of default as of 01.01.2020. This is evidenced by the value of the multiple correlation coefficient Multiple R, equal to 0.93. The value of the determination coefficient Multiple R^2 is 0.87, i.e. the probability of default of an enterprise is 87% determined by the selected financial ratios; other changes depend on random factors. The other indicators (Adjusted R^2, Fisher criterion) meet the requirements. All financial ratios are significant, except the equity ratio due to the negative/or close to zero value of the indicator for many borrowers. The inverse relationship between the quick ratio and the probability of default is explained by the fact that extreme values of the indicator (large or small) are equally impractical, since they reflect low business efficiency and lost profit.

We built a linear multivariate regression model, where the dependent variable de-

Table 2

Financial position score

Ratio	Ratio values					
Financial independence ratio K1	K ⩾ 0.4	0.3 ⩽ K < 0.4	0.2 ⩽ K < 0.3	0.1 ⩽ K < 0.2	0.05 ⩽ K < 0.1	0.05 > K
Points	20	15	12	8	5	0
Equity ratio K2	K ⩾ 0.2	0.1 ⩽ K < 0.2	0.05 ⩽ K < 0.1	0.01 ⩽ K < 0.05	0 < K < 0.01	K ⩽ 0
Points	15	12	10	5	3	0
Current liquidity ratio K3	K ⩾ 1.5	1.3 ⩽ K < 1.5	1.2 ⩽ K < 1.3	1.1 ⩽ K < 1.2	1 ⩽ K < 1.1	K < 1
Points	20	15	12	8	5	0
Quick liquidity ratio K4	K ⩾ 0.5	0.3 ⩽ K < 0.5	0.1 ⩽ K < 0.3	0.05 ⩽ K < 0.1	0.01 ⩽ K < 0.05	K < 0.01
Points	10	8	6	3	2	0
Net profit margin K5	K ⩾ 0.01	0 ⩽ K < 0.01	K < 0			
Points	15	8	0			
Current assets turnover K6	K > 3	2 ⩽ K < 3	1 ⩽ K < 2	0.5 ⩽ K < 1	K < 0.5	
Points	20	15	10	5	0	
Total points	100	73	50	29	15	0
Financial position	good		average	bad		

Source: compiled by the author.

Table 3

Regression summary for dependent variable

N = 57	Regression summary for dependent variable: Var8 (Spreadsheet4) *R* = 0.93065278 *R*? = 0.86611460 Adjusted *R*? = 0.84698811 *F* (7.49) = 45.284 *p* < 0.0000 Std. Error of estimate: 0.19656					
	*b**	Std. Err.	b	Std. Err.	*t* (49)	*p*-value
Intercept			0.97335	0.064505	15.08964	0.000000
Var1	−0.38867	0.140749	−0.65277	0.236384	−2.76147	0.008076
Var2	0.18735	0.107068	0.38223	0.218431	1.74987	0.086401
Var3	−1.57190	0.462818	−0.19195	0.056517	−3.39637	0.001363
Var4	1.73174	0.445216	0.21145	0.054362	3.88967	0.000303
Var5	−0.34743	0.098730	−1.14411	0.325121	−3.51903	0.000946
Var6	−0.35390	0.068559	−0.22464	0.043518	−5.16203	0.000004
Var7	0.15889	0.062817	0.00215	0.000850	2.52942	0.014693

Source: compiled by the author.

Table 4

Financial condition according to the score

Financial condition	Score	Financial condition description
1	2	3
Good	91–100	Stability of production, positive value of net assets, profitability and solvency, compliance with the mandatory financial relative indicators, absence of negative phenomena that can affect the financial stability of the borrower in the future: net loss, decrease by more than 25% in production / sales (revenue) / profitability, growth of accounts payable / receivable compared to the previous reporting period or the same period last year by more than 25%)
	83–90	
	66–82	
	62–65	
	58–61	
	53–57	
Average	41–52	No direct threats to the current financial position in the presence of negative phenomena that can affect the financial stability of the borrower in the future: decrease in net assets, decrease in production / sales (revenue) / profitability, increase in accounts payable / receivable compared to the previous reporting period or the same period last year with the share of overdue debt 25–40%)
	31–40	
	26–30	
Bad	16–25	Threatening negative phenomena (net loss in the reporting period, decrease in production (revenue) by more than 50%, increase in overdue payables / receivables with a share of more than 40% in total payables / receivables, decrease in net assets by 50% or more) whose likely result may be bankruptcy or persistent insolvency of the borrower
	0–15	

Source: compiled by the author.

scribes the probability of default, and the independent variables characterize the values of financial ratios as of 01.01.2020:

$$B = 0.973 - 0.653K1 - 0.192K3 + 0.211K4 - 1.144K5 - 0.225K6 + 0.002K7, \quad (5)$$

where K1 is the financial independence ratio;
K3 is the current liquidity ratio;
K4 is the quick liquidity ratio;
K5 is the net profit margin;
K6 is the current assets turnover;
K7 is the debt/EBITDA.

These results justify the correspondence between the statistics and expert assessments.

The enterprises that were the bank's borrowers in 2012–2019 are divided into 9 rating groups according to the score. When making the rating groups, it was necessary to detail the characteristics of the financial

Table 5

Correspondence between the type of financial condition, probability of default and losses in case of default

Score	Number of troubled borrowers (in default)	Number of non-troubled borrowers	Total number of borrowers	Number of defaults	Probability of default, %	Default loss rate, %
1	2	3	4 = 2 + 3	5	6 = 5/4 * 100%	8
91–100	2	12	14	0	0.00	Less than 30
83–90	6	56	62	1	1.61	
66–82	9	29	38	1	2.63	
62–65	4	24	28	1	3.57	
58–61	10	21	31	2	6.45	
53–57	20	25	45	6	13.33	
41–52	35	44	79	21	26.58	31–70
31–40	76	126	202	70	34.65	
26–30	59	89	148	56	37.84	
16–25	22	32	54	21	38.89	More than 70
0–15	10	0	10	10	100.00	
Total	253	458	711	189	26.58	

Source: compiled by the author.

condition to consider the factors influencing the probability of default (*Table 4*).

The probability of default was calculated as the ratio of the number of default cases of borrowers in a given group to the total number of borrowers in the group. The movement of borrowers from the problematic to non-problematic category due to the improvement of the financial condition and elimination of the circumstances based on which the debt was recognized as problematic was not considered. The level of default losses was determined as follows. The main methods of debt repayment by borrowers in good financial condition are repayments by the agreement schedule or the settlement agreement schedule. Losses are associated with a shortfall in funds during the sale of property in the procedure of enforcement proceedings. Debt repayment by borrowers with average and poor financial condition is the sale of property in bankruptcy and enforcement proceedings, as well as the assignment (sale) of rights (claims). The level of losses given default was established based on the average "recovery rate" ("collection/debt") for the bank for the given period by formula (4). We compiled a table of correspondence between the type of financial condition, the probability of the borrower's default and the level of losses in case of default (*Table 5*).

There is a close relationship between the type of financial condition, the probability of default and the level of losses in case of default.

We can assess the model's forecasting potential by substituting the initial data of borrowers in formula (5). Based on *Table 5* and the score of the financial condition, we can determine the probability of the borrower's default and the level of losses in this case. Expected credit losses are calculated by multiplying the probability of default by the borrower, the level of losses given default and the amount of debt on the reporting date that is at risk of default. Loan provision is created in the amount of expected credit losses. A certain conventionality of the model is worth noting, since we use a limited list of indicators. The research effectiveness is confirmed by the positive results.

CONCLUSIONS

We considered the method for calculating credit losses under IFRS 9. Based on sample data for 57 borrowers who are agricultural enterprises, we calculated the financial ratios and defined the score for the financial condition, scoring intervals and the status of the borrower (in default or not). We built a regression model where the independent variables are financial ratios, and the dependent variable is the probability of default. When the result of the calculation according to a model close to 1, the probability of default is high, with a value close to zero, the probability of default is low.

We studied the financial condition of 711 borrowers of the bank for the period 2012–2019: the score was calculated, the borrowers were divided into rating groups. The probability of default is calculated as the ratio of the number of default cases of borrowers in a given group to the total number of borrowers in the group. The level of losses given default was formed based on the average "recovery rate" ("collection/debt") for the bank for the period under review. If we know the probability of default, the level of losses and loan debt, we can determine the expected credit losses and the amount of provisions.

The model makes it possible to roughly estimate the probability of borrowers' default. The calculation of the score according to the selected financial ratios helps assign borrowers to a certain rating group, determine credit risks and the possibility of providing loans. Our contribution to theoretical science consists in a combination of expert and statistical approaches to assessing financial ratios that determine the probability of borrowers' default. The practical significance of the study is in applying the approaches to a large array of initial data over a long observation period. Improving the model requires considering non-financial indicators when the probability of default is assessed.

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New Risk Measures "*VaR* to the Power of *t*" and "*ES* to the Power of *t*" and Distortion Risk Measures

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ABSTRACT

Distortion risk measures have been popular in financial and insurance applications in recent years due to their attractive properties. **The aim** of the article is to investigate whether risk measures "*VaR* in the power of *t*", introduced by the author, belong to the class of distortion risk measures, as well as to describe the corresponding distortion functions. The author introduces a new class of risk measures "*ES* to the power of *t*" and investigates whether it belongs to distortion risk measures, and also describes the corresponding distortion functions. The author used the composite **method** to design new distortion functions and corresponding distortion risk measures, to prove that risk measures "*VaR* to the power of *t*" and "*ES* to the power of *t*" belong to the class of distortion risk measures. The paper presents examples to illustrate the relevant concepts and results that show the importance of risk measures "*VaR* to the power of *t*" and "*ES* to the power of *t*" as subsets of distortion risk measures that allow identifying various financial catastrophic risks. The author **concludes** that risk measures "*VaR* to the power of *t*" and "*ES* to the power of *t*" can be used in risk management of companies when assessing remote, highly catastrophic risks.

Keywords: catastrophic risks; distortion risk measures; distortion functions; composite method; coherent risk measures; risk measures "*VaR* to the power of *t*"; risk measures "*ES* to the power of *t*"

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INTRODUCTION

The risk measure is a mapping ρ of a set of random variables *X* associated with risk portfolios of assets and/or liabilities (the result variables of these portfolios) into a real line *R*. In the following discussion, *X* will be represented as the value of the corresponding losses, i.e. positive values of the *X* variables will represent losses, while negative values will represent gains. Distortion risk measures represent a special and important group of risk measures widely used in finance and insurance as a calculation of capital requirements and the principles of calculating indicators related to risk appetite for the regulator and company executive. Several popular risk measures have proven to belong to distortion risk measures. For example, value at risk (VaR), tail value at risk, expected shortfall (ES) [1–3] or Wang's distortion measure [4]. Distortion risk measures satisfy the most important properties that a "good" risk measure should have, including positive homogeneity, translation invariance, and monotonicity [5].

In our previous works, we introduced a family of risk measures called "VaR to the power of t" ($VaR_p^{(t)}[X]$) for any confidence probability *p* and any real $t \geq 1$ [6–8]. In these works, computational formulas for risk measures $VaR_p^{(t)}[X]$ were obtained. Also, the relationships between these measures and the measures such as $ES_p[X]$ for some specific loss distribution laws were investigated. We revealed that the relative persistence level for each measure can depend both on the loss distribution law and on the confidence probability with which these measures are calculated. However, for almost all loss distribution laws and for all confidence probabilities of practical interest, risk measure $VaR_p^{(t)}[X]$ for any real $t \geq 2$ turns out to be more persistent, providing a more "careful" risk assessment than, say, risk measure $ES_p[X]$.

D. Denneberg, S. Wang and J. Dhaene [9, 10] proved that when the corresponding distortion function is concave, the distortion risk measure is also sub-additive. VaR is one of the most popular risk measures used in risk management and banking supervision because of its computational simplicity and for some regulatory reasons, regardless of its shortcomings as a risk measure. For example, VaR is not a sub-additive risk measure [11, 12]. Being coherent [2, 3], ES risk measure is only interested in losses in excess of VaR and ignores useful information about the distribution of losses below Va R.

L. Zhu and H. Li [13] presented and studied the tail distortion risk measure reformulated by F. Yang [14] as follows. For the distortion function *g*, the tail distortion risk measure at the confidence level *p* for the loss variable *X* is defined as the distortion risk measure with the distortion function:

$$g_p(x) = \begin{cases} g(\frac{x}{1-p}), if \ \ 0 \leq x \leq 1- p \\ 1, if \ \ 1- p < x \leq 1. \end{cases}$$

C. Yin and D. Zhu [15] described three methods for building distortion risk measures: the composite method, the mixing method, and the copula-based approach. We will use the results of this work.

Many researchers have proposed new classes of distortion measures.

For example, J. Belles-Sampera, M. Guillén, M. Santolino [16] proposed a new class of distortion risk measures called GlueVaR risk measures to extend VaR and ES. They can be expressed as a combination of VaR and ES indicators at different levels of confidence probabilities. They obtained closed-form analytical expressions for the most commonly used distribution functions in finance and insurance. The subfamily of these risk measures satisfies the tail sub-additivity property, which means that diversification benefits can persist, at least in certain cases. The application of GlueVaR risk measures related to capital allocation was discussed by J. Belles-Sampera, M. Guillén, M. Santolino [17].

U. Cherubini and S. Mulinacci [18] proposed a class of distortion measures based on contamination from an external "scenario" variable.

For a scenario-dependent variable whose risk is modeled by a copula function with horizontally concave portions, they give conditions for the coherence axiom and offer examples of this class measures based on the copula function.

It would be interesting to investigate the relationship between two classes of risk measures: distortion risk measures and *VaR* to the power of *t*.

We introduce a family of new risk measures "*ES* to the power of *t*" ($ES_p^{(t)}[X]$) at any confidence probability *p* and any real $t \geq 1$. We investigated the relationship of two classes of risk measures: distortion and *ES* to the power of *t*. It is proved that risk measures "*ES* to the power of *t*" is a subset of distortion risk measures. Thus, for any $t \geq 1$, any risk measure "*ES* to the power of *t*" is a distortion risk measure with a certain distortion function. In this case, this distortion function will be presented.

It is hard to believe in a unique risk measure that can encompass all of its characteristics. It does not exist. Moreover, since a single number is associated with each risk measure, it cannot exhaust all information about the risk. According to [8], risk measures "*VaR* to the power of *t*" allow by changing the value of *t*, to study the right tail of the loss distribution with any accuracy required for the given case, i.e. investigate the tail of the distribution as carefully as it is necessary in the given circumstances. It is prudent to look for risk measures ideal for a particular problem. Since all the proposed risk measures are flawed and limited in application, selecting the appropriate risk measure is still relevant in risk management.

DISTORTION RISK MEASURES

Distortion functions

A distortion function g: [0, 1] → [0, 1] is a non-decreasing function such that g $g(0) = 0, g(1) = 1$. Many distortion functions *g* have already been proposed in the literature. Some commonly used distortion functions are listed here.

The work by M. Denuit, J. Dhaene, M. Goovaerts and R. Kaas [12] presents the summary of other distortion functions.

- Function $g(x) = 1_{\{x>1-p\}}$, where 1_A is the indicator function and equals 1 at event A, and equals 0 otherwise, is a concave distortion function. Here, in applications, *p* will represent the preselected confidence level with which the corresponding risk measure is intended to be calculated.
- Incomplete beta-function

$$g(x) = \frac{1}{\beta(a,b)} \int_0^x t^{a-1}(1-t)^{b-1} dt,$$

where *a* > 0 and *b* > 0 are the parameters and

$$\beta(a,b) = \int_0^1 t^{a-1}(1-t)^{b-1} dt.$$

In particular, if *b* = 1, we obtain the power distortion function $g(x) = x^a$, and if *a* = 1, we obtain the dual-power distortion function $g(x) = 1-(1-x)^b$.

- Power distortion $g(x) = x^\alpha$ is a concave distortion function if $0 < \alpha < 1$ and a convex distortion function if $\alpha > 1$.
- Exponential distortion $g(x) = \frac{e^x - 1}{e - 1}$ is a convex distortion function.
- Sinusoidal distortion $g(x) = \sin\frac{\pi}{2}x$ is a concave distortion function.
- Function $g(x) = xe^{1-x}$ is a concave distortion function.
- Logarithmic distortion $g(x) = \frac{\ln(x+1)}{\ln 2}$ is a concave distortion function.
- Distortion Wang $g(x) = \Phi(\Phi^{-1}(x) + \Phi^{-1}(p))$, $0 < p < 1$, where Φ is the standard normal distribution function. Obviously, this is an increasing function [since these are functions $\Phi(x)$ and $\Phi^{-1}(x)$] and $g(0) = \Phi(\Phi^{-1}(0) + \Phi^{-1}(p)) = \Phi(-\infty) = 0$ and $g(1) = \Phi(\Phi^{-1}(1) + \Phi^{-1}(p)) = \Phi(+\infty) = 1$, and

$$g(\frac{1}{2}) = \Phi(\Phi^{-1}(\frac{1}{2}) + \Phi^{-1}(p)) = \Phi(\Phi^{-1}(p)) = p$$

- Lookback distortion

$g(x) = x^p(1 - p\ln x), p \in (0,1]$.

Obviously, this is an increasing function, which is easy to check: $g'(x) = -p^2 x^{p-1} \ln x > 0$ if $x \in [0,1]$, and $g(0) = \lim_{x \to +0} g(x) = 0$ and $g(1) = 1$.

• Identity function $g(x)=x$ is the smallest concave distortion function and also the largest convex distortion function.

• $g_0(x)=1_{\{x>0\}}$ is concave on [0,1] and is the largest of all non-identical concave distortion functions. $g^0(x)=1_{\{x=1\}}$ is convex on [0,1] and is the smallest of all non-identical convex distortion functions.

• For $0 < p < 1$, $g(x)=\min\{\frac{x}{1-p},1\}$ is the smallest concave distortion function of all $g(x)\geq 1_{\{x>1-p\}}$.

Distortion risk measures

If (Ω, F, P) is a common probability space where all random variables that represent the risks are defined. If F_X is an integral distribution function of random variable X, we denote the dual distribution function as $\bar{F}_X$, i.e. $\bar{F}_X(x)=1-F_X(x)=P\{X>x\}$.

Let g be the distortion function.

Distorted expectation of random variable X is $\rho_g[X]$ and is defined as

$$\rho_g[X]=\int_0^{+\infty} g(\bar{F}_X(x))dx+\int_{-\infty}^{0}[g(\bar{F}_X(x))-1]dx, \qquad (1)$$

provided that at least one of the two integrals above is finite. If X is a non-negative random variable, then ρ_g is simplified to

$$\rho_g[X]=\int_0^{+\infty} g(\bar{F}_X(x))dx.$$

This definition implies that if the distortion function is an identical function, i.e. $g(x)=x$, then the distorted expectation coincides with the usual expectation: $\rho_g[X]=E[X]$.

Due to the fact that the expected value of a random variable is considered the most important way to assess the future value of random variable X, we assume that since risks arise due to some value deviation of a random variable from its expected value, then risk measures can be modeled as a "distortion" of the expected value using the appropriate distortion function.

Distorted expectation $\rho_g[X]$ is called the *distortion risk measure with distortion function g* [19].

We can prove that, as was first observed by M. Denuit, J. Dhaene, M. Goovaerts and R. Kaas [12], the known risk measure VaR [1–3] is a distorted risk measure corresponding to distortion function $g(x)=1_{\{x>1-p\}}$, $p\in(0,1)$, i.e. the following definition is true.

Definition 1 [19]

For the distortion function $g(x)=1_{\{x>1-p\}}$, $p\in(0,1)$, if distribution function F_X is continuous, the corresponding risk measure is $\rho_g[X]=VaR_p[X]$.

J. Dhaene et al. [19] also proved two important facts that describ the relationship of all distortion risk measures obtained by distortion functions that are continuous on the right on [0,1) or left on (0,1] with the risk measures Va R.

Theorem 1

When g is a continuous distortion function on the right on [0,1), the distorted expectation $\rho_g[X]$ has the following representation:

$$\rho_g[X]=\int_{[0,1]} VaR^{+}_{1-q}[X]dg(q),$$

where $\mathrm{VaR}^{+}_{p}[X]=\sup\{x\,|\,F_X(x)\leq p\}$

Theorem 2

When g is a continuous distortion function on the left on [0,1), the distorted expectation $\rho_g[X]$ has the following representation:

$$\rho_g[X]=\int_{[0,1]} VaR_{1-q}[X]dg(q)=\int_{[0,1]} VaR_q[X]d\bar{g}(q),$$

Where $\mathrm{VaR}_p[X]=\inf\{x\,|\,F_X(x)\geq p\}$ and $\bar{g}(q)=1-g(1-q)$ — are the dual distortion to g.

Obviously, $\bar{\bar{g}}=g$, and g is continuous on the left if and only if $\bar{g}$ is continuous on the right; g is concave if and only if $\bar{g}$ is convex.

Distortion risk measures are a special class of risk measures introduced by D. Denneberg [9] and modified by S.S. Wang [4, 20].

Distortion risk measures satisfy many properties, including positive homogeneity, translation

invariance, and monotonicity. A risk measure is coherent if it satisfies the following set of four properties [11, 21]:

(M) monotonicity: $\rho(X) \le \rho(Y)$ if $P(X \le Y) = 1$;

(*P*) positive homogeneity: for any positive constant $c > 0$ and loss X, $\rho(cX) = c\rho(X)$;

(*S*) sub-additivity: for any losses X, Y, then $\rho(X+Y) \le \rho(X) + \rho(Y)$;

(T) translation invariance: if c is constant, then $\rho(X+c) = \rho(X) - c$.

Risk measure ρ is called a convex risk measure if it satisfies the properties of monotonicity, translation invariance and the following convexity property:

(*C*) convexity: $\rho(\lambda X + (1-\lambda) Y) \leqslant \lambda \rho(X) + (1-\lambda)\rho(Y)$, $0 \leqslant \lambda \leqslant 1$.

Obviously, under the assumption of positive homogeneity, monotonicity, and translation invariance, the convexity of the risk measure is equivalent to sub-additivity.

Another distortion risk measure [19], besides VaR, is the well-known measure ES (expected shortfall), conditional VaR [1–3].

Definition 2 [19]

For distortion function $g(x) = \min\{\frac{x}{1-p}, 1\}$, $p \in [0,1]$ under the assumption that the distribution function is continuous, the corresponding distorted risk measure is $\rho_g[X] = \mathrm{ES}_p[X]$.

The following theorem [17] is useful and can be used to order distortion risk measures in terms of their distortion functions.

Theorem 3 [17]

If $g(x) \le g^*(x)$ for $x \in [0,1]$, then $\rho_g[X] \leqslant \rho_{g^*}[X]$ for any random variable X.

DISTORTION RISK MEASURES *VAR* TO THE POWER OF *T*, $t \geqslant 1$, ($VaR_p^{(t)}$)

Today, risk measure VaR is probably the second most commonly used risk measure, both in theory and practice, after volatility (standard deviation). Since the end of the twentieth century, ES (Expected Shortfall) measure, conditional VaR, the measure of expected tail losses exceeding VaR, has found sufficient application in risk management. ES is perceived as a risk measure that specifies VaR measure, more conservative, considering tail losses, unlikely but large ("black swan").

The concept of a new measure "VaR squared" $VaR^{(2)}$ [6, 7] estimates risks more conservatively than VaR and is often more conservative than ES, assessing risk as a certain threshold value that is not overcome with a given probability (as VaR), and not as some average value from the set of "bad", tail loss values, like ES.

Following the ideas in [6, 7], in [8] we introduced the concept of risk measures VaR to any power $t \ge 1$, and derived formulas that allow to calculate $VaR^{(t)}$ as usual measure VaR with a certain modified confidence probability.

The concept of *VaR* to any natural power $VaR^{(n)}$ [6, 7] introduced a new risk measure to supplement VaR, tracking rare tail events associated with great financial losses.

Risk measure VaR squared" $VaR^{(2)}$ *with a confidence level p* is the value that will not be exceeded by the loss if its threshold value VaR_p is exceeded with a confidence level p during a given time.

Work [8] presents the following formula:

$$VaR_p^{(2)}[X] = VaR_{1-(1-p)^2}[X]. \qquad (2)$$

Thus, to calculate new catastrophic risk measure "VaR squared", a general formula has been obtained. We should just calculate risk measure VaR with confidence level $1-(1-p)^2$.

The concept of $VaR^{(2)}$ in [8] was generalized considering the fact that the confidence probability p' when determining $VaR^{(2)}$, i.e. the threshold value that the profit will not exceed (the loss will exceed), provided that it is not exceeded (exceeded) by VaR_p with probability p', may differ from p. This risk measure, which can be called "bi-VaR", was designated as $VaR_{p,p'}^{(2)}$ and the following formula was obtained:

$$VaR_{p,p'}^{(2)}[X] = VaR_{1-(1-p)(1-p')}[X]. \qquad (3)$$

We will introduce the concept of risk measures *VaR to the power of n*, where n is any natural

number, and will give formulas to calculate risk measures *VaR to the power of n*, $VaR^{(n)}$ [8].

We represent usual risk measure VaR as:

$$VaR_p^{(1)}[X] = VaR_p[X] = VaR_{p_1}[X],$$

where $p_1 = 1-(1-p)$.

According to the formula,

$VaR_p^{(2)}[X] = VaR_{p_2}[X]$, where $p_2 = 1-(1-p_1)^2$.

Naturally, according to the definition, we can assume that "*VaR to the third power*" is just $VaR_{p_2,p}^{(2)}[X]$. Thus, we get that

$VaR_p^{(3)}[X] = VaR_{p_2,p}^{(2)}[X] = VaR_{p_3}[X]$, where according to (3) $p_3 = 1-(1-p_2)(1-p)$.

Following this way, we introduce risk measure "*VaR to the power of n*" for any natural number *n* as $VaR_{p_{n-1},p}^{(2)}[X]$, where $p_{n-1} = 1-(1-p)^{n-1}$ and we obtain that

$VaR_p^{(n)}[X] = VaR_{p_{n-1},p}^{(2)}[X] = VaR_{p_n}[X]$, where according to (3) $p_n = 1-(1-p_{n-1})(1-p)$.

The concept of risk measures "*VaR to the power of n*" was introduced [8] for any natural number *n* and the formula was obtained that reduces their calculations to the calculation of usual risk measure VaR with a confidence level changed in a certain way.

$$VaR_p^{(n)}[X] = VaR_{1-(1-p)^n}[X]. \qquad (4)$$

Thus, to calculate risk measure $VaR_p^{(n)}$, we should just to calculate risk measure VaR with confidence level $1-(1-p)^n$.

RISK MEASURES "POLY-VaR"

We will introduce (like we did in [8]) a family of measures that generalize measures $VaR_p^{(n)}[X]$ and allow the confidence probabilities used for various powers of VaR to be different.

We will represent usual risk measure VaR as:

$$VaR_p[X] = VaR_{\tilde{p}_1}, \text{ where } \tilde{p}_1 = p_1 = p = 1-(1-p).$$

By formula (7), we introduce the concept of risk measure "poly-VaR to the second power", "bi-VaR":

$VaR_{p_1,p_2}^{(2)}[X] = VaR_{\tilde{p}_2}[X]$, where $\tilde{p}_2 = 1-(1-p_1)(1-p_2)$.

Accordingly, risk measure "poly-VaR to the third power" is as follows:

$$VaR_{p_1,p_2,p_3}^{(3)}[X] = VaR_{\tilde{p}_2,p_3}^{(2)}[X] = VaR_{\tilde{p}_3}[X],$$

where $\tilde{p}_3 = 1-(1-\tilde{p}_2)(1-p_3)$.

Thus, risk measure "*poly-VaR to the power of n*" is defined as follows:

$$VaR_{p_1,p_2,\ldots,p_n}^{(n)}[X] = VaR_{\tilde{p}_{n-1},p_n}^{(2)}[X] = VaR_{\tilde{p}_n}[X],$$

where $\tilde{p}_n = 1-(1-\tilde{p}_{n-1})$.

Work [8] provides the following formula to calculate the *poly-VaR to the power of n*":

$$VaR_{p_1,p_2,\ldots,p_n}^{(n)}[X] = VaR_{1-(1-p_1)(1-p_2)\ldots(1-p_n)}[X], \qquad (5)$$

that expresses it in terms of usual risk measure VaR with the confidence probability recalculated in a certain way.

RISK MEASURE VAR TO ANY REAL POWER $t \geqslant 1$, $VaR_p^{(t)}[X]$

Any real number $t \geq 1$ can be unambiguously represented as:

$t = k + \alpha$, where *k* is a natural number, and α is a real number, and $0 \leq \alpha < 1$. Obviously, *k* is the integer part of *t*, and α is its fractional part.

Naturally, risk measure *VaR* to any real power $t \geq 1$, $VaR_p^{(t)}[X]$ is as follows [8]:

$$VaR_p^{(t)}[X] = VaR_{\underbrace{p,p,\ldots,p}_{k},\alpha p}^{(k+1)}[X]. \qquad (6)$$

In particular, using formulas (5) and (6), we have:

$$VaR_p^{(1+\alpha)}[X] = VaR_{p,\alpha p}^{(2)}[X] = VaR_{1-(1-p)(1-\alpha p)}[X] \quad (7)$$

and

$$VaR_p^{(2+\alpha)}[X] = VaR_{p,p,\alpha p}^{(3)}[X] = VaR_{1-(1-p)^2(1-\alpha p)}[X] \quad (8)$$

etc.,

$$VaR_p^{(t)}[X] = VaR_p^{(k+\alpha)}[X] = VaR_{1-(1-p)^k(1-\alpha p)}[X]. \quad (9)$$

By means of risk measures $VaR_p^{(t)}[X]$, a risk manager can research the left tail of the profit distribution law for confidence probabilities that are multiples of the initial confidence probability *p*, as well as the fraction of this probability, to obtain very detailed information about less probable but more catastrophic risks.

NEW RISK MEASURES *ES* TO ANY POWER OF $T, t \geqslant 1, ES_p^{(t)}[X]$

We have already discussed an important risk measure, $ES_p[X]$ (Expected Shortfall) risk measure (conditional VaR), the measure of expected tail losses exceeding VaR. It is used as a risk measure, specifying VaR measure, more conservative, considering tail losses, unlikely, but great. In the second section, we described risk measure $VaR_p^{(t)}[X]$, which at $t \geq 2$ often gives a more conservative risk assessment than $ES_p[X]$.

In this paper, we introduce a new family of risk measures "ES to the power of *t*" for any $t \geq 1$.

First, we will introduce the concept of new risk measure — *"ES squared"*.

Risk measure *"ES squared"* denoted as $ES_p^{(2)}[X]$, is the value of the expected tail losses exceeding $VaR_p^{(2)}[X]$, i.e. by definition $ES_p^{(2)}[X] = E[X \mid X > VaR_p^{(2)}[X]$. (Symbol $E[X|A]$ denotes the conditional mathematical expectation of the random variable *X* if event *A* takes place).

Note that since $VaR_p^{(2)}[X] = VaR_{1-(1-p)^2}[X]$, the value of $ES_p^{(2)}[X]$ can be obtained by averaging the values of corresponding $\mathrm{VaR}_q[X]$ to variable *q* on segment $[1 - (1-p)^2, 1]$.

If the loss distribution continues, we obtain the following useful representation for $ES_p^{(2)}[X]$:

$$ES_p^{(2)}[X] = \frac{1}{(1-p)^2} \int\limits_{[1-(1-p)^2,1]} VaR_q[X]dq. \quad (10)$$

By analogy with ES squared, we introduce the concept of new risk measure *ES to the power of n*, where *n* is any natural number.

Risk measure "ES to the power of n", which we will designate as $ES_p^{(n)}[X]$, is the value of the expected tail losses exceeding $VaR_p^{(n)}[X]$, i.e. by definition $ES_p^{(n)}[X] = E[X \mid X > VaR_p^{(n)}[X]$.

Note that since $VaR_p^{(n)}[X] = VaR_{1-(1-p)^n}[X]$, the value of $ES_p^{(n)}[X]$ can be obtained by averaging the values of corresponding $\mathrm{VaR}_q[X]$ to variable *q* on segment $[1 - (1-p)^n, 1]$.

If the loss distribution continues, we obtain the following useful representation for $ES_p^{(n)}[X]$:

$$ES_p^{(n)}[X] = \frac{1}{(1-p)^n} \int\limits_{[1-(1-p)^n,1]} VaR_q[X]dq. \quad (11)$$

Note that a useful formula is obtained from formula (11), which allows expressing $ES_p^{(n)}[X]$ by usual risk measure ES with the confidence probability changed in a certain way:

$$ES_p^{(n)}[X] = ES_{1-(1-p)^n}[X]. \quad (12)$$

Now we will introduce new concept "*ES* to the power of *t*", where *t* is any real number, $t \geq 1$. We represent *t* as: $t = k + \alpha$, where *k* is a natural number, and *a* is a real number $0 < \alpha < 1$.

We will call *risk measure "ES to the power of t"*, denoted as $ES_p^{(t)}[X]$, the value of the expected tail losses exceeding $VaR_p^{(t)}[X]$, i.e. by definition $ES_p^{(t)}[X] = E[X \mid X > VaR_p^{(t)}[X]$.

Note that since $VaR_p^{(t)}[X] = VaR_{1-(1-p)^k(1-\alpha p)}[X]$, the value of $ES_p^{(t)}[X]$ can be obtained by averaging the values of corresponding $\mathrm{VaR}_q[X]$ to variable *q* on segment $[1 - (1-p)^k(1-\alpha p), 1]$.

If the loss distribution continues, we obtain the following useful representation for $ES_p^{(t)}[X]$:

$$ES_p^{(t)}[X] = \frac{1}{(1-p)^k(1-\alpha p)} \int\limits_{[1-(1-p)^k(1-\alpha p),1]} VaR_q[X]dq. \quad (13)$$

Note that a useful formula is obtained from formula (13), which allows expressing $ES_p^{(t)}[X]$ by usual risk measure ES with the confidence probability changed in a certain way

$$ES_p^{(t)}[X] = ES_{1-(1-p)^k(1-\alpha p)}[X]. \quad (14)$$

The following relations are valid between all the introduced risk measures:

$$VaR_p[X] \le ES_p[X],\ VaR_p^{(2)}[X] \le ES_p^{(2)}[X], \ldots,$$
$$VaR_p^{(n)}[X] \le ES_p^{(n)}[X], \ldots$$
$$VaR_p[X] \le VaR_p^{(2)}[X] \le \ldots \le VaR_p^{(n)}[X] \le \ldots$$
$$ES_p[X] \le ES_p^{(2)}[X] \le \ldots \le ES_p^{(n)}[X] \le \ldots$$

However, the ratio between risk measures $ES_p^{(n)}[X]$ and $VaR_p^{(n+1)}[X]$ may depend on the distribution law X and even on the confidence level p [7].

METHODS FOR CREATING NEW DISTORTION FUNCTIONS AND DISTORTION RISK MEASURES

Distortion functions can be viewed as a starting point for a family of distortion risk measures. Thus, building and selecting distortion functions play an important role in developing families of risk measures with different properties. C. Yin and D. Zhu [15] consider three methods: the composite method, mixing methods and copula-based method, which allow building new classes of distortion functions and measures using the available ones.

In this work, we will discuss only the composite method.

Composite method

The first approach to building distortion functions is the composite method that uses a composition of distortion functions.

If $h_1, h_2, \ldots$ are distortion functions, we will define $f_1(x) = h_1(x)$ and complex functions $f_n(x) = f_{n-1}(h_n(x))$, $n = 1, 2, \ldots$ It is easy to check that $f_n(x)$, $n = 1, 2, \ldots$ are also distortion functions. If $h_1, h_2, \ldots$ are concave distortion functions, then each $f_n(x)$ is concave, and they satisfy the conditions: $f_1 \le f_2 \le f_3 \le \ldots$ and the corresponding risk measures satisfy (by Theorem 3) $\rho_{f_1}[X] \le \rho_{f_2}[X] \le \rho_{f_3}[X] \le \ldots$

We will consider two distortion functions g_1 and g_2. If $g_2(x) = \begin{cases} \frac{x}{1-p}, if\ \ 0 \le x \le 1-p \\ 1, if\ \ 1-p < x \le 1, \end{cases}$,

then

$$g_p(x) = g_1(g_2(x)) = \begin{cases} g_1\left(\frac{x}{1-p}\right), if\ \ 0 \le x \le 1-p \\ 1, if\ \ 1-p < x \le 1, \end{cases}.$$

Corresponding risk measure $\rho_{g_p}[X]$ is a tail distortion risk measure first presented by L. Zhu and H. Li [13] and reformulated by F. Yang [14]. In particular, in the space of continuous random variable losses X

$$\rho_{g_p}[X] = \int_0^\infty g_p(1 - P(X \le x \mid X > VaR_p[X]))dx.$$

If $g_1(x) = x^r, 0 < r < 1$

and $g_2(x) = \begin{cases} \frac{x}{1-p}, if\ \ 0 \le x \le 1-p \\ 1, if\ \ 1-p < x \le 1, \end{cases}$,

then

$$g_{12}(x) = g_1(g_2(x)) = \begin{cases} \left(\frac{x}{1-p}\right)^r, if\ \ 0 \le x \le 1-p \\ 1, if\ \ 1-p < x \le 1, \end{cases}$$

and

$$g_{21}(x) = g_2(g_1(x)) = \begin{cases} \frac{x^r}{1-p}, if\ \ 0 \le x \le (1-p)^{\frac{1}{r}} \\ 1, if\ \ (1-p)^{\frac{1}{r}} < x \le 1, \end{cases}$$

Obviously, $g_1 < g_{21}$ and $g_2 < g_{12}$, so by Theorem 3 $\rho_{g_1}[X] < \rho_{g_{21}}[X]$ and $\rho_{g_2}[X] < \rho_{g_{21}}[X]$.

In reality, it is sometimes necessary to distort the initial distribution more than once.

We will consider a few more examples of distortion functions obtained by the composite method as a composition of known distortion functions and will study the corresponding risk distortion measures.

Case 1

We will study exponential distortion function $g(x) = \frac{e^x - 1}{e - 1}$ is a convex distortion function and indicator concave distortion function $1_{\{x>1-p\}}$.

It is easy to check that the composition of any distortion function $g(x)$ (in particular, this one) with $1_{\{x>1-p\}}$ in the following order $g(1_{\{x>1-p\}}) = 1_{\{x>1-p\}}$, i.e. it does not create a new distortion function. If we change the order of creating the superposition, i.e. consider distortion function $1_{\{x>1-p\}}(g(x))$.

However, since $h(x) = 1_{\{x>1-p\}}(g(x)) = 1_{\{g(x)>1-p\}}(x)$ and inequality $\frac{e^x - 1}{e-1} > 1-p$ is equivalent to inequality $x > \ln(1+(e-1)(1-p))$, then

$$h(x) = 1_{\{x>1-p\}}(g(x)) = 1_{\{x>\ln(1+(e-1)(1-p))\}}(x) = \\ = 1_{\{x>1-[1-\ln(1+(e-1)(1-p))]\}}(x).$$

According to Definition 1, $\rho_h[X] = VaR_{1-\ln(1+(e-1)(1-p))}[X]$ is distortion risk measure corresponding to the given distortion function, i.e. known risk measure VaR with the confidence level changed in such a way. This risk measure grows very slowly with an increase in confidence.

For example, if the initial confidence level is $p = 0.95$, then $\rho_h[X] \approx VaR_{0.032}[X]$.

Case 2

We will look at logarithmic distortion function $g(x) = \frac{\ln(x+1)}{\ln 2}$, a concave distortion function, as well as at indicative concave distortion function $1_{\{x>1-p\}}$.

Let's consider a distortion function built with this superposition: $1_{\{x>1-p\}}(g(x))$.

However, since $h(x) = 1_{\{x>1-p\}}(g(x)) = 1_{\{g(x)>1-p\}}(x)$ and inequality $\frac{\ln(x+1)}{\ln 2} > 1-p$ is equivalent to inequality $x > 2^{1-p} - 1$, then

$$h(x) = 1_{\{x>1-p\}}(g(x)) = 1_{\{x>2^{1-p}-1\}}(x) = \\ = 1_{\{x>1-[1-(2^{1-p}-1)]\}}(x) = 1_{\{x>1-[2-2^{1-p}]\}}(x).$$

According to Definition 1, $\rho_h[X] = VaR_{2-2^{1-p}}[X]$ is distortion risk measure corresponding to the given distortion function, i.e. known risk measure VaR with the confidence level changed in such a way. This risk measure grows fast with increasing confidence probability.

For example, if the initial confidence level is $p = 0.95$, then $\rho_h[X] \approx VaR_{0.97}[X]$.

Case 3

We will look at sinusoidal distortion function $g(x) = \sin\frac{\pi}{2}x$, a concave distortion function, as well as at indicative concave distortion function $1_{\{x>1-p\}}$.

Let's consider a distortion function built with this superposition: $1_{\{x>1-p\}}(g(x))$.

However, since $h(x) = 1_{\{x>1-p\}}(g(x)) = 1_{\{g(x)>1-p\}}(x)$ and inequality $\sin\frac{\pi}{2}x > 1-p$ is equivalent to inequality $x > \frac{2}{\pi}\arcsin(1-p)$, then

$$h(x) = 1_{\{x>1-p\}}(g(x)) = 1_{\{x>\frac{2}{\pi}\arcsin(1-p)\}}(x) = \\ = 1_{\{x>1-[1-\frac{2}{\pi}\arcsin(1-p)]\}}(x).$$

According to Definition 1, $\rho_h[X] = VaR_{1-\frac{2}{\pi}\arcsin(1-p)}[X]$ is distortion risk measure corresponding to the given distortion function, i.e. known risk measure VaR with the confidence level changed in such a way. This risk measure grows fast with increasing confidence probability.

For example, if the initial confidence level is $p = 0.95$, then $\rho_h[X] \approx VaR_{0.9682}[X]$.

Case 4

We will consider power distortion function $g(x) = x^\alpha$, which is a concave distortion function at $0 < \alpha < 1$ and a convex distortion function at $\alpha > 1$, as well as indicator concave distortion function $1_{\{x>1-p\}}$.

Let's consider a distortion function built with this superposition: $1_{\{x>1-p\}}(g(x))$.

However, since $h(x) = 1_{\{x>1-p\}}(g(x)) = 1_{\{g(x)>1-p\}}(x)$ and inequality $x^\alpha > 1-p$ is equivalent to inequality $x > (1-p)^{\frac{1}{\alpha}}$,

then

$$h(x)=1_{\{x>1-p\}}(g(x))=1_{\{x>(1-p)^{\frac{1}{\alpha}}\}}(x)=1_{\{x>1-(1-(1-p)^{\frac{1}{\alpha}})\}}(x).$$

According to Definition 1, $\rho_h[X]=VaR_{1-(1-p)^{\frac{1}{\alpha}}}[X]$ is distortion risk measure corresponding to the given distortion function, i.e. known risk measure VaR with the confidence level changed in such a way.

The growth of these risk measures with increasing confidence probability strongly depends on the choice of parameter α.

For example, if the initial confidence level is $p = 0.95$, then at $\alpha=2$, $\rho_h[X]\approx VaR_{0.025}[X]$ this risk measure grows very slowly with increasing confidence probability; at $\alpha=1$, $\rho_h[X]\approx VaR_{0.95}[X]$ it is standard VaR measure; and at $\alpha=\frac{1}{2}$, $\rho_h[X]\approx VaR_{0.9975}[X]$ this risk measure grows rapidly with increasing confidence probability.

Case 5

Let's consider $g(x)=xe^{1-x}$ function, a concave distortion function, as well as indicative concave distortion function $1_{\{x>1-p\}}$.

Let's consider a distortion function built with this superposition: $1_{\{x>1-p\}}(g(x))$.

However, since $h(x)=1_{\{x>1-p\}}(g(x))=1_{\{g(x)>1-p\}}(x)$ and inequality $xe^{1-x}>1-p$ is equivalent to inequality $-xe^{-x}<-\frac{1-p}{e}$, from which it follows that $x>-W(-\frac{1-p}{e})$, where $W(x)$ is the well-known Lambert W-function [22], therefore

$$h(x)=1_{\{x>1-p\}}(g(x))=1_{\{x>-W(-\frac{1-p}{e})\}}(x)=$$
$$=1_{\{x>1-[1+W(-\frac{1-p}{e})]\}}(x).$$

According to Definition 1, $\rho_h[X]=VaR_{1+W(-\frac{1-p}{e})}[X]$ is distortion risk measure corresponding to the given distortion function, i.e. known risk measure VaR with the confidence level changed in such a way. This risk measure grows fast with increasing confidence probability.

For example, if the initial confidence level is $p = 0.95$, then $-\frac{1-p}{e}\approx -0.0184$ and then, using the well-known expansion of the Lambert W-function in a power series $|x|<\frac{1}{e}$ converging at

$$W(x)=\sum_{n=1}^{\infty}\frac{(-n)^{n-1}}{n!}x^n=x-x^2+\frac{3}{2}x^3-\frac{8}{3}x^4+\frac{125}{24}x^5-\ldots,$$

we get $W(-0.0184)\approx -0.0187$ and thus, $\rho_h[X]\approx VaR_{0.9813}[X]$.

Case 6

Let's consider $g(x)=\min\{\frac{x}{1-p},1\}$ function, a concave distortion function, as well as indicative concave distortion function $1_{\{x>1-p\}}(x)$.

Let's consider a distortion function built with this superposition: $1_{\{x>1-p\}}(g(x))$.

However,

$$h(x)=1_{\{x>1-p\}}(g(x))=\begin{cases}1, \text{ if } x>(1-p)^2\\ 0, \text{ if } 0\le x\le(1-p)^2\end{cases}=1_{\{x>(1-p)^2\}}(x).$$

If we introduce concave distortion function $g_2(x)=x^{\frac{1}{2}}$ that belongs to the family of distortion functions studied in Case 4, then $1_{\{x>1-p\}}(g_2(x))=1_{\{x>(1-p)^2\}}(x)$.

Thus, distortion function $h(x)$ can also be represented as the following superposition:

$$h(x)=1_{\{x>1-p\}}(g_2(x))=\begin{cases}1, \text{ if } x>(1-p)^2\\ 0, \text{ if } 0\le x\le(1-p)^2\end{cases}=$$
$$=1_{\{x>(1-p)^2\}}(x)=1_{\{x>1-(1-(1-p)^2\}}(x).$$

According to Definition 1, $\rho_h[X]=VaR_{1-(1-p)^2}[X]$ is distortion risk measure corresponding to the given distortion function, i.e. known risk meas-

ure VaR with the confidence level changed in such a way. This risk measure grows fast with increasing confidence probability.

However, if we recall formula (2) for VaR squared, we get:

$$\rho_h[X] = VaR_p^{(2)}[X].$$

Thus, we found out that new risk measure VaR squared also belongs to the class of distortion risk measures, and it corresponds to the distortion function obtained as a superposition of function $1_{\{x>1-p\}}(x)$ with any distortion function: $g(x) = \min\{\frac{x}{1-p}, 1\}$ or $g_2(x) = x^{\frac{1}{2}}$.

We can prove that the following, more general definition is true.

***Definition* 3**

Risk measure *VaR* to the power of *n* (for any natural *n*) belongs to the class of distortion risk measures and corresponds to the distortion function obtained in any superposition of a function with any distortion function: $g(x) = \min\{\frac{x}{1-p}, 1\}$ or $g_n(x) = x^{\frac{1}{n}}$:

$$h(x) = 1_{\{x>1-p\}}(\underbrace{g(g(...(g(x))}_{n-1-\text{times}}) = 1_{\{x>1-p\}}(g_n(x)),$$

i.e. $VaR_p^{(n)}[X] = \rho_h[X]$.

Proof

We will consider function $g(x) = \min\{\frac{x}{1-p}, 1\}$, a concave distortion function. The following superposition $\underbrace{g(g(...(g(x))}_{n-1-times}$ also represents a concave distortion function as follows:

$$\underbrace{g(g(...(g(x))}_{n-1-times} = \begin{cases} 1, \ if \ \ x > (1-p)^{n-1} \\ \dfrac{x}{(1-p)^{n-1}}, \ if \ \ 0 \le x \le (1-p)^{n-1} \end{cases},$$

concave distortion function $h(x) = 1_{\{x>1-p\}}(\underbrace{g(g(...(g(x))}_{n-1-times}$ is as follows:

$$h(x) = 1_{\{x>1-p\}}(\underbrace{g(g(...(g(x))}_{n-1-times} =$$

$$\begin{cases} 1, \ if \ \ x > (1-p)^n \\ 0, \ if \ \ 0 \le x \le (1-p)^n \end{cases} = 1_{\{x>(1-p)^n\}}(x).$$

If we introduce concave distortion function $g_n(x) = x^{\frac{1}{n}}$ that belongs to the family of distortion functions studied in Case 4, then $1_{\{x>1-p\}}(g_n(x)) = 1_{\{x>(1-p)^n\}}(x) = h(x)$.

Thus, distortion function $h(x)$ can also be represented as the following superposition:

$$h(x) = 1_{\{x>1-p\}}(g_n(x)) = 1_{\{x>(1-p)^n\}}(x) = 1_{\{x>1-(1-(1-p)^n\}}(x).$$

According to Definition 1, $\rho_h[X] = VaR_{1-(1-p)^n}[X]$ is distortion risk measure corresponding to the given distortion function, i.e. known risk measure VaR with the confidence level changed in such a way. This risk measure grows fast with increasing confidence probability.

However, if we recall formula (4) for VaR to the power of *n*, we get $\rho_h[X] = VaR_p^{(n)}[X]$.

The definition is proved.

The more general statement is also valid for *VaR* risk measures to any power of $t \ge 1$.

***Definition* 4**

Risk measure *VaR* to the power of *t*, $\mathrm{VaR}_p^{(t)}[X]$ (at any actual $t \ge 1$), where *t* is as follows: $t = k + \alpha$, where *k* is a natural number, and α is a real number, moreover $0 \le \alpha < 1$, it is a distorted risk measure and it is obtained as a risk measure corresponding to the distortion function, which can be represented as superposition of distortion functions $1_{\{x>1-p\}}(x)$,

$$g(x) = \min\{\frac{x}{1-p}, 1\}, \ \text{and} \ \ g_\alpha(x) = \min\{\frac{x}{1-\alpha p}, 1\},$$

and $g_{k-1}(x) = x^{\frac{1}{k-1}}$ in the following two ways:

$$h(x) = 1_{\{x>1-p\}}(\underbrace{g(g(...(g}_{k-1-times}(g_\alpha(x)) = 1_{\{x>1-p\}}(g_{k-1}(g_\alpha(x))),$$

i.e. $VaR_p^{(t)}[X] = \rho_h[X]$.

Proof

Functions $g(x)=\min\{\frac{x}{1-p},1\}$ and $g_\alpha(x)=\min\{\frac{x}{1-\alpha p},1\}$ are concave distortion functions. Next superposition $\underbrace{g(g(...(g}_{k-1-times}(g_\alpha(x))...)$ also represents a concave distortion function as follows:

$$\underbrace{g(g(...(g}_{k-1-times}(g_\alpha(x))...)=\begin{cases}1, \ if \ \ x>(1-p)^{k-1}(1-\alpha p)\\ \dfrac{x}{(1-p)^{k-1}(1-\alpha p)},\\ if \ \ 0\le x\le(1-p)^{k-1}(1-\alpha p),\end{cases}$$

and concave distortion function $h(x)=1_{\{x>1-p\}}(\underbrace{g(g(...(g}_{k-1-times}(g_\alpha(x)...)$ is as follows:

$$h(x)=$$

$$=\begin{cases}1, \ if \ \ x>(1-p)^{k}(1-\alpha p)\\ 0, \ if \ \ 0\le x\le(1-p)^{k}(1-\alpha p)\end{cases}=1_{\{x>(1-p)^k(1-\alpha p)\}}(x).$$

With function $g_{k-1}(x)=x^{\frac{1}{k-1}}$, the distortion function $h(x)$ can also be represented as the following superposition:

$$h(x)=1_{\{x>1-p\}}(g_{k-1}(g_\alpha(x)))=$$
$$=1_{\{x>(1-p)^k(1-\alpha p)\}}(x)=1_{\{x>1-(1-(1-p)^k(1-\alpha p))\}}(x).$$

According to Definition 1, $\rho_h[X]=VaR_{1-(1-p)^k(1-\alpha p)}[X]$ is distortion risk measure corresponding to the given distortion function, i.e. known risk measure VaR with the confidence level changed in such a way.

However, if we recall formula (9) for *VaR* to the power of *t*, we get $\rho_h[X]=VaR_p^{(t)}[X]$.

The definition is proved.

In general, any concave distortion function *g* gives the distribution tail more weight than the identical function *g*(*x*) = *x*, while any convex distortion function *g* gives the tail less weight than the identical function *g*(*x*) = *x* [15]. Therefore, in particular, any concave distortion function *g* gives the distribution tail more weight than any convex distortion function.

It is good to know when building a risk measure with the required properties.

The question is if risk measure $ES_p^{(2)}[X]$ is a distorted risk measure.

Case 6

We will consider function $g(x)=\min\{\frac{x}{1-p},1\}$, a concave distortion function, as well as distortion function built with superposition: $g(g(x))$.

It is easy to check,

$$h(x)=g(g(x))=\begin{cases}1, \ if \ \ x>(1-p)^2\\ \dfrac{x}{(1-p)^2}, \ if \ \ 0\le x\le(1-p)^2\end{cases}$$

and

$$h'(x)=\begin{cases}0, \ if \ \ x>(1-p)^2\\ \dfrac{1}{(1-p)^2}, \ if \ \ 0\le x\le(1-p)^2.\end{cases}$$

According to Theorem 2, the distorted risk measure corresponding to a given distortion function turns out to be a measure that can be represented as follows

$$\rho_h[X]=\int\limits_{[0,(1-p)^2]}VaR_{1-q}[X]\frac{1}{(1-p)^2}dq+$$

$$+\int\limits_{[(1-p)^2,1]}VaR_{1-q}[X]\times 0dq=$$

$$=\frac{1}{(1-p)^2}\int\limits_{[0,(1-p)^2]}VaR_{1-q}[X]dq=$$

$$=\frac{1}{(1-p)^2}\int\limits_{[1-(1-p)^2,1]}VaR_q[X]dq.$$

However, if we recall formula (10) for *ES* squared, we get $\rho_h[X]=ES_p^{(2)}[X]$.

We found out that new risk measure ES squared, introduced in this work, also belongs to the class of distortion risk measures, and it corresponds to the described distortion function.

The question is if risk measure $ES_p^{(n)}[X]$ is a distorted risk measure.

Definition 5

Risk measure ES to the power of *n* (for any natural *n*) belongs to the class of distortion risk measures, and it corresponds to the distortion function obtained as any superposition of functions $g(x)=\min\{\frac{x}{1-p},1\}$ as follows:

$$h(x)=\underbrace{g(g(...(g(x))}_{n-times},\ \text{i.e. } \mathrm{ES}_p^{(n)}[X]=\rho_h[X].$$

Proof

Function $g(x)=\min\{\frac{x}{1-p},1\}$ is a concave distortion function. Next superposition $\underbrace{g(g(...(g(x))}_{n-times}$ also represents a concave distortion function as follows:

$$h(x)=\underbrace{g(g(...(g(x))}_{n-times}=\begin{cases}\dfrac{x}{(1-p)^n},\ if\ \ 0\le x\le(1-p)^n\\ 1,\ if\ \ (1-p)^n<x\le 1\end{cases}$$

and

$$h'(x)=\begin{cases}0,\ if\ \ x>(1-p)^n\\ \dfrac{1}{(1-p)^n},\ if\ \ 0\le x\le(1-p)^n\end{cases}.$$

According to Theorem 2, the distorted risk measure corresponding to a given distortion function *h*(*x*) turns out to be a measure that can be represented as follows

$$\rho_h[X]=\int\limits_{[0,(1-p)^n]}VaR_{1-q}[X]\frac{1}{(1-p)^n}dq+$$

$$+\int\limits_{[(1-p)^n,1]}VaR_{1-q}[X]\times 0dq=$$

$$=\frac{1}{(1-p)^n}\int\limits_{[0,(1-p)^n]}VaR_{1-q}[X]dq=$$

$$=\frac{1}{(1-p)^n}\int\limits_{[1-(1-p)^n,1]}VaR_q[X]dq.$$

However, if we recall formula (11) for *ES* to the power of *n*, we get $\rho_h[X]=ES_p^{(n)}[X]$.

We found out that new risk measure *ES* to the power of *n* also belongs to the class of distortion risk measures. It corresponds to the described distortion function and is presented as usual risk measure ES with the confidence probability changed in a certain way.

The definition is proved.

The question is if risk measure $ES_p^{(t)}[X]$ is a distorted risk measure.

Definition 6

Risk measure *ES* in power of *t* for any real $t\ge 1$, represented as $t=k+\alpha,$ where *k* is a natural number, and *a* is a real number, $0<\alpha<1$, belongs to the class of distortion risk measures, and corresponds to the distortion function obtained as any superposition of functions $g(x)=\min\{\frac{x}{1-p},1\}$ and $g_\alpha(x)=\min\{\frac{x}{1-\alpha p},1\}$ as follows:

$$h(x)=\underbrace{g(g(...(g(}_{k-times}g_\alpha(x))...),\ \text{i.e. } \mathrm{ES}_p^{(t)}[X]=\rho_h[X].$$

Proof

Function $g(x)=\min\{\frac{x}{1-p},1\}$ is a concave distortion function. Superposition $\underbrace{g(g(...(g(x))}_{n-times}$ also represents a concave distortion function as follows:

$$h(x)=\underbrace{g(g(...(g(}_{k-times}g_\alpha(x))...)=$$

$$=\begin{cases}\dfrac{x}{(1-p)^k(1-\alpha p)},\ if\ \ 0\le x\le(1-p)^k(1-\alpha p)\\ 1,\ if\ \ (1-p)^k(1-\alpha p)<x\le 1,\end{cases}$$

and

$$h'(x)=\begin{cases}0,\ if\ \ x>(1-p)^k(1-\alpha p)\\ \dfrac{1}{(1-p)^k(1-\alpha p)},\ if\ \ 0\le x\le(1-p)^k(1-\alpha p)\end{cases}.$$

According to Theorem 2, the distorted risk measure corresponding to a given distortion function $h(x)$ turns out to be a measure that can be represented as follows:

$$\rho_h[X] = \int\limits_{[0,(1-p)^k(1-\alpha p)]} VaR_{1-q}[X]\frac{1}{(1-p)^k(1-\alpha p)}dq + \int\limits_{[(1-p)^n,1]} VaR_{1-q}[X]\times 0 dq =$$

$$= \frac{1}{(1-p)^k(1-\alpha p)} \int\limits_{[0,(1-p)^k(1-\alpha p)]} VaR_{1-q}[X]dq =$$

$$= \frac{1}{(1-p)^k(1-\alpha p)} \int\limits_{[1-(1-p)^k(1-\alpha p,1]} VaR_q[X]dq .$$

If we recall formula (13) for *ES* to the power of *t*, we get: $\rho_h[X] = ES_p^{(t)}[X]$.

We found out that new risk measure *ES* to the power of *t* also belongs to the class of distortion risk measures. It corresponds to the described distortion function and is presented as usual risk measure ES with the confidence probability changed in a certain way.

The definition is proved.

We will now consider case 7 of two random variables *X* and *Y* with different discrete distribution laws, whose risks do not distinguish between the known risk measures VaR and ES [15]. Generalizing risk measure ES with random values of losses that obey discrete distribution laws has its own specifics. In particular, if the random loss *X* obeys a discrete distribution, then $ES_p[X]$ is expressed through the values of VaR and the expected value of the excess losses over VaR [15]:

$$ES_p[X] = VaR_p[X] + \frac{1-F_X(VaR_p[X])}{1-p} E[X - VaR_p[X] \mid X > VaR_p[X]]. \quad (15)$$

This example by C. Yin and D. Zhu [15] shows that risk measures $VaR_p[X]$ and $ES_p[X]$ may not distinguish between the risks created by *X* and *Y*. At the same time, an example of a certain risk measure that distinguishes between their risks is given. This measure coincides with risk measure $ES_p^{(2)}[X]$ introduced in this work.

Case 7

Let us consider two random variables *X* and *Y* that simulate risks with distribution functions, respectively:

$$F_X(x) = \begin{cases} 0, if\ \ x < 0, \\ 0.6, if\ \ 0 \le x < 100 \\ 0.975, if\ \ 100 \le x < 500 \\ 1,\ if\ \ x \ge 500 \end{cases}$$

and

$$F_Y(x) = \begin{cases} 0, if\ \ x < 0, \\ 0.6, if\ \ 0 \le x < 100 \\ 0.99, if\ \ 100 \le x < 1100 \\ 1,\ if\ \ x \ge 1100 \end{cases}$$

It is easy to check that $E(X) = E(Y) = 50$, $VaR_{0.95}[X] = VaR_{0.96}[X] = 100$, $VaR_{0.95}[Y] = VaR_{0.96}[Y] = 100$.

ES can be calculated by formula (15) and we get:

$$ES_{0.95}[X] = ES_{0.95}[Y] = 300,$$

$ES_{0.96}[X] = ES_{0.96}[Y] = 350$. When $p = 0.95$ and $p = 0.96$, then according to the risk measures VaR and ES, both *X* and *Y* have the same risk! However, the maximum loss for *Y* (1100) more than doubles the loss for *X* (500), and it is clear that risk *Y* is greater than risk *X*.

We now consider distortion measure ρ_h with distortion function искажения $h(x) = g(g(x))$ and

$$g(x) = \begin{cases} \frac{x}{1-p}, if\ \ 0 \le x \le 1-p \\ 1, if\ \ 1-p < x \le 1, \end{cases}$$

The, according to case 6,

$$\rho_h[X] = \frac{1}{(1-p)^2} \int\limits_{[1-(1-p)^2,1]} VaR_q[X]dq = ES_p^{(2)}[X].$$

And numerically for $p = 0.95$

$$\rho_h[X] = \frac{1}{(0.05)^2} \int\limits_{[1-0.05^2,1]} VaR_q[X]dq = ES^{(2)}_{0.95}[X],$$

i.e.

$$\rho_h[X] =$$

$$= \frac{1}{0.0025} \int\limits_{[0.9975,1]} VaR_q[X]dq = \frac{500}{0.0025}(1-0.9975) = 500$$

and

$$\rho_h[Y] =$$

$$= \frac{1}{0.0025} \int\limits_{[0.9975,1]} VaR_q[X]dq = \frac{1100}{0.0025}(1-0.9975) = 1100.$$

Then at $p = 0.95$, $\rho_h[X] = ES^{(2)}_{0.05}[X] = 500$ and $\rho_h[Y] = ES^{(2)}_p[Y] = 1100$.

In this case, risk measure $\rho_h = ES^{(2)}_p$, distinguishing between different risk levels for X and Y, turned out to be more suitable for risk management than usual risk measures VaR and ES.

CONCLUSIONS

A vigorous theoretical study of a class of distortion risk measures took place in the last decade. They have recently become widespread in financial and insurance applications due to their attractive properties. In his earlier works, the author introduced and investigated risk measures "*VaR* to the power of *t*" that allow identifying various financial catastrophic risks. In this paper, the author described and developed a composite method for creating a new class of distortion functions and corresponding distortion risk measures. By this method, the author proves that risk measures "*VaR* to the power of *t*" belong to the class of distortion risk measures, and describes the corresponding distortion functions. Also, the author introduces a new class of risk measures "ES to the power of *t*", proves that they also belong to the class of distortion risk measures and describes the corresponding distortion functions. Various cases illustrate the relevant concepts and results that demonstrate the importance of "*VaR* to the power of *t*" and "ES to the power of *t*" risk measures as subsets of distortion risk measures identifying various financial catastrophic risks. Distortion risk measures are currently well studied and have many useful and convenient properties. Thus, all the properties possessed by the distortion risk measures [12] are also possessed by the families of measures "*VaR* to the power of *t*" and "ES to the power of *t*".

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Factors of Financial Imbalance in the Compulsory Pension Insurance System: the Case of Russia

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ABSTRACT

The aim of the article is to study the impact of tax and tariff policy on the financial balance of the compulsory pension insurance system in Russia, as well as to substantiate proposals for its financial stabilization. The authors analyzed the consequences of regression applied on wages while forming tariffs for pensions. The **methods** used in this study were economic, statistical and empirical methods, analysis and synthesis, abstraction, systemic-structural approach. The authors analyzed the influence of preferential tariffs for certain types of economic activity and the use of simplified tax systems for organizations on the income of the Pension Fund of the Russian Federation. The work contains the calculation of income shortfalls in the compulsory pension insurance system resulting from the use of regression and tax benefits when calculating insurance payments to the budget of the Pension Fund of Russia. The authors estimated the financial consequences of the pension valorization in the Soviet period and the pension indexation policy in Russia resulted in the rising costs of the Pension Fund of Russia. **The conclusion** is that the current procedure for determining insurance contributions to the Pension Fund of the Russian Federation, which provides for a large number of benefits, does not correspond to generally accepted world practice and creates major risks for the financial balance of the pension system. This may cause increasing poverty among seniors. Raising the retirement age did not solve the problem of balancing the pension system, but exacerbated it. The regression in the payment of insurance premiums led to a conundrum in Russia, when an increase in wages resulted in the decrease of the Pension Fund of the Russian Federation's income. This is associated with the precarization of wages and the desire of business to minimize tax payments. The prospect of further research is to study the conditions for financial stabilization of compulsory pension insurance during the Russian economic crisis. The analysis showed that there is a need to create an independent actuarial center for setting tariffs for deductions to the Pension Fund of the Russian Federation, as well as the redistribution of areas of responsibility between the Pension Fund of the Russian Federation and the Ministry of Finance of Russia.

Keywords: insurance rates; pension reform; financial balance of the pension system; tax exemptions; pension fund deficit

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INTRODUCTION

There are many contradictions about the whole compulsory pension insurance system and its financial balance [1]. On the one hand, its fundamental consistency is challenging today, since the demographic burden is growing and the labor market structure is changing. On the other hand, there are various methods to balance it: either by raising the retirement age, or by changing the record system for senior citizenship (the Russian system of scoring pension rights), which basically means decreasing social guarantees. In each case, the approaches to developing the pension system did not include an analysis or study of consequences.

There is a brief answer to the opponents of the pay-as-you-go (PAYG) pension system: it has survived and ensured the normal pension maintenance in all European countries that experienced two demographic shocks in a very short time due to the world wars, which is also confirmed by foreign studies [2]. Besides, widely advertised by the World Bank in the late 90s, the Chilean experimental transition from the PAYG pension system to the funded one, ended in an economic fiasco. The current discussion about the need to introduce an unconditional basic income is nothing, but a variation of the pay-as-you-go social security system.

It is difficult to talk to the followers of the idea of raising the retirement age. They mostly refer to foreign countries, where the retirement age is later than in Russia. Here, it is very easy to refer to our own specifics, but it should be proved. Moreover, the increase of the retirement age in our country was justified by the fact that the insurance pension system is financially imbalanced, which leads to large-scale budget transfers. For example, when discussing this issue in the State Duma, they declared that in the period 2024–2026 maintaining pensions at the current level would require a greater transfer from the federal budget to the Pension Fund of the Russian Federation up to at least 5 trillion roubles, while the financial and economic justification for adopting the Law "On Insurance Pensions" established the indicators of 3.7–2.8 trillion roubles. This provided a completely wrong idea about the real transfers to the Pension Fund from the federal budget.

Compensations for reduced rates of insurance premiums constitute about 1 trillion roubles of total transfers. They do not relate to providing insurance pensions, but are subsidies for developing certain types of economic activities.

There was a thesis about the need to increase the retirement age so that the improved pension system ensured the independence of the Russian Pension Fund budget from transfers from the federal budget.[1] At the same time, the laws of all countries with the compulsory pension insurance system usually provide for subsidiary responsibility of the state for insurance pension funds.

The followers of balancing the compulsory pension insurance system did not consider the dynamics of the size of budget transfers to the Pension Fund of the Russian Federation: they provided almost half of the payments of insurance pensions in 2011, only one third in 2015 (despite the decrease in the basic insurance rate from 26% to 22%), and in 2018 (with an effective insurance rate of about 18%), the share of budget funds in financing insurance pensions was 27%.[2] In 2018, there was an accelerated growth of insurance pensions to level the protest moods of the population related to the increase in the retirement age. 500 billion roubles out of 1,840 billion budget transfers made up compensation for reduced rates of insurance premiums.[3]

[1] How much does the country's budget cost to support the Russian Pension Fund? URL: http://duma.gov.ru/news/27893/ (accessed on 29.05.2020).

[2] The same.

[3] The same.

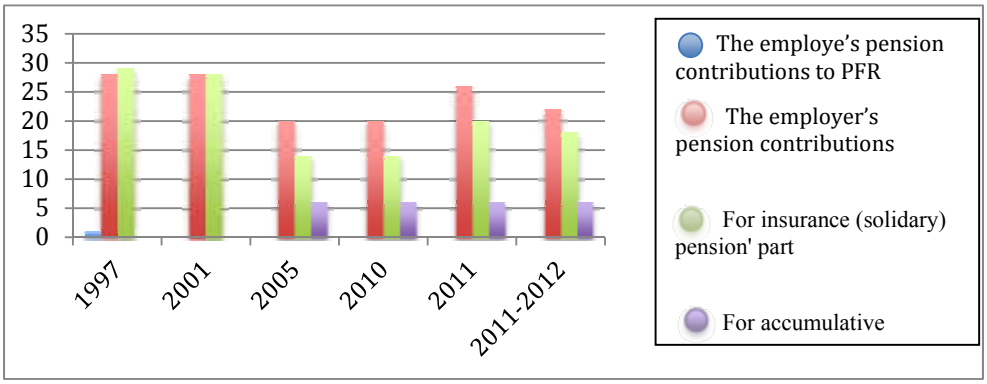

Fig. **Changes in rates for social contributions to the pension system, %**

Source: Federal Law of May 27, 1998 No. 79-FZ "On the Budget of the Pension Fund of the Russian Federation for 1997" (as amended and supplemented). URL: http://base.garant.ru/12111723/#ixzz6O6QUHy9a (accessed on 20.05.2020); Federal Law of August 8, 2001 No. 125-FZ "On the budget of the Pension Fund of the Russian Federation for 2001". URL: http://base.garant.ru/183608/#ixzz6O6RBsNwU (accessed on 20.05.2020); Federal Law of December 28, 2004 No. 184-FZ "On the Budget of the Pension Fund of the Russian Federation for 2005" (as amended and supplemented). URL: http://base.garant.ru/12138256/#ixzz6O6Ru6Kd4 (accessed on 20.05.2020); Federal Law of November 30, 2009 No. 307-FZ "On the budget of the Pension Fund of the Russian Federation for 2010 and for the planning period of 2011 and 2012". URL: http://base.garant.ru/12171299/ (accessed on 20.03.2020).

To avoid another pension reform, we suggest focusing on the current problems of the social insurance system, rather than criticizing the reforms of the pension system [3]. The current situation testifies to the reassurance of the state and the followers of balancing pension maintenance by raising the retirement age, which can lead to great social problems. We suggest considering the factors rarely mentioned in scientific discussions.

THE FIRST ISSUE IS DEVELOPING A REASONABLE TARIFF POLICY

One of the conditions for balancing the income and expenses of the Pension Fund is the tariff policy and the validity of decisions made in this field. In reality, we face permanent changes in this area. They concern both the calculation of the general tariff and the tariffs applied to certain types of economic activities or certain groups of citizens employed in the economy.

Changes to the tariff policy began in 2002 (*Fig.*). It was then decided to reduce the general rate of the pension insurance tariff from 28% to 22%. 6%[4] went to the funded system and, naturally, did not go to the Pension Fund to pay insurance pensions. At the beginning of the reform (before 2005), due to the need for a stepwise transition, the amount allocated to the funded pension was relatively insignificant (*Table 1*) — 81 billion roubles. However, after 2005, it increased from 385 billion roubles in 2005 to 1,519.8 billion roubles in 2014. Thus, due to a decrease in contributions to the PAYG component by mandatory contributions to the funded part, there appeared the major gap between the income and expenses of the Pension Fund.

The following step in the approaches to developing the tariff for pension insurance was a consistent decrease in insurance tariffs in general. From January 1, 2005, the rate of contributions to the Pension Fund was reduced from 28% to 20%. This was made not to maintain the balance of the

[4] According to the decision on a funded pension at the expense of compulsory contributions from the wages fund, employers had to consistently increase contributions from 2% in 2002 to 6% by 2007.

Table 1

Calculation of losses from changes in the rate of payment of insurance premiums to the FIU due to the introduction of a funded pension

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Remuneration for employees (including remuneration and mixed income not observed by direct statistical methods), thousand roubles	46.8	47.1	46.1	43.8	44.5	46.7	47.4	52.6	49.6	49.6	44.3	46.2	47.2
Volume of gross domestic output (current prices, billion roubles)	10 830.5	13 208.2	17 027.2	21 609.8	26 917.2	33 247.5	41 276.8	38 807.2	46 308.5	55 967.2	68 163.9	73 133.9	79 199.7
Potential funds not received by the Pension Fund due to the funded pension	304.2	373.1	470.7	568.5	719.2	931.6	1173.9	1224.8	1378.1	1665.6	1811.8	2027.3	2242.9
Funds not received by the Pension Fund due to the funded pension minus receipts from the informal sector	81.13	198.98	251.04	385.19	487.3	631.2	795.4	829.9	933.8	1128.6	1227.7	1373.7	1519.8

Source: developed and compiled by the authors.

Pension Fund of Russia, but to create more benefits for business and to bring wages out of the shadows. This decision was also justified by the "surplus" in financing the basic pension (14%). The new gap between the total income and expenses of the Pension Fund reached 318.8 billion roubles in 2005.

The artificial deficit of the Pension Fund income accumulated by 2005 due to the tariff reduction in favor of the funded pension and the reduction of the tariff rate by 8% amounted to about 558 billion roubles. Before the 2002 reform, even during the 1998 financial crisis, the balance of the Pension Fund was absolute: in 2001, the Pension Fund budget surplus was about 100 billion roubles, or almost 16% of annual insurance premiums. The first step in unbalancing the Pension Fund budget was made in 2001 by proceeding from the introduction of the Uniform Social Tax (UST), which approved recourse payments to social funds: the higher was the wage, the lower was the insurance payment. This is a unique innovation that does not exist almost anywhere else in the world. Employers started using this scheme to pay envelope wages. The wages of the majority of employees were reduced (and so the UST payments and receipts to the Pension Fund of Russia), and the wages of managers increased. A reduced social tax was charged and paid on higher wages. Consequently, the tariff manipulation had a negative effect on the social insurance system.[5]

The regression in the payment of insurance premiums created a paradox in the Russian pension system: increasing wages of employees reduced the Pension Fund income. This is explained by a few reasons. These are "gray" wage payment schemes, a reduction of employees, crisis conditions for the Russian economy, the desire of business to reduce tax payments, a decrease in the population and the employed in the economy, while this trend continues in the future, as well as relatively few (slightly over 15%) employees, for who a regressive scale of contributions to the pension fund was used [4]. The data of state statistics on wages in the context of industries for calculating revenues to the pension fund do not provide a real picture, since many people do not work full-time. For example, the indicated salary is 100 thousand roubles can in reality be 50 thousand roubles, and therefore no regression scale will apply to it.

The developers of the regression approach with contributions considered neither its short-term negative impact on the withdrawal of wages out of the shadows, nor the long-term consequences for the balance of the Pension Fund expenses and income. Artificial lowering the wages of employees to "save" the UST, in fact, creates the need for the government to provide support measures to poor pensioners in the future (i.e., additional transfers to the PAYG system), who failed to save for a normal pension due to the optimization of the UST payments by applying regression to high wages. Liabilities for payments of pensions, on the contrary, grew due to the need to index the latter to the inflation rate.

Dividing pensions into basic and insurance, introducing a regressive scale of the UST payment depending on the size of wages, decreasing the UST tariff by 8% and redirecting 6% of the tariff on creating a funded pension by 2007 increased the dependence of the Pension Fund budget on the federal budget: the share of receipts from the federal budget in the total Pension Fund budget exceeded 50% [5].

We consider the case of reducing tariffs for the payment of insurance premiums when introducing special tax payment regimes and for certain types of economic activity. The public analytical materials of the Federal Tax Service of Russia reveal that only for the period of 2014–2018, the num-

[5] In 2011, the UST was canceled, but from 2017 it was restored in the new transformation cycle of the tax system.

Table 2

Some indicators of special tax regimes applied in 2017–2018

Special Tax Regime Index	2017	2018	Growth rate
STS (Simplified Tax System):			
Income, bln roubles	13130	16967	129.2
Number of taxpayers, people	3056467	3241687	106.1
UTII (Unified Tax on Imputed Income):			
Income (imputed), bln roubles	892	904	101.3
Number of taxpayers, people	2044154	2072711	101.4
SAT (Single Agricultural Tax):			
Income, bln roubles	1549	1690	109,1
Number of taxpayers, people	100673	97035	96,4
Patent:			
Income (potential), bln roubles	215	242	112,5
Number of taxpayers who have been granted a patent, people	287766	325630	113,2

Source: Analytical review "The role of small business in the economy". URL: https://analytic.nalog.ru/portal/index.ru-RU.htm (accessed on 20.03.2020).

ber of taxpayers working in the simplified tax system increased by 29%, with a significant increase in 2017 and 2018 (106.3% and 106.1%, respectively). This is due to the following factors:

- low (compared to the general tax regime) tax rate (15% or 6%, depending on the selected tax object);
- a simplified accounting option;
- cancellation of corporate income tax, VAT and property tax of organizations or individuals (in relation to property that has no cadastral value).

These tax regimes allow to reduce the burden of paying insurance premiums to extra-budgetary funds. Introducing special tax regimes creates more favorable conditions for destructing the insurance principles of the current compulsory social security system, since the relationship between the size of wages and contributions to the Pension Fund is lost.

According to the Federal Tax Service,[6] in the Russian economy, 5.7 million of 8.1 million economic entities (organizations and individual entrepreneurs) applied special tax regimes at the beginning of 2019. At the end of 2018, the share of taxpayers applying special tax regimes in the total number of taxpayers was 71% (it was 59% in 2014). The share of taxpayers working under the gen-

[6] The role of small business in the economy. Analytical overview. URL: https://analytic.nalog.ru/portal/index.ru-RU.htm (accessed on 29.05.2020).

Table 3

Accrual and receipt of payments for taxes on total income for simplified tax regimes (as of 01.01.2019, thousand roubles)

Total in Russia	Total payments received	Income to social funds:		
		Federal Compulsory Medical Insurance Fund	Social Insurance Fund	Pension Fund of the Russian Federation
Tax imposed with the application of the simplified tax system	422 190 406	2346	2346	3492
Including:				
Tax imposed on taxpayers who chose income as a tax object	292 464 351	835	835	X
Out of it:				
Tax imposed on taxpayers who chose income as a tax object	292 447 695	X	X	X
Tax imposed on taxpayers who chose income as a tax object (for tax periods ended before January 1, 2011)	16 656	835	835	X
Tax imposed on taxpayers who chose income as a tax object reduced by expenses	129 942 671	349	349	X
Out of it:				
Tax imposed on taxpayers who chose income as a tax object reduced by expenses	129 935 665	X	X	X
Tax imposed on taxpayers who chose income as a tax object reduced by expenses (for tax periods ended before January 1, 2011)	7006	349	349	X
Minimum tax credited to the budgets of state non-budgetary funds [paid (collected) for tax periods that expired before January 1, 2011]	5816	1162	1162	3492
The minimum tax credited to the budgets of the constituent entities of the Russian Federation (for tax periods that expired before January 1, 2016)	–222 432	X	X	X
Unified tax on imputed income for certain types of activities	64 458 992	857	857	X
Including:				
Unified tax on imputed income for certain types of activities	64 441 838	X	X	X
Unified tax on imputed income for certain types of activities (for tax periods that expired before January 1, 2011)	17 154	857	857	X

Table 3 (continued)

Total in Russia	Total payments received	Income to social funds:		
		Federal Compulsory Medical Insurance Fund	Social Insurance Fund	Pension Fund of the Russian Federation
Single Agricultural Tax	13 628 402	159	288	X
Including:				
Single Agricultural Tax	13 623 914	X	X	X
Single Agricultural Tax (for tax periods ended before January 1, 2011)	4 488	159	288	X
Tax imposed with the application of the patent taxation system	12 467 406	X	X	X
Including:				
Tax imposed with the application of the patent taxation system, credited to the budgets of urban districts	5 023 309	X	X	X
Tax imposed with the application of the patent taxation system, credited to the budgets of municipal districts	1 340 935	X	X	X
Tax imposed with the application of the patent taxation system, credited to the budgets of cities of federal significance	5 999 727	X	X	X
Tax imposed with the application of the patent taxation system, credited to the budgets of urban districts with intracity division	103 427	X	X	X
Tax imposed with the application of the patent taxation system, credited to the budgets of intracity districts	8	X	X	X
Tax levied on the patent value due to the application of the simplified tax system	944	0	0	X
Including:				
Tax levied on the patent value due to the application of the simplified tax system	935	X	X	X
Tax levied on the patent value due to the application of the simplified tax system (for tax periods ended before January 1, 2011)	9	0	0	X

Source: Report adjusted by form No. 1-NM as of 01.01.2019, consolidated for the Russian Federation. URL: https://www.nalog.ru/rn77/related_activities/statistics_and_analytics/forms/7600100/ (accessed on 29.05.2020).

eral tax regime fell from 41% to 29%. Special tax regimes make it possible not only to reduce the tax burden, but also (as in the case of regression) create preconditions for paying under the counter, i.e. no payments to the Pension Fund system.

If we calculate the possible payments to the Pension Fund from organizations with the simplified option and have chosen income as the tax object, we will see a huge gap (*Tables 2, 3*).

At 22% rate, the contributions of these organizations from the wage fund to the Pension Fund of Russia should have been 199.46 billion roubles in 2018. In fact, they were only 3.4 billion roubles (*Table 3*) from all types of simplified taxation. The deficit of social contributions for those employed in organizations with preferential tax regimes is more than 200 billion roubles per year. Some items subject to taxation on total income by simplified tax regimes from *Table 4* had no contributions.

The deficit in the Pension Fund is primarily related to tax regulation, and then to demographic factors. Compared to 2014, the number of employees in organizations and individual entrepreneurs using the simplified tax system was about 12.5 million people in 2018, i.e. increased by 450 thousand people (by 3.7%). The total share of these employees in the total working population was about 19%. In other words, over 4 years the share of "normal" payers of social contributions (employed in enterprises with a regular tax regime) decreased by 450 thousand people. These are much greater losses than those associated with mortality and fertility.

Optimization of taxation and insurance contributions not only reduces potential revenues to the social security system, but also creates a strategic problem. In the long term, there will appear a large group of citizens unable to prove their seniority and the right for an insurance pension, since taxes were not paid for them. This means they will be doomed to poverty. There will also be a category of citizens for whom the minimum contributions to the Pension Fund were paid, which means they will receive a minimum pension. In this regard, in the future, the state will have to divert a significant amount of funds from the federal and regional budgets for social benefits for poverty [6].

The tax approach provides for various preferences in paying insurance premiums to the Pension Fund, in contrast to other economic and social factors, creates imbalances for the Pension Fund budget in the current period, and for the consolidated budget in the future (*Table 4*).

Table 4 shows that tax breaks provided for the payment of insurance premiums to off-budget funds for certain types of economic activity create no less problems. The information industry and financial activities have the greatest preferences. The highest burden is on industrial and manufacturing industries. The total income lost by the Pension Fund of Russia per year due to the difference in the percentage of contributions paid for all types of economic activity amounted to 378.7 billion roubles in 2017. The total tax transformations of insurance premium rates leads to a deficit in Pension Fund income of more than 578.7 billion roubles.

The situation in this area remains practically unchanged. Since 2019, new legislation in the field of employment has come into force.[7] However, self-employed citizens do not provide contributions to the compulsory insurance system (although they are able to). This deprives them of the right to receive state insurance pension. According to preliminary data from the Federal Tax Service, at the beginning of August 2019,

[7] Federal Law No. 422-FZ of November 27, 2018 "About carrying out an experiment on establishment of special tax regime "A tax on professional income" in the federal city of Moscow, in the Moscow and Kaluga regions as well as in the Republic of Tatarstan".

Table 4

Summary on the composition of organizations' labour costs by the studied types of economic activity in 2017

Type of economic activity	Wages fund of employees, thousand roubles	Insurance premiums for compulsory insurance paid to state extra-budgetary funds (thousand roubles)	Insurance premiums to the Pension Fund of Russia, thousand roubles	Effective percentage of insurance premiums in the Pension Fund of Russia	Lost insurance premiums, thousand roubles
Total in economics	11 893 227 607	3 189 194 016	2 237 735 807	18.8	378 774 266
Including:					
Mining	850 215 799	233 309 514	165 292 250	19.4	21 755 226
Manufacturing industries	2 953 628 531	852 557 596	616 267 314	20.9	33 530 963
Electricity, gas and steam supply; air conditioning	764 094 377	212 165 395	151 037 845	19.8	17 062 918
Water supply; wastewater disposal, waste collection and disposal, pollution elimination activities	172 749 589	47 900 215	34 080 248	19.7	3 924 661
Construction	762 373 272	201 900 578	140 910 716	18.5	26 811 404
Wholesale and retail trade. Repair of motor vehicles and motorcycles	1 515 036 821	394 875 375	273 672 429	18.1	59 635 671
Transportation and storage	1 491 321 134	406 574 075	287 268 384	19.3	40 822 265
Hotels and catering	164 514 135	45 610 429	32 449 298	19.7	3 743 812
Information and communication	560 908 484	126 339 669	81 466 991	14.5	41 932 876

Table 4 (continued)

Type of economic activity	Wages fund of employees, thousand roubles	Insurance premiums for compulsory insurance paid to state extra-budgetary funds (thousand roubles)	Insurance premiums to the Pension Fund of Russia, thousand roubles	Effective percentage of insurance premiums in the Pension Fund of Russia	Lost insurance premiums, thousand roubles
Financial and insurance	837 546 254	198 157 558	131 153 857	15.7	53 106 319
Real estate	321 088 487	84 778 399	59 091 320	18.4	11 548 147
Professional, scientific and technical activities	1 231 528 200	312 197 468	213 675 212	17.4	57 260 992
Administrative activities and related additional services	268 222 526	72 827 745	51 369 943	19.2	7 639 013
Industrial production (industry)	4 740 688 296	1 345 932 720	966 677 657	20.4	76 273 769

Source: developed and compiled by the authors based on Rosstat data. URL: https://www.gks.ru/labour_costs?print=1 (accessed on 10.06.2020).

there were 162 thousand people. These are the citizens who cannot count on an insurance pension if their insurance record (the period of payment of insurance premiums to the Pension Fund) is not at least 18 years. *Table 5* shows the calculations for the total aggregate losses per year after all types of reductions in the tariff rate for payment of insurance contributions to the Pension Fund of the Russian Federation for compulsory social insurance.

INDEXING PENSIONS

The second most important factor in the financial imbalance of the Pension Fund is the introduction of a system for indexing pensions.

To increase the size of pensions for a certain category of pensioners in 2010, the government carried out the valorization of pensions established during the Soviet period and in the period up to 2002. Indexing was neither associated with the growth of wages, nor with the growth of contributions to the Pension Fund. This sharply increased the Pension Fund expenses (the average labor pension in 2010 increased to 170.2% of the pensioner's subsistence minimum). According to Rosstat, in 2009 this ratio was 1.3 times.[8]

In general, the principles of indexing pensions in the Russian Federation are not

[8] On pension maintenance and the living standard of pensioners. URL: https://www.gks.ru/bgd/regl/b10_04/IssWWW.exe/Stg/d01/1-pens.htm (accessed on 20.05.2020).

Table 5

Results of tax changes in 2003–2018 (calculations were made in the statistics and budget parameters for the specified period)

No.	Budget losses of the Pension Fund of Russia	Billion roubles
1	Changes in tariff policy and introduction of compulsory funded pension	2841.3
1.1	By introducing insurance contributions for funded pension	682.2
1.2	By reducing the tariff from 26% to 22%	709.5
1.3	By reducing the tariff to 10% from wages above the insured level	851.4
1.4	Introduction of preferential tariffs for certain types of economic activities and the use of a simplified tax payment system	578.7
1.5	Benefits for TAD: 50 thousand jobs	19.5

Source: developed and compiled by the authors.

related to insurance approaches. According to the ILO recommendations,[9] the main criterion for the effectiveness of the compulsory pension system is the replacement rate for lost earnings, which should reach 40% [7]. In classical Western models of compulsory pension insurance, indexing pensions is aimed at maintaining this coefficient for those pensioners who left the labor market long ago. Indexing pensions is carried out strictly in proportion to the growth rate of wages. Consequently, indexing pensions takes place only if wages increase. This is the solution for balancing the income and expenses of the pension system. It is possible to increase expenses as much as income has increased.

In Russia, they followed this rule until the early 2000s. Then the principle was transformed. Pensions were now indexed at a higher rate. In such a way, a socio-political approach followed the normal economic approach: an accelerated rise in pensions to address poverty and political stability. If during this period the government distributed responsibility (the Pension Fund would be responsible for balancing the budget in terms of income, and the federal budget would take responsibility for fighting poverty among pensioners), then today the Pension Fund budget would have been perfectly balanced.

CONCLUSIONS

Thus, the problems of pension maintenance attract the attention of both Russian [8–11] and foreign specialists [12–16]. In their monograph "Criteria for disability in de-

[9] ILO Convention No. 102 "On Minimum Standards of Social Security" (Geneva, June 25, 1952) (as amended and supplemented). URL: http://base.garant.ru/2541190/ (accessed on 21.05.2020).

termining the retirement age and ways to modernize the compulsory social insurance system" [8], the authors investigated the issues of determining the retirement age on a large body of data. They proved that its increase in our country will not reach the expected effect in the future, due to the specifics of the Russian labor market, focused on workers of the most working age, demographic, economic and financial factors. The work discussed the problems of pension maintenance and social guarantees for workers employed in jobs with harmful and hazardous working conditions, as well as at enterprises in unfavorable climatic conditions. The authors of other publications devoted to pension issues also note the wrong decision to increase the retirement age and prove the financial inconsistency of this approach [9]. One of the main reasons for the Russian Government to reform the pension system was an attempt to find financial resources by reducing the number of pension recipients. The projected savings should have amounted to about 800 billion roubles, but they did not consider that "... for example, RUB700 billion roubles of potential savings will be spent on increasing pensions ..." [9]. These disadvantages of reforming the pension system are pointed out by Yu. M. Voronin and Yu. N. Maksimov in their work "Once again on the reform of the pension reform of the 2018 model: It is prudent to postpone — the appeal of scientists to the deputies of the State Duma" [11].

Foreign authors pay great attention to the health issues of older workers before and after retirement [12], since it is the most important factor in determining the criteria for retirement. Scientists in European countries pay attention to the need to consider risks that may arise between generations with their pension maintenance [13, 14]. Austrian researcher points out that many pension systems are regressive due to differences in life expectancy across occupational groups, which must be considered when building pension systems [14]. It is advisable to better study the French pension reform that resulted in the unemployment decrease among older workers [15].

However, the experience of developing countries was not fully considered. For example, Taiwanese experts note that when implementing innovations, it is necessary to consider the institutional and socio-cultural contradictions that can jeopardize the results of reforming the system [16].

The analysis of the Russian compulsory pension insurance system based on statistical data, as well as the generalization of research by Russian and foreign scientists on this topic, allows us to make the following conclusions.

First, the ongoing reforms did not balance the compulsory pension insurance system. On the one hand, the regression in the payment of insurance premiums led to a decrease in the Pension Fund income. On the other hand, an artificial understatement of wages to reduce the amount paid by the UST in the long term may lead to an increase in the number of poor pensioners. This, in turn, will require the state to support certain costs.

Second, the use of special tax regimes in for insurance pension contributions leads to the destruction of insurance principles and causes an imbalance for the Pension Fund budget at the present time, and for the funded one in the future.

The main problems in the pension system of Russia are related not to the demographic situation, but with the imbalance in the Pension Fund budget as a result of numerous reforms in the tariffs of contributions to pension insurance and implementing social programs to increase the income of pensioners of the Soviet period.

A few conditions must be satisfied for the financial stabilization of compulsory pension insurance in the Russian Federation. First, a special national actuarial center must be now authorized to set tariffs for

contributions to the Pension Fund. It should be independent from the Government of the Russian Federation and be governed on the basis of tripartism.

Second, it is necessary to redistribute the responsibility between the Pension Fund and the Ministry of Finance of Russia. The Pension Fund should be responsible for indexing pensions by income level. The Ministry of Finance of Russia should be responsible for financing special pensions and additional indexing to a level above inflation.

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Algorithm for Internal State Financial Control by the Treasury of Russia: Problems and Solutions

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ABSTRACT

The paper discusses an integrated research of implementing internal state financial control by the Federal Treasury. **The aim** of the study is to show the organization and stages (algorithm) of implementing internal state financial control, to identify problems and possible solutions. **The relevance** of the study determines the modern development of financial control, aimed at automation and digitalization. Scientific novelty is in systematizing problems of financial control and finding new solutions. The author uses **methods** of analysis, synthesis, induction, deduction, scientific abstraction, logical thinking, the dialectical method of cognition and observation. The study **results** in describing an algorithm for internal state financial control by the Treasury of Russia, and identifies problems (weaknesses) related to the planning and implementation of control measures in the financial and budgetary sphere, as well as possible solutions. The author points out the need to revise the procedures for implementing internal state financial control and its new forms with the current methods of financial control. The study suggests such a new form of financial control as automated remote financial monitoring, which warns on the impermissibility of violations in the financial and budgetary sphere. The author **concludes** that in order to automate and digitalize internal state financial control, it is necessary to create a unified information base, including systematized information according to the criteria set by the state. This will allow for a deeper economic analysis of using budgetary funds allocated by the state for certain purposes, at the stages of preliminary and subsequent control, that will improve and increase the efficiency of financial control, and save time and labor during control activities. The author **recommends** to improve the regulatory framework governing the implementation of financial control by the Russian Treasury, including internal state financial control.

Keywords: Federal Treasury; financial control; internal state financial control; control measures; financial and budgetary sphere

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INTRODUCTION

There are many gaps that impede the further development of implementing financial control. First, we would like to emphasize to the lack of a single regulatory legal act in the field of finance in the Russian Federation (hereinafter — Russia), that would document basic concepts such as "financial system", "structure of the financial system" and "financial control". These concepts are the foundation for an effective model of the state financial management system, which is the subject of ongoing research [1] and generates a diverse approach to their interpretation.

Before, Presidential Decree No. 1095 (25.07.1996) "On measures to ensure state financial control in the Russian Federation" [1] indicated what includes state financial control and which authorities it is entrusted to. However, the Decree became invalid in 2018.

Under Art. 265 of the Budget Code of the Russian Federation,[2] state (municipal) financial control is currently divided into external and internal, preliminary and subsequent.

At the federal level, external state financial control is the control activity of the Accounts Chamber of the Russian Federation, the authority of internal state financial control lies with the Federal Treasury.

At the regional level, under the regulatory legal acts of the constituent entities of the Russian Federation, external state financial control is exercised by the control and accounting bodies of the constituent entities of the Russian Federation, and internal state financial control is exercised by the executive authorities of the constituent entities of the Russian Federation.

At the municipal (local) level, under the regulatory legal acts of local governments in each constituent entity of the Russian Federation, external municipal financial control is exercised by the control and accounting bodies of municipalities, and internal state financial control is exercised by municipal financial control bodies, which are local administration bodies in the constituent entities of the Russian Federation.

In Russia, much attention is paid to the implementation of external and internal state (municipal) control.

When analyzing the implementation of external state financial control in the scientific literature, they often investigate the performance audit within the state financial control system [2], as well as issues of its improvement [3–6].

The directions of development of internal state financial control, problems and solutions are also discussed in scientific legal and economic literature [7–18], at various meetings,[3] seminars [19] and international conferences [20–23].

Head of the Federal Treasury R. E. Artyukhin and the Deputy Head of the Federal Treasury in charge of control in the financial and budgetary sphere E. A. Isaev gave interviews,[4] where highlighted the devel-

[1] Presidential Decree No. 1095 (25.07.1996) (as amended on 18.07.2001). On measures to ensure state financial control in the Russian Federation (invalidated from October 25, 2018 due to the issuance of the Decree of the President of the Russian Federation of October 25, 2018 No. 610).

[2] Budget Code of the Russian Federation of July 31, 1998 No. 145-FZ (as amended on July 31, 2020).

[3] Presentation by E.A. Isaev "Specific of the implementation of control in the financial and budgetary sphere in 2020 and prospects for 2021" (presented at a videoconference meeting in the Federal Treasury on May 20, 2020). URL: https://roskazna.ru/kontrol/vnutrenniy-gosudarstvennyy-finansovyy-kontrol/ (accessed on 20.08.2020). A meeting of the Working Group of the Accounts Chamber of the Russian Federation and the Federal Treasury on State Financial Control took place on May 27, 2020. URL: https://roskazna.ru/novosti-i-soobshheniya/novosti/1440888/ accessed on 20.08.2020). On August 7, 2020, Deputy Head of the Federal Treasury Eli Isaev held a videoconference meeting with the territorial bodies of the Federal Treasury on the implementation of control activities in 2020 and planning for 2021. URL: https://roskazna.gov.ru/novosti-i-soobshheniya/novosti/1451411/ (accessed on 20.08.2020).

[4] Interview with the Head of the Russian Treasury R.E. Artyukhin "The Russian Treasury feels confident about the future and is dynamically developing" in Finance journal. 2017;(11):3–8. URL: https://roskazna.ru/upload/iblock/071/finansy-_-11–2017-_r.e.-artyukhin.pdf (accessed on 20.08.2020). Interview with the Deputy Head of

opment prospects of the Federal Treasury, including those related to the direction of internal state financial control.

At the legislative level, the authority of control and supervision in the financial and budgetary sphere lies with the Federal Treasury and its territorial bodies are regulated by the Budget Code of the Russian Federation (Article 269.2), the implementation standards for the internal state (municipal) financial control[5] (provided for in clause 3 of Article 269.2 of the Budget Code of the Russian Federation), the rules for the Federal Treasury to control the financial and budgetary sphere, approved by the Government of the Russian Federation dated November 28, 2013 No. 1092 (as amended on December 27, 2019)[6] (which are applied to control activities started before August 24, 2020 — before the release of the Standard approved by the Russian Government Decree of August 17, 2020 No. 1235), the rules approved by the Russian Government Decree of 11.28.2013 No. 1092 (as amended on August 17, 2020),[7] the Regulation on the Federal Treasury, approved by the Government of the Russian Federation of 01.12.2004 No. 703 [p. 5.15 (1)],[8] the Housing Code of the Russian Federation of December 29, 2004 No. 188-FZ

the Russian Treasury E.A. Isaev "It is necessary to improve control methods and introduce new effective tools into practice" in Finance journal. 2017;(11):17–22. URL: https://roskazna.ru/upload/iblock/57e/finansy-_-11–2017-_e.a.-isaev_.pdf (accessed on 20.08.2020).

[5] Decree of the Government of the Russian Federation of 06.02.2020 No. 95 "On approval of the federal standard for internal state (municipal) financial control "Principles of control activities of internal state (municipal) financial control" (effective from 01.07.2020). Decree of the Government of the Russian Federation of 06.02.2020 No. 100 "On Approval of the Federal Standard for Internal State (Municipal) Financial Control "Rights and Obligations of Officials of Internal State (Municipal) Financial Control Bodies and Objects of Internal State (Municipal) Financial Control (their officials) implementation of internal state (municipal) financial control" (effective from 01.07.2020). Decree of the Government of the Russian Federation of 27.02.2020 No. 208 "On approval of the federal standard for internal state (municipal) financial control "Planning inspections, audits and surveys" (effective from 01.07.2020). Decree of the Government of the Russian Federation of August 17, 2020 No. 1235 "On approval of the federal standard for internal state (municipal) financial control "Conducting inspections, audits and examinations and registration of their results" (applies to control activities begun on August 24, 2020). Decree of the Government of the Russian Federation of July 23, 2020 No. 1095 "On approval of the Federal standard for internal state (municipal) financial control "Implementation of the results of inspections, audits, surveys". Decree of the Government of the Russian Federation of August 17, 2020 No. 1237 "On approval of the federal standard for internal state (municipal) financial control "Rules for pre-trial appeal of decisions and actions (inaction) of internal state (municipal) financial control bodies and their officials". Order of the Treasury of Russia dated 01.03.2017 No. 39 (as amended on 05.12.2018) "On approval of the Standard for the internal organization of a control event "General requirements for the internal organization of a control event" (planned to be canceled). Order of the Treasury of Russia dated December 29, 2017 No. 385 "On approval of the Standard of internal organization "Exercise by the Federal Treasury of powers on internal state financial control in the field of budgetary legal relations". Order of the Ministry of Finance of Russia dated 03.10.2018 No. 203n "On approval of the Standard for the implementation of internal state financial control by the Federal Treasury "Checking the provision of subsidies from the federal budget to federal budgetary and autonomous institutions and (or) their use" (effective from 29.12.2018). Order of the Ministry of Finance of Russia dated 05.28.2018 No. 113n "On approval of the Standard for the implementation of internal state financial control by the Federal Treasury "Verification of the provision of interbudgetary transfers from the federal budget for a specific purpose, and (or) their use" (effective from 14.08.2018).

[6] Decree of the Government of the Russian Federation of November 28, 2013 No. 1092 (as amended of December 27, 2019) "On the procedure for the exercise by the Federal Treasury of powers to control the financial and budgetary sphere" (together with the "Rules for the exercise by the Federal Treasury of powers to control in the financial and budgetary sphere") (as amended and supplemented, entered into force on 03.01.2020) (applies to control activities initiated before 24.08.2020).

[7] Decree of the Government of the Russian Federation of November 28, 2013 No. 1092 (as revised on August 17, 2020) "On the procedure for the Federal Treasury to exercise its powers to control the use of specialized non-profit organizations that carry out activities aimed at ensuring the overhaul of common property in apartment buildings, funds, received as state support, municipal support for capital repairs, as well as funds received from the owners of premises in apartment buildings that form capital repair funds on the account (accounts) of the specified specialized non-profit organizations" (together with the "Rules for the exercise by the Federal Treasury of powers to control the use of specialized non-profit organizations that carry out activities aimed at ensuring the overhaul of common property in apartment buildings, funds received as state support, m municipal support for capital repairs, as well as funds received from owners of premises in apartment buildings that form capital repair funds on the account (accounts) of the specified specialized non-profit organizations") (entered into force on 27.08.2020).

[8] Resolution of the Government of the Russian Federation of 01.12.2004 No. 703 (as amended on 15.06.2019) "On the Federal Treasury".

(Article 186),[9] Federal Law of July 21, 2007 No. 185-FZ (part 1.2 of Article 20),[10] Federal Law of April 05, 2013 No. 44-FZ (parts 8, 9 and 11.2 of Art. 99)[11] and the Code of the Russian Federation on Administrative Offenses (Part 1 of Art. 28.3, Clause 11 of Part 2 of Art. 28.3, 23.7).[12] In some cases, by the Administrative Regulations approved by Order of the Ministry of Finance of Russia dated March 20, 2014 No. 18n.[13]

Planning and selecting control objects, as well as organizing control measures (hereinafter — CM) is carried out under the orders of the Russian Treasury dated July 13, 2018 No. 199,[14] dated December 26, 2018 No. 433,[15] dated January 31, 2017 No. 15[16] and dated December 16, 2019 No. 401,[17] and is also regulated by the Federal Law of 02.05.2006 No. 59-FZ.[18]

When carrying out CM and implementing inspection materials, officials of the Federal Treasury and its territorial bodies exercise their powers under the rules approved by the Government of the Russian Federation of November 28, 2013 No. 1092 (as amended on 12.27.2019) and (as amended on 08.17.2020), the standards for implementing internal state (municipal) financial control, including the Standard approved by order of the Treasury of Russia dated 01.03.2017 No. 39, and the Standard approved by the Government of the Russian Federation dated 17.08.2020 No. 1235, the Code of the Russian Federation on Administrative Offenses, orders of the Treasury Russia dated 28.05.2019 No. 17n, dated 16.12.2019 No. 401, dated 14.06.2016 No. 9n, dated 30.11.2016 No. 437, dated 28.11.2017 No. 328, dated 28.09.2018 No. 288, dated 18.08.2017 No. 206 and dated December 29, 2017 No. 402, the Classifier of violations (risks) detected by the Federal Treasury in the course of control in the financial and budgetary sphere (approved by the Federal Treasury on December 19, 2017),[19] by the Accounts Chamber of the Russian Federation No. 128, the Ministry of Finance of Russia No. 214n dated 25.12.2015,[20] as well as by the Decree of the

[9] Housing Code of the Russian Federation of December 29, 2004 No. 188-FZ (as amended on July 31, 2020).

[10] Federal Law of 21.07.2007 No. 185-FZ (as amended on 07.04.2020) "On the Fund for Assistance to Reforming the Housing and Communal Services".

[11] Federal Law No. 44-FZ of 05.04.2013 (as amended on 31.07.2020) "On the contractual system in the field of procurement of goods, works, services to meet state and municipal needs.".

[12] Code of the Russian Federation on Administrative Offenses of December 30, 2001 No. 195-FZ (as amended on July 31, 2020) (as amended and supplemented, entered into force on August 11, 2020).

[13] Order of the Ministry of Finance of Russia dated March 20, 2014 No. 18n "On Approval of the Administrative Regulations for the Execution of the State Function of Control in the Financial and Budgetary Sphere by the Federal Service for Financial and Budgetary Supervision".

[14] Order of the Russian Treasury dated July 13, 2018 No. 199 (as revised on August 24, 2018) "On approval of the Procedure for planning control measures in the financial and budgetary sphere carried out by the Federal Treasury and departments of the Federal Treasury for the constituent entities of the Russian Federation, and invalidating some orders of the Federal Treasury" (planned to be canceled).

[15] Order of the Treasury of Russia dated December 26, 2018 No. 433 «On approval of methods for selecting control measures for developing plans for control measures of the Federal Treasury and territorial bodies of the Federal Treasury in the financial and budgetary sphere» (planned to be canceled).

[16] Order of the Treasury of Russia dated January 31, 2017 No. 15 (as amended on May 30, 2018) "On approval of the Rules for assigning identifiers for control measures of the Federal Treasury and its territorial bodies in the financial and budgetary sphere".

[17] Order of the Treasury of Russia dated December 16, 2019 No. 401 (as revised on March 18, 2020) "On approval of the Classifier of internal (operational) treasury risks in the areas of activity of the Federal Treasury department for a constituent entity of the Russian Federation (constituent entities of the Russian Federation located within the boundaries of the federal district)".

[18] Federal Law of 02.05.2006 No. 59-FZ (as amended on 27.12.2018) "On the procedure for considering applications from citizens of the Russian Federation".

[19] Classifier of violations (risks) detected by the Federal Treasury in the course of control in the financial and budgetary sphere (approved by the Federal Treasury on December 19, 2017, as amended on December 31, 2019).

[20] Order of the Accounts Chamber of the Russian Federation No. 128, the Ministry of Finance of Russia No. 214n dated 25.12.2015 (as amended on 24.08.2017) "On approval of the Regulation on the state information system "The official website of the Russian Federation in the information and telecommunication network Internet for posting information on the implementation of the state (municipal) financial audit (control) in the field of budgetary legal relations".

President of the Russian Federation dated 03.03.1998 No. 224.[21]

In 2020, due to the spread of coronavirus infection COVID-19 on the territory of Russia, when carrying out control measures, the Federal Treasury is also guided by the Decree of the Government of the Russian Federation of 03.04.2020 No. 438,[22] under which some restrictions are associated with the implementation of field CM [the grounds for the departure of officials persons of internal state (municipal) financial control bodies can only be orders of the President of the Russian Federation, the Government of the Russian Federation and the requirements of the prosecutor].

The reporting on the CM conducted by the Federal Treasury and its territorial bodies is documented under the order of the Ministry of Finance of Russia dated 05.18.2016 No. 67ni[23] and the order of the Federal Treasury No. 375[24] dated 22.11.2018.

RESEARCH RESULTS

Based on the regulatory legal acts specified in this article, we conclude that it takes a lot of time and energy to plan and implement CM, as well as the materials.

The procedure for implementing the CM conducted by the Federal Treasury and its territorial bodies under paragraph 2 of Art. 269.2 of the Budget Code of the Russian Federation in the form of inspections (field and office), audits and surveys, is enshrined in the rules for the exercise by the Federal Treasury of powers to control the financial and budgetary sphere, approved by the Government of the Russian Federation dated November 28, 2013 No. 1092 (refers to CM, started before August 24 2020), as well as the standards for internal state (municipal) financial control, including the Standard for the internal control event "General requirements for the internal organization of the control event", approved by Order of the Treasury of Russia dated 01.03.2017 No. 39, as well as the Federal Standard internal state (municipal) financial control "Conducting inspections, audits and examinations and registration of their results", approved by Decree of the Government of the Russian Federation of August 17, 2020 No. 1235 (applies to CM, started on August 24, 2020).

Until August 24, 2020, the procedure for implementing CM, enshrined in clause 28 of the rules approved by Decree of the Government of the Russian Federation dated November 28, 2013 No. 1092 (as amended on December 27, 2019), included the appointment of CM, their implementation and implementation of the results.

Starting from August 24, 2020, the appointment of CM, their preparation and conduct [including the appointment (organization) of examinations, the registration of their results] and the registration of the results of the CM are governed by clause 2 of the Federal standard approved by the Decree of the Government of the Russian Federation dated August 17, 2020 No. 1235. The implementation of the results of the CM are governed by the Federal Standard approved by the Decree of the Government of the Russian Federation of July 23, 2020 No. 1095.

Under clause 1.4 of the Standard approved by Order of the Treasury of Russia

[21] Decree of the President of the Russian Federation of 03.03.1998 No. 224 (as amended on 25.07.2000) "On ensuring the interaction of state bodies in the fight against offenses in the economic sphere".

[22] Decree of the Government of the Russian Federation of 03.04.2020 No. 438 (as amended on 28.07.2020) "On the specifics of the implementation in 2020 of state control (supervision), municipal control and on amending paragraph 7 of the Rules for preparation by state control (supervision) and control of annual plans for scheduled inspections of legal entities and individual entrepreneurs".

[23] Order of the Ministry of Finance of Russia dated 05.18.2016 No. 67ni (as amended on 04.04.2017) "On approval of the form and procedure for submitting a report on the results of the Federal Treasury of control measures in the financial and budgetary sphere".

[24] Order of the Treasury of Russia dated November 22, 2018 No. 375 "On the submission of reports, information, information, documents on the implementation of control measures in the financial and budgetary sphere and the monitoring of control activities" (as amended on May 14, 2020).

dated 03.01.2017 No. 39 (also applies after August 24, 2020, until the release of the new departmental standard), the stages of CM implementation are more detailed and include planning, preparation and appointment of CM, conducting and formalizing their results, reviewing and implementing them, monitoring the execution of submissions (instructions) for the results, as well as reporting on the results.

Fig. shows an algorithm for the internal state financial control of the Treasury of Russia, which allows for the clear view of the mechanism for exercising control in the financial and budgetary sphere at the federal level step by step (by actions, stages), as well as the complexity and risk intensity of the process itself, associated with the need for strict adherence to the regulations established at the legislative level of procedures and deadlines. In certain life situations, in practice, weak points (problems) requiring solutions (sometimes global ones) are identified.

Table contains a list of problems in implementing state financial control by the Treasury of Russia and possible solutions.

Despite today's problems, all executive authorities, including the Treasury of Russia, are being digitalized and automated [24, 25]. Therefore, implementing internal state financial control, the mechanism for detecting violations in the financial and budgetary sphere also require the development of other control principles and methods [26]. It is also necessary to increase the forms of existing control methods (for example, to introduce remote forms when carrying out desk inspections), not excluding the use of international experience [27, 28].

For example, today at the legislative level (Art. 267.1 of the Budget Code of the Russian Federation) methods of financial control in the form of inspections, audits and surveys are documented. They state that "inspections are divided into office and field, including counter ones". At the same time, they do not describe the forms of implementing CM.

Within preliminary control, considering the risk-oriented approach by the Federal Treasury, there must be a law to consolidate the application of analysis and monitoring during the implementation of control and expert-analytical measures in the prescribed manner [as it is provided for (municipal) control (clause 3 of Art. 268.1).

At the stage of preliminary financial control, we propose automated remote financial monitoring as a new control form. The monitoring should result in a automatically created document warning of a possible offense in the financial and budgetary sphere, including an administratively punishable one.

The idea of the proposed innovations is as follows. At the stage of budget execution, the "Electronic Budget" system and the Unified Information System in procurement carry out information interaction at the stage of preliminary control according to criteria and parameters defined by the state. This considers a risk-oriented approach using methods of economic and mathematical modeling. The calculation procedure and the selection of criteria and parameters must be documented in a regulatory legal act. Recipients of funds from the federal budget (including subsidies, subventions, loans, investments, etc.) receive an automatic warning about the inadmissibility of violations in the financial and budgetary sphere, recorded in an automatically generated document. We see this document as a Warning about the inadmissibility of violations in the financial and budgetary sphere.

If the control object ignores and does not correct the deficiencies (signs of violations) identified automatically mode or does not provide the control body with objective reasons why they cannot be eliminated, including those proving the absence of guilt

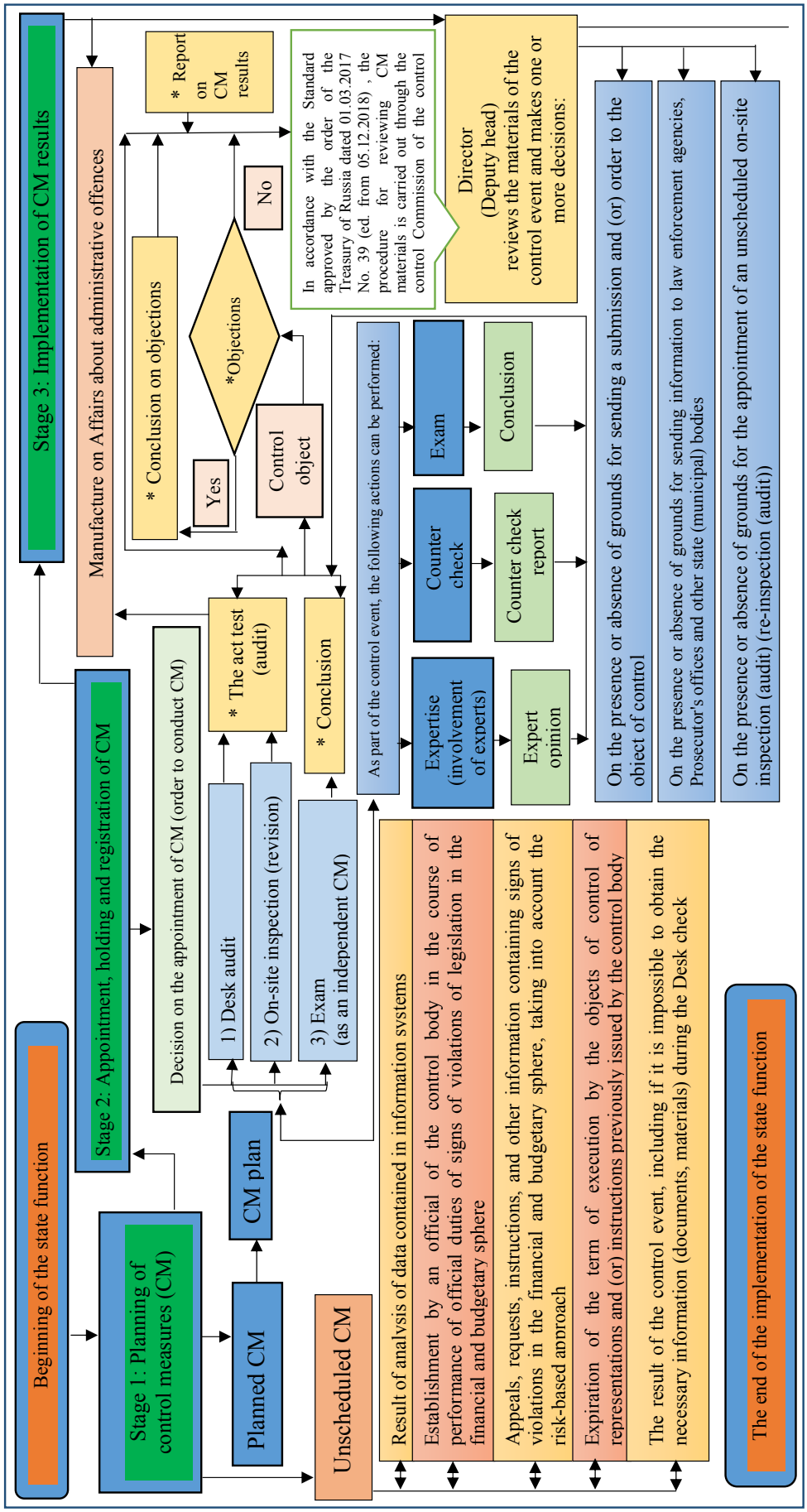

Fig. **Algorithm of internal state financial control of the Russian Treasury**
Source: data visualization by the author based on the Standards approved by the resolutions of the Government of the Russian Federation of 27.02.2020 No. 208, of 17.08.2020 No. 1235, and of 23.07.2020 No. 1095.

Table

Problems in implementing state financial control by the Treasury of Russia and possible ways to eliminate them

No.	Action	Problems (weaknesses) related to appointing, conducting and implementing control measures (according to the author)	Possible solutions for eliminating problems (weaknesses) and reducing the risks
1	2	3	4
1.	**CM planning**		
1.1	Financial and budgetary sphere	1. The lack of clear, normatively established, uniform, regulated and systematized sources of information that are the basis for planning and assigning CM (considering a risk-based approach)	1. Integration of systematized information from various sources into the applied software product ASP-Planning (hereinafter – PPP ASP-Planning) of the Federal Treasury, as well as other publicly available open information posted on the Internet (for example, data from the Unified State Register of Legal Entities from the website of the tax inspection) in order to select objects of control according to the risk intensity criteria established by law when planning CM
		2. The lack of accounting in the costs of working time of controllers-auditors, considering the timing of working hours, the statutory period of time associated with preparing for CM (for reference: under clause 29 of the Administrative Regulations approved by order of the Ministry of Finance of Russia dated 20.03.2014 No. 18n deadline implementation of the administrative procedure for the preparation and appointment of a control measure in the Federal Service for Financial and Budgetary Supervision was no more than ten working days. In practice, this period was no more than three days, was recorded in the inspection report (as preparatory procedures for CM) and was included in the period for the implementation of CM with the entry of time expenditures in man-days in the SPP ASP-Planning)	2. The previous experience of organizing CM, accumulated earlier by the Federal Service for Financial and Budgetary Supervision should be considered. The departmental legal act of the Federal Treasury should provide a period of time that allows the controller-auditor [primarily the head of the audit (verification) group] to prepare for the CM rogram, the work plan for conducting the CM, familiarize the members of the verification (audit) group with the issues of verification, study the regulatory legal acts, issue an order for the CM, get acquainted with the acts of previous CM related to the object of control, study financing, as well as the main directions of its use, etc.
		3. Planning of control objects is based on the regular staffing of the control and auditing unit, and not from the actual staffing. Therefore, the number of checks per one auditor is more than the norm. As a result, the duration of the CM and the composition of the audit (verification) group has to be reduced to fulfill the entire staff load provided for by the approved CM Plan of the Federal Treasury and the CM Plan of the territorial bodies, which cannot but affect the quality of CM and the labor intensity of the process	3. To introduce changes to the methods for calculating load indicators on structural divisions of territorial bodies when planning CM, which is Appendix No. 10 to the Procedure for planning control measures in the financial and budgetary sphere, carried out by the Federal Treasury and departments of the Federal Treasury for the constituent entities of the Russian Federation, approved by order of the Federal Treasury of 13.07.2018 No. 199, planning CM for the corresponding year according to the actual number, based on the data as of December 31, preceding the planned period, since no territorial bodies will be able to change the number of the population in the next year in the next two to three months, since admission to the civil service is carried out in compliance with a number of procedures that take time

Table (continued)

No.	Action	Problems (weaknesses) related to appointing, conducting and implementing control measures (according to the author)	Possible solutions for eliminating problems (weaknesses) and reducing the risks
1.2	Consideration of written appeals on issues of control measures in the financial and budgetary sphere	1. The control body sometimes receives appeals from citizens and legal entities in order to punish the "offenders", using the financial control body as an "instrument of revenge". Moreover, the appeals of these persons are sometimes annoying and are about nothing. For example, they may first point to violations in the field of wages, reflecting in their appeal fabulous amounts of payments to the heads of state institutions and underpayments to employees, which in practice is not confirmed by the results of the CM. Then they report about the outstanding work in the same institution, which CM also do not confirm. Thus, the state financial control body spends money and time on mindless CM, which negatively affects the performance of control activities	1. Since the Federal Standard of 06.02.2020 No. 100 deproves the state control body of the right not to consider the applications of unscrupulous citizens and legal entities, it is proposed to consider the possibility and procedure for specific actions for the state control body in the departmental regulatory legal act
2.	**Appointment, conduct and registration of CM**		
2.1	Organization and conduct of CM (planned and unplanned)	1. The Classifier of violations (risks) does not detail violations (risks), including those related to illegal and ineffective spending of federal budget funds. 1. There is also a closed list of violations in the absence of such a type of violation as "Other violations (risks), shortcomings in the financial and budgetary sphere". This does not help develop the versatility and nature of detected violations (to find atypical violations) and subsequently note them in the statements of the Federal Treasury, formed when posting the results of control measures in the PPP ASP-Planning. Moreover, references to regulatory legal acts in the Classifier are largely outdated due to the changes in the legislation of the Russian Federation	1. Today, the Classifier of violations (risks) requires changes, including due to changes in the norms of law. The references by type of violation are given in this regulatory legal act applied by the Federal Treasury
		2. There are contradictions in implementing CM procedures. Under clauses 48, 61 and 62 of the rules approved by the Government of the Russian Federation dated November 28, 2013 No. 1092 (as amended on December 27, 2019), applied to CM, started before August 24, 2020, based on the results of an on-site inspection (revision) first, a certificate of completion of control actions is drawn up, and then, an act, which must be signed within 15 working days after signing a certificate of completion of control actions. Meanwhile, under clauses 5.6.19 and 5.6.20 of the Standard approved by Order of the Treasury of Russia dated 01.03.2017 No. 39, a certificate of completion of control actions and an inspection report are drawn up and handed over to the control object simultaneously (the time for compiling an act within 15 working days by the Federal by the Treasury in the departmental regulatory legal act was excluded) Today, due to the release of the Standard dated August 17, 2020 No. 1235 (applied to CM started after 08/24/2020), the CM procedure is also not clear. This Standard sets deadlines for conducting CM, but at the same time it is indicated that control actions are carried out and an inspection (audit) act and a conclusion based on the results of the survey are drawn up. Thus, clause 48 of this Standard states that "the registration of the results of inspections (audits), counter inspections, examinations assigned under clauses 36 and 42 of the Standard is carried out within 15 working days from the end date of control actions". Registration of the results of other surveys is carried out no later than the last day of the survey. It is not clear why 15 working days are provided for registration of the results, since this period is included in the CM period. In this case, the control body is limited in time to carry out control actions. If 15 working days period is not included in the CM period and this period is really intended for registering the CM results, then it is not clear how to calculate the CM period and what it includes. Also, the reference in clause 33 to clause 19 of this Standard is not clear, whether all the control actions specified in it are applicable to a desk audit (for example, inventory, measurement, etc.), which is carried out exclusively at the place of the control object	2. It is proposed to clarify the procedure for CM implementation in the departmental Standard of the control body

Table (continued)

No.	Action	Problems (weaknesses) related to appointing, conducting and implementing control measures (according to the author)	Possible solutions for eliminating problems (weaknesses) and reducing the risks
3.	**Implementation of CM results**		
3.1	Organizing implementation of CM results	1. The lack of a normatively established period of time for the implementation of the completed CM and accounting it in the cost of working time, considering the timing, leads to the fact that after CM are complete, the inspectors have to simultaneously participate in the next CM and draw up the materials of the previous one, which affects the CM quality. In practice, the Federal Service for Financial and Budgetary Supervision for a period of no more than 15 working days provided item 45(b) of the Administrative Regulations approved by Order of the Ministry of Finance dated 20.03.2014 No. 18n. In fact, it took 3 to 15 working days, depending on the nature of the violations, since administrative liability is provided for some offenses. Therefore, under the Code of Administrative Offenses of the Russian Federation, it was required to draw up a protocol on an administrative offense	1. It is proposed to amend the methods for calculating load indicators on structural divisions of territorial bodies when planning a CM, which is Appendix No. 10 to the Procedure for planning control measures in the financial and budgetary sphere, carried out by the Federal Treasury and departments of the Federal Treasury for the constituent entities of the Russian Federation, approved by Order of the Federal Treasury of 07.13.2018 No. 199, providing when planning the CM for the corresponding year, considering the load in time, allowing the controller-auditor: – to initiate cases of administrative offenses and conduct administrative investigations; – enter the CM results in the PPP ASP-Planning; – enter information about the CM results in the state information system "The official website of the Russian Federation in the information and telecommunications network Internet for posting information on the implementation of the state (municipal) financial audit (control) in the field of budgetary legal relations", whose placement procedure is stipulated by the Order of the Treasury of Russia dated December 29, 2017 No. 402, or assign these responsibilities to other officials. Today, this responsibility has been assigned by the Federal Treasury to auditors. For reference: in the Federal Service for Financial and Budgetary Supervision, these functions were delimited among other departments (legal and control and analytical in accordance with the specifics of the duties performed)
3.2	Execution of proceedings on cases of administrative offenses and registration of cases on administrative offenses	1. In the Federal Treasury, the lack of a normative legal act regulating the procedure for initiating and considering "secret" and "top secret" cases of administrative offenses	1. It is proposed to provide for the procedure for initiating and considering "secret" and "top secret" cases of administrative offenses in the Order of the Treasury of Russia dated November 30, 2016 No. 437 (as amended on December 18, 2019) and the Order of the Russian Treasury dated November 28, 2017 No. 328 (as amended 12.18.2019), by making the appropriate changes
		2. Initiating cases of administrative offenses occurs only after consideration of violations by the control commission, when violations are accepted or not accepted, which is contrary to the Administrative Code (according to which the decision on an offense and guilt should be made by a person authorized to consider the case, and not by the control commission). In practice, the decision of the control commission may not always be objective, since not all members of the commission look at the documents confirming violations	2. In our opinion, the first thing to do is to initiate cases, to consider them, and to submit proposals to the control commission, considering the time for the cases. It is proposed to amend the departmental Standard approved by order of the Treasury of Russia dated 03.01.2017 No. 39 (revised from 12.05.2018), indicating that "violations in the financial and budgetary sphere that have signs of offenses, the responsibility for the commission of which is stipulated by the Administrative Code, are issued to the control commission after drawing up protocols and considering cases of administrative offenses"

Table (continued)

No.	Action	Problems (weaknesses) related to appointing, conducting and implementing control measures (according to the author)	Possible solutions for eliminating problems (weaknesses) and reducing the risks
		3. Today, when carrying out control actions during the CM period, officials of the Federal Treasury and its territorial bodies often meet with control objects who do not want to provide information or provide information in a timely manner for exercising control in the financial and budgetary sphere. Under Art. 19.7 of the Code of Administrative Offenses of the Russian Federation for failure to submit or untimely submission of documents to the state body (official) exercising state financial control, administrative liability is provided in the form of a warning or an administrative fine — 300–500 roubles for officials; 3000–5000 roubles for legal entities These types of liability do not stop the control objects from committing an offense in terms of non-submission of documents due to the fact that the sanctions are insignificant and, in general, for the control object are more beneficial than the established amount of violations to be returned to the federal budget	3. In our opinion, to reduce the risk associated with the failure to submit documents or with their untimely provision, which significantly reduces the effectiveness of the results of control activities, it is necessary to exclude from Art. 19.7 of the Code of Administrative Offenses of the Russian Federation administrative responsibility in the form of a warning and increase the amount of an administrative fine by 10 times (or more)
3.3	Placing information on the CM results in information systems	1. Placing information based on the CM results in information systems and software complexes of the Federal Treasury should not be related to the official duties of controllers-auditors (traveling to the control objects and not being constantly at their workplace), since their main activity is the CM implementation	1. For uniform distribution of the CM results, it is proposed to consolidate this function in the duties of other officials who do not belong to the auditing unit, which, in our opinion, are directly related to reporting on control implementation in the financial and budgetary sphere of the Federal Treasury (its territorial bodies); they are not involved in conducting CM in the general rate, and are permanently in the building of the Federal Treasury (its territorial body) and do not leave for control objects. Working in different software products requires compliance and knowledge of technological regulations, which are constantly updated
3.4	Interaction with the Federal Treasury, regulatory and supervisory, law enforcement and other bodies	1. The prosecutor's office delivers applications (requests) for immediate CM (or the allocation of specialists for planned CM conducted by the prosecutor's office, for example, on the instructions of the General Prosecutor's Office) that do not contain signs of violations. This inables high-quality CM, as well as distracts the control body's from conducting planned CM provided by the Federal Treasury and territorial bodies. Also, when checking the control object, it often turns out that the signs of violations in the financial and budgetary sphere indicated by the prosecution authorities are described in the requirement formally and have no grounds. Thus, the time of the inspection body was wasted, and the unscheduled CM was carried out with no result	1. In the Agreement on the procedure for interaction between the Prosecutor General's Office of the Russian Federation and the Federal Treasury, to provide for specific situations when the prosecutor's office applies to the supervisory authority with the "Requirement to conduct CM" or "Requirement to appoint a specialist" to comply with the requirements provided for in Art. 6 of the Federal Law of 17.01.1992 No. 2202–1 (as amended on 31.07.2020) "On the Prosecutor's Office of the Russian Federation"

Source: compiled by the author.

of the control object, then it automatically should be fined. Accordingly, the procedure will return funds to the budget, for example, by sending a notification about applying budgetary enforcement measures.

Today, under Art. 306.2 of the Budget Code, measures of budgetary coercion can be applied as follows:

- undisputed collection of funds provided from one budget of the budgetary system of the Russian Federation to another budget of the budgetary system of the Russian Federation;
- undisputed collection of funds for the use of funds provided from one budget of the budgetary system of the Russian Federation to another budget of the budgetary system of the Russian Federation;
- undisputed collection of penalties for late return of budget funds;
- suspension (reduction) of the provision of interbudgetary transfers (excluding subventions).

The source of funding and the nature of the violation are important.

The existing procedure does not provide for the collection of funds to the federal budget for violations from state institutions, which are fully financed from the federal budget. It would be fair that a mechanism for returning funds allocated from the federal budget for violations committed in the financial and budgetary sphere would be provided for legal entities and officials of state institutions, since they are fully responsible for their use.

DIRECTIONS IN THE DEVELOPMENT OF INTERNAL STATE (MUNICIPAL) FINANCIAL CONTROL

The Federal Treasury is trying hard to put the mechanism of remote interaction into practice, as well as remote access technologies.

The promising directions in the development of internal state (municipal) control are as follows:

1. **Application of remote forms of control using information available in the control body itself.** At the same time, authorized officials should be guided by the following principles:

- *automation* — the use of technologies that automate permanent and monotonous processes, as well as ensure the prompt processing of a large amount of data and the automated generation of documents;
- *informatization* — the use of information available in state and municipal information systems at all stages of CM implementation without requesting it from the control object.

For example, in the Federal Treasury, when providing access in the "view" mode, the controllers-auditors have the opportunity to analyze information from individual subsystems (components, modules) of the state integrated public finance information system "Electronic budget", whose operator is the Federal Treasury in accordance with the Order Ministry of Finance of Russia dated 30.12.2019 No. 259n.[25] These subsystems include: expense management subsystem, procurement management subsystem, income management subsystem, cash management subsystem, payroll management subsystem, non-financial assets management subsystem, accounting and reporting subsystem, etc.

Due to the lack of access to these subsystems in practice (despite the fact that the powers to exercise control in the financial and budgetary sphere were transferred to the Treasury of Russia in February 2016), controllers-auditors today do not have experience in them, they do not know the possibility of forming and obtaining

[25] Order of the Ministry of Finance of Russia dated December 30, 2019 No. 259n "On approval of the list of subsystems (components, modules) of the state integrated information system for public finance management 'Electronic budget' operated by the Ministry of Finance of the Russian Federation, and the list of subsystems (components, modules) of the state integrated information system the public finance management system 'Electronic budget' operated by the Federal Treasury".

the necessary information. It takes time to study the technological regulations of work in these subsystems.

2. **Obtaining remote access (in "view" mode) to the software products of the control object from the control object itself.** This is possible in the personal account, which has the information about the activities of the control object, including those related to the expenditure of funds, accounting (budget) and reporting. It should be possible to print out the necessary information, automatically certified by the electronic signature of the authorized person of the control object.

Today, under clause 6 of the Standard approved by Decree of the Government of the Russian Federation No. 1235 of August 17, 2020, the Federal Treasury already has the opportunity to make requests for access to information systems owned and operated by the control object. Meanwhile, the control object requires experience and knowledge of the specifics of the activity to work in these systems. Given the CM timeframes provided by the Standard and approved by Decree of the Government of the Russian Federation of August 17, 2020 No. 1235, they are impossible to acquire.

3. **Amendments to regulatory legal acts in terms of the possibility, in some cases, to go to the control object for a desk check, for example, for the purpose of conducting an inspection**.

For example, under Art. 92 of the Tax Code of the Russian Federation,[26] tax authorities performing a desk tax audit based on a value-added tax declaration, which declares the right to a tax refund, as well as in cases where it reveals contradictions between information about transactions, or any inconsistencies in the information on transactions, is entitled, *based on a revised resolution of the official of the tax authority* carrying out the inspection, approved by the head (deputy) of the tax authority, to inspect the territories, premises, documents and items of the person in respect of whom the tax audit is being carried out.

Today, under clauses 19 and 33 of the Standard approved by Decree of the Government of the Russian Federation of August 17, 2020 No. 1235, the Federal Treasury, as an internal state financial control body, does not have an unambiguous understanding of whether it is possible to carry out control actions with a visit to the control object during a desk audit, since:

- first, Decree of the Government of the Russian Federation of 03.04.2020 No. 438 restricts the departure of internal state financial control bodies in 2020 to control objects;
- second, the Federal Treasury has a departmental regulatory legal act (Order of the Treasury of Russia dated May 28, 2019 No. 17n), in which there is no approved form of access to control actions during a desk audit (for example, a tax authority has a motivated decision of the tax authority, provided for in Appendix 15 to the Order of the Federal Tax Service of Russia dated 07.11.2018 No. MMB-7–2/628 @[27]);
- third, paragraph 3 of Art. 267.1 of the Budget Code of the Russian Federation provides a definition of an in-house audit, by which it is carried out at the location of the state (municipal) financial control body based on budget statements, accounting

[26] Tax Code of the Russian Federation (part one) of July 31, 1998 No. 146-FZ (as amended on July 20, 2020).

[27] Order of the Federal Tax Service of Russia dated 07.11.2018 No. MMB-7–2/628@ "On approval of the forms of documents provided for by the Tax Code of the Russian Federation and used by tax authorities in exercising their powers in relations regulated by the legislation on taxes and fees, the grounds and procedure for extending the term conducting an on-site tax audit, requirements for documents submitted to the tax authority on paper, the procedure for interaction of tax authorities in fulfilling orders to request documents, requirements for drawing up a tax audit report, requirements for drawing up an act on the discovery of facts that testify to those provided for by the Tax Code of the Russian Federation tax offenses (with the exception of tax offenses, cases on the detection of which are considered in the manner prescribed by Article 101 of the Tax Code of the Russian Federation)".

(financial) statements and other documents submitted at its request. According to this provision, the right to access the control object is not provided.

4. **Creating a single information base for all state (municipal) financial control bodies.** It should include certain systematized information according to criteria set by the state, obtained both from the information systems of the Federal Treasury and from other open sources of information generated by various executive authorities. This database will make it possible to perform the control function at the federal, regional and municipal levels both to the bodies of internal state (municipal) control and external state (municipal) financial control.

CONCLUSIONS

The development of the digital economy in Russia will inevitably entail the digitalization of the control and supervisory activities of all financial control bodies in the near future.

Today, despite the difficulties in implementing control activities due to the spread of coronavirus infection COVID-19, it is very important to create and develop an optimally convenient effective mechanism and algorithm for implementing internal state (municipal) financial control in the digital economy. It should also correspond to the mission of the Russian Treasury "To promote Russia's leadership in the world in the quality of public finance management for the benefit of citizens."

We proposed some directions in the development of internal state (municipal) financial control (considering the resolution of the indicated problems). They will allow the bodies of state (municipal) financial control to independently form a sample of documents and information of the required format in electronic form, reduce the time to prepare and obtain information from the control object, and minimize paper workflow. Electronic signatures on documents and other information in the software products of the control object will provide the required level of protection of transmitted information, reduce corruption risk and increase the efficiency and quality of implementing control measures.

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Economic Nature and Classification of Stablecoins

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ABSTRACT

The article discusses the nature of stablecoins and their specifics in the financial market. **The aim** of the article is to reveal the economic nature and characteristics of various types of stablecoins. The author used system-functional and system-structural research **methods** as well as methods of statistical analysis and synthesis. The paper analyses different approaches to the interpretation of stablecoins and their regulation in developed countries, as well as provides the author's interpretation and classification of stablecoins. The article analyses the main indicators of stablecoins and identifies the potential benefits and risks associated with payment. The **conclusion** is that stablecoins are to be interpreted as a new hybrid type of digital financial assets. Stablecoins are not homogeneous and may have different economic and legal characteristics. Clearly identified blockchain-based issuers issue most stablecoins as tradable digital bonds or depository receipts that can be used as a means of exchange, savings, and payment. The major economic and functional criteria for the classification of stablecoins are: the form of collateral, the category of users, and the scale of circulation. The research has shown that currently the most widely used are centralized stablecoins, backed by fiat currencies and gold, used for exchange transactions and retail payments. Local stablecoins are primarily a store of value and a medium of exchange. Their widespread use can significantly affect the development of the crypto-asset market by increasing its liquidity and stimulating the development of more stable forms of digital financial assets. Global stablecoins may gain widespread use as a cross-border means of payment. They can increase the speed of cross-border settlements and reduce their costs, as well as provide wider financial inclusion for users without bank accounts. To realize the potential benefits of stablecoins, one should address the legal, regulatory and supervisory challenges associated with national and cross-border circulation of stablecoins.

Keywords: stablecoins; crypto-assets; digital financial assets; virtual currencies; cryptocurrencies; distributed ledger technology (DLT); blockchain; collateral stablecoins; algorithmic stablecoins; local stablecoins (LSC); global stablecoins (GSC)

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INTRODUCTION

Over the past years, the introduction of digital information technology in the financial sector has led to the emergence of a new class of assets called "crypto-assets" or "virtual assets".[1] Crypto-assets are based on distributed ledger technology,[2] which allows for the decentralized storage of information related to the issue, trade and transfer of assets. Due to the technological possibilities of issuing crypto-assets, they may include instruments of various economic and legal nature: monetary, equity, debt, etc.

Under the crypto-assets classification adopted in a number of countries (UK,[3] Switzerland,[4] USA [1], etc.), digital tokens can be divided into three main types by their nature: payment tokens (exchange tokens); security tokens (tokens as digital analogues of securities); utility tokens.

In economic literature *payment tokens* are often synonymous with virtual currencies.[5] They are not issued or endorsed by any centralized authority or monetary regulator and are intended to be used as a means of exchange or means of payment. *Security tokens* are digital counterparts (in terms of rights and obligations) to traditional investment instruments such as stocks or bonds. *Utility tokens* provide holders with access to a current or promising product or service of the company-issuer, but do not give holders the rights to own shares in the company or to interest income from investments.

Today, virtual currencies are the most significant among crypto-assets.[6] To a certain extent, they act as a means of payment, a store of value and an object of investment. At the same time, virtual currencies, like crypto-assets, are not homogeneous. They can be issued by different issuers, for different purposes and within different blockchains,[7] due to which they can have excellent economic and legal characteristics.

At the beginning of November 2020, there were more than 7,600 crypto-assets in circulation with the capitalization of more than $435.7 billion. Leading virtual currency Bitcoin[8] accounted for more than 64.2% of the total crypto-asset capitalization.[9]

Cryptocurrencies are one of the most significant subtypes of virtual currencies. The key characteristics of cryptocurrencies are as follows: 1) a trust mechanism for creating their value due to the decentralized nature of the issue; 2) a built-in mechanism of direct value exchange as a result of the use of distributed ledger technology; 3) a unique institutional mechanism where information and financial transactions are managed with no intermediaries. Due to the absence of a clearly identifiable issuer, there is no way to influence the market supply value and the volume of cryptocurrency turnover, which largely determines the high volatility of their market rate. Therefore, cryptocurrencies do not sufficiently

[1] In Russia, the term "digital financial assets" is used as a counterpart.

[2] The term "distributed ledgers" means a decentralized or distributed unified system for accounting data on financial transactions, consisting of chains built according to certain rules from formed blocks of transactions that are used in decentralized virtual currency schemes. Digital Currencies. Bank for International Settlements, The Committee on Payments and Market Infrastructures. 2015;(137). 24 p.

[3] Guidance on Cryptoassets. Financial *Conduct Authority. Policy Statement.* 2019;(22). 55 p.

[4] Guidance for Enquiries Regarding the Regulatory Framework for Initial Coin Offerings (ICOs). *Swiss Financial Market Supervisory Authority (FINMA).* 2018. 11 p.

[5] In fact, as will be shown further in the research, virtual currencies are inherently different from digital tokens.

[6] Virtual currency can be defined as a digital expression of value that can be bought and sold digitally and can function as: 1) a means of exchange; and/or 2) an account unit; and/or 3) store of value, but does not have legal status in any jurisdiction (i.e. is not a legal tender from a regulatory point of view in most developed and developing countries) [2].

[7] Blockchain is a subtype of distributed ledgers, a database consisting of a chain of blocks, each containing information about the previous ones. The database is stored decentralized simultaneously on all computers of the system participants.

[8] Bitcoin is the first decentralized virtual currency (cryptocurrency), created in 2008 by a programmer or a group of programmers known by nickname Satoshi Nakamoto. Due to the high capitalization in the crypto-asset market, it is a system-forming virtual currency (for more details see [3]).

[9] Calculated according to: Coinmarketcap.com. URL: http://www.coinmarketcap.com (accessed on 07.10.2020).

perform standard monetary functions both from the standpoint of monetary theory and their use in the financial market, since their exchange value demonstrates unpredictable fluctuations of large amplitude. Banking regulators, consider cryptocurrencies an insecure means of exchange.[10]

It raises the question of creating digital assets that could provide greater stability of the market rate. This would allow for wider use of the assets as means of payment and savings. The idea of linking cryptocurrencies to certain assets was substantiated in the Whitepaper of MasterCoin, written by J. R. Willett in January 2012 [4], but was never implemented at that time. Over time, many leading cryptocurrency exchanges, such as Coinbase, Binance, Bitfinex, and others, began to provide users with the opportunity to keep funds in electronic wallets on exchanges in both virtual currencies and fiat money. This partially reduces the risk of high volatility of cryptocurrency rates, since the latter can be sold at any time for fiat currencies, gold or other assets.

In recent years, cryptocurrency futures and options became the tools to mitigate currency risk when dealing with cryptocurrencies. In this case, it is only about mechanisms to minimize currency risk, but not to ensure the stability of the cryptocurrency rate comparing to fiat money. This is a prerequisite for the wide circulation of cryptocurrencies. Thus, the most important task for many users is to ensure the stability of the cryptocurrency rate both in the short term to stimulate their wider use in payments and transfers, and in the long-term, to increase their savings by economic agents [5].

All these methods for minimizing risks of price volatility of cryptocurrencies are traditional. However, one of the most innovative ways to reduce price volatility is to create a variety of digital assets that, by their very nature, could provide a more stable market rate. In 2015, the idea of issuing a digital asset, whose price would depend on the value of the underlying asset to which it is tied, was implemented on the basis of the blockchain by Tether Limited. New digital financial assets are called stablecoins,[11] or secured digital assets. They can maintain the stability of their market rate through either the underlying collateral or algorithmic technology that regulates their market supply.

The aim of the article is to reveal the economic nature and characteristics of various types of stablecoins. To achieve this, we solve the following tasks: analyze various approaches to the interpretation of stablecoins and their regulation in developed countries; offer own interpretation and classification of stablecoins, considering their economic characteristics; analyze the main indicators of using stablecoins and identify the potential benefits and risks of their use for payment purposes.

Today, there is no unified interpretation and classification of stablecoins, which vary significantly both between countries and between international financial institutions. Being a variety of crypto-assets, stablecoins require a reasonable classification and economic interpretation of the various monetary and/or financial instruments included in stablecoins. The economic interpretation, in our opinion, should contribute to the development of unified mechanisms for monetary, investment and tax regulation of stablecoin turnover both at the national and international levels.

RESEARCH METHODS

Currently, most of the scientific research on stablecoins follow their empirical use. The

[10] Statement on Crypto-Assets. *Bank for International Settlements, Basel Committee on Banking Supervision*. 2019. URL: https://www.bis.org/publ/bcbs_nl21.htm (accessed on 06.08.2020).

[11] We will also widely use synonyms of the term "stablecoins", such as: "stablecoins", "digital coins with a stable rate", "backed digital assets".

main publications are presented in the studies by foreign authors and international financial organizations. The issues of the feasibility of issuing stable coins, their key characteristics, the tasks they are designed to solve, are considered in the works by economists of the Bank for International Settlements,[12] the European Central Bank [6]; International Monetary Fund [7] and others.

The largest audit, fintech companies and cryptocurrency exchanges also study this issue. For example, in January 2019, Price Water Cooper House released a report describing the emergence and evolution of stable value digital coins [8]. The development of the stablecoin market and the analysis of individual secured digital assets are devoted to studies of Binance cryptocurrency exchange,[13] fintech company Blockchain.org,[14] as well as experts from specialized Internet sources such as ForkLog [9] and others.

The order of functioning of secured stablecoins has been well-studied. However, the mechanisms for stabilizing the rate of unsecured stablecoins are mentioned by few scientific publications, for example [10, 11], etc. Works analyzing the fundamental and methodological problems of stablecoins, in fact, have been isolated and are currently aimed mainly at the Libra project developed by social network Facebook [12].

This study established the methods for interpreting the nature of stablecoins and identifying their characteristics on the method of rising from the abstract to the concrete, from the abstract provisions of monetary theory to the practical use of stablecoins as a digital financial asset in the modern payment system and in the financial market. We used the system-functional and system-structural methods, which made it possible to propose our own classification of stablecoins and identify the existing relationships between traditional money and assets and crypto-assets, as well as methods of statistical analysis and synthesis to assess the level of modern development of the stablecoin market.

ECONOMIC INTERPRETATION OF STABLOCOINS

The mechanism for ensuring the purchasing power of a derivative by holding an equivalent amount of the underlying asset is not new. A similar mechanism for ensuring the purchasing power of money was used repeatedly in the process of evolution of monetary forms, when it became necessary to link a new form of money that had no intrinsic value to a monetary form that had intrinsic value. As the latter, precious metals such as gold were most often used. An example of such purchasing power assurance is the classic full-cover banknotes[15] that appeared in the 18th — 19th centuries in most European countries. Such banknotes were representatives of high-grade money (gold and silver coins) in the vaults of the issuer. The issue of secured banknotes into circulation marked the beginning of a long transition from secured high-grade money to representatives of high-grade money and further — unsecured money.[16]

When issuing any new form of defective money, issuers always had to look for a reliable value anchor that would ensure the

[12] Investigating the Impact of Global Stablecoins. *Bank for International Settlements. G7 Working Group on Stablecoins Research.* 2019;(187). 37 p.

[13] For more details, see: The Evolution of Stablecoins. *Binance Research.* 2019. URL: https://research.binance.com/ analysis/ stablecoins-evolution (accessed on 16.08.2020).

[14] The State of Stablecoins. *Blockchain Luxembourg S.A.* 2019. 140 p.

[15] Initially, the volume of banknotes in circulation was tied to a fixed amount of precious metal held in the issuing bank. This, on the one hand, would limit the volume of banknotes in circulation, on the other hand, it would stimulate economic agents to use a new monetary form.

[16] The process was caused both by the growing demand for means of circulation and means of payment to service an increasing number of transactions in the national and international commodity and financial markets, and by the technical capabilities to create new types and forms of money characterized by the lowest transaction costs.

purchasing power of the new monetary form in the absence of initial trust either in the issuer or in new forms of money. The last statement cannot be directly applied to modern fiat or fiduciary money, whose mandatory and permitted forms of use are established by law. Even in the case of fiduciary money, their purchasing power is based primarily on the confidence of users in the economic and financial policies of the monetary authorities or the activities of private issuers.[17]

The use of the mechanism for stabilizing the market rate of stablecoins, similar to the mechanism for ensuring the purchasing power of inferior money, is innovative. This mechanism is based on new information technologies that provide control over the circulation of digital coins. Unlike fiat money, stablecoins are not a generally recognized means of payment, they may not be issued by credit institutions, and they may not be subject to regulation by the monetary authorities. Therefore, the availability of adequate collateral for stablecoins is an important factor in market success in the context of the lack of confidence in their issuers.

Stablecoins can be viewed as a type of virtual currency backed or pegged to the price of a cryptocurrency, another asset, or a pool of assets to maintain a stable value.[18] Unlike traditional "unsecured" cryptocurrencies, which are generally decentralized [13] and do not have an identifiable issuer, or at least an institution that is financially liable to users, stablecoins represent a "demand" for a specific issuer (on its underlying assets, funds or other rights) (Investigating the Impact of Global Stablecoins, 2019).

Due to the technological specifics of issue and use of various blockchains, as well as due to various methods and mechanisms to maintain the stability of the exchange rate, which causes the emergence of various property rights, stablecoins can differ significantly from each other [14]. In most of developed countries, regulators can now interpret stablecoins as deposits,[19] securities or derivatives,[20] electronic money,[21] and also as a kind of crypto-asset.[22]

The last two interpretations are most common due to the most similar functional characteristics of these financial instruments with stablecoins.

A unified approach to the interpretation of stablecoins may be absent not only at the international level, but also at the level of individual countries. For example, in the United States, there are several approaches to the interpretation of stablecoins, proposed by various regulatory bodies at both the federal and state levels. A possible interpretation of stablecoins in the United States is as a security. Thus, according to representatives of the US Securities and Exchange Commission (SEC), labeling stablecoins as "digital asset" does not affect their regulatory status, which depends on the circumstances of their use.[23] In particular, to stablecoins, like to other digital assets, the Howey test[24] can be used in the United States to de-

[17] A similar analogy can be used in relation to electronic money as a new monetary form that appeared at the beginning of the 21st century. The use of this form is provided for by legislation, which requires the issuer of the electronic value to obligatory reimburse it at the request of the holder in cash or deposit money. This provides a guarantee for the holder of electronic funds to fulfill monetary obligations on the part of the issuer.

[18] Retail CBDCs: The Next Payments Frontier. *Official Monetary and Financial Institutions Forum (OMFIF),* IBM. URL: https://www.omfif.org/wpcontent/uploads/2019/11/Retail-CBDCs-The-next-payments-frontier.pdf (accessed on 07.08.2020).

[19] For more details, see: "Stable Coin" Guidelines. *Financial Market Supervisory Authority (FINMA).* 2019. 3 p.

[20] For more details, see: "Stable Coin" Guidelines. *Financial Market Supervisory Authority (FINMA).* 2019. 3 p.

[21] For example: Strategic Hub for Innovation and Financial Technology. Framework for "Investment Contract" Analysis of Digital Assets. *U.S. Securities and Exchange Commission.* 2019. 8 p.

[22] For more details, see: Guidance on Cryptoassets. *Financial Conduct Authority. Policy Statement.* 2019;(22). 55 p. ("Payment Services Act", 2019).

[23] Strategic Hub for Innovation and Financial Technology. Framework for "Investment Contract" Analysis of Digital Assets. *U.S. Securities and Exchange Commission.* 2019. 8 p.

[24] In 1946, in the case of the SEC against W.J. Howey Co, The US Supreme Court has defined an "investment contract" as

termine whether certain transactions qualify as an "investment contract". As a result, the SEC can consider the nature and functionality of each stablecoin separately.

In theory, when the value of stablecoins is backed by fiat currencies, the lack of price fluctuation should result in the impossibility of making a profit from owning stablecoins, making any expectation of profit for the holder unfounded. Regarding stablecoins backed by fiat currencies with a fixed redemption price, the SEC now maintains that, similar to traveler's checks, they function as a tradable means of exchange and payment that can be exchanged for a fixed amount of fiat money. At the same time, stablecoins backed by crypto-assets or unsecured stablecoins can be regarded by the SEC as securities.[25]

From the standpoint of the US banking regulation, stablecoins with fiat collateral and a fixed redemption price can be considered in a number of states, in particular, in the state of New York, as a certificate of debt that is in circulation like money and, accordingly, the issuer of stablecoins must obtain a banking license or a trust company license.[26] At the same time, the Financial Crimes Enforcement Network (FinCEN) of the US Treasury treats stablecoins as convertible virtual currencies, and considers their issuers as money transmitters (money transfer intermediaries). The appropriate regulatory regime should apply in their respect.[27] While most US states do not distinguish between stablecoins with different types of collateral, some states, such as Texas, distinguish between stablecoins that are backed by fiat currencies and those backed in a different way. Under the Texas Money Services Act, stablecoins backed by fiat currencies represent "money" or "monetary value" and, accordingly, these stablecoins are regulated by the state law on money transmitters.[28]

The interpretation of stablecoins as deposits or securities, depending on their functions, is used by the Financial Market Supervisory Authority (FINMA) of Switzerland. If stablecoins are backed by fiat currencies with a fixed rate of return, they are classified as deposits under banking law. If stablecoins are pegged to a basket of currencies, and the reimbursement rate depends on the price of the basket at the time of reimbursement, such stablecoins should be interpreted depending on who manages the underlying assets and risks. If stablecoin holders do this, then stablecoins equate to a collective investment scheme. If the issuer does so, stablecoins are treated as a bank deposit. When stablecoins are pegged to commodities, the interpretation of stablecoins by the Swiss Financial Markets Authority will depend on the nature of the asset claim and the type of commodity. If there is only a contractual requirement to the issuer for a precious metal stored in a bank or depository, then stablecoin is considered a deposit due to its similarity to funds stored in bank metal accounts. In contrast, if there is a contractual requirement for other commodities, stablecoin is generally treated as a security or derivative.[29]

In Japan, regulation of all types of crypto-assets is carried out under the new edi-

an investment of money in a joint venture that is expected to generate profits through management and business efforts. URL: https://supreme.justia.com/cases/federal/us/328/293/(accessed on 10.11.2020).

[25] See: Strategic Hub for Innovation and Financial Technology. Framework for "Investment Contract" Analysis of Digital Assets. U.S. *Securities and Exchange Commission*. 2019. 8 p.

[26] Stablecoins: A Global Overview of Regulatory Requirements in Asia Pacific, Europe, the UAE and the US. *Clifford Chance*. 2019. September. 20 p.

[27] For more details, see: Application of FinCEN's Regulations to Certain Business Models Involving Convertible Virtual Currencies. *FinCEN*. URL: https://www.fincen.gov/sites/default/files/2019–05/FinCEN%20Guidance%20CVC% 20FINAL%20508.pdf (accessed on 16.08.2020).

[28] Texas Department of Banking, Supervisory Memorandum 1037: Regulatory Treatment of Virtual Currencies Under the Texas Money Services Act. 2019, April 1. URL: http://www.dob.texas.gov/public/uploads/files/consumer-information/sm1037.pdf (accessed on 16.08.2020).

[29] "Stable Coin" Guidelines. *Financial Market Supervisory Authority (FINMA)*. 2019. 3 p.

tions of the Payment Services Act and the Financial Instruments and Exchange Act, which entered into force in 2020. However, this legislation cannot always be applied to all stablecoins. From the standpoint of the Financial Services Agency (FSA), depending on their legal status, stablecoins may differ from typical forms of crypto-assets. For example, stablecoins backed by fiat money cannot be interpreted as traditional crypto-assets. They can potentially be viewed as prepaid payment instruments or payment functions. The latter, initiated by such stablecoins, can be considered as remittances.[30]

The Monetary Authority of Singapore have similar views. In Singapore, under the new version of the Payment Services Act (PSA), which came into force in 2020, stablecoins backed by fiat money can be considered as electronic money. Their issuers may be subject to regulation as payment service providers that issue electronic money. At the same time, unsecured stablecoins (for example, algorithmically controlled stablecoins) can be considered digital payment tokens, and their issuers can therefore be regulated as payment service providers for transactions using digital payment tokens.[31]

The Monetary Authority of Singapore also admits that the issue and circulation of certain types of stablecoins, such as basket-backed assets, may be securities or derivatives and be regulated under the Securities and Futures Act (SFA).[32]

There is no harmonized approach to the regulation of crypto-assets in general and stablecoins in particular in the European Union. A number of researchers believe that the legal basis that can be applied to a certain type of stablecoins, namely, stablecoins backed by fiat currencies, is the electronic money regulation regime [6].

The legal regime for electronic money was established by the European Parliament and the Council in the second Electronic Money Directive (EMD2). The Directive defines electronic money as "electronic (including magnetically) as represented by a claim on the issuer which is issued on receipt of funds for the purpose of making payment transactions and which is accepted by a natural or legal person other than the electronic money issuer".[33]

Thus, if a stablecoin is issued formally in accordance with all the requirements of the Electronic Money Directive, it can be considered as electronic money in the EU countries, and the activities of its issuer should be regulated by the relevant regulatory requirements. It is likely that any stablecoin can formally embody monetary value in electronic form, be used to make payments and be accepted as a means of payment by individuals or legal entities other than the issuer. However, stablecoins do not necessarily represent a claim on the issuer and/or may not be issued based on the receipt of an equivalent amount of funds by the issuer.

In the UK, similarly to European Union countries, fiat-backed stablecoins can be considered e-money tokens,[34] if they meet the definition of e-money under the UK regulation, which still coincides with e-money regulation in the EU countries. Stablecoins backed by commodities or other assets, as well as unsecured stablecoins in the UK, can be interpreted functionally as debt securi-

[30] Revisions to Payment Services Act & Financial Instruments and Exchange Act on Crypto Assets. *Anderson Mori & Tomotsune, Financial Services & Transactions Group.* 2019. May. 26 p.

[31] Payment Services Act (Revision). *Singapore Statutes Online Plus.* 2019. 191 p.

[32] Stablecoins: A Global Overview of Regulatory Requirements in Asia Pacific, Europe, the UAE and the US. *Clifford Chance.* 2019; Sept. 20 p.

[33] Directive 2009/110/EC "On the Taking up, Pursuit and Prudential Supervision of the Business of Electronic Money Institutions". *Official Journal of the European Union,* 2009;16Sept. (267):7–17.

[34] Electronic Money Regulation 2011. Statutory Instruments 2011. No. 99. Financial Services and Markets. URL: http://www.legislation.gov.uk/uksi/2011/99/contents/made (accessed on 16.04.2020).

ties, derivatives or shares in a collective investment scheme.[35]

However, not in all countries, fiat-backed stablecoins can be interpreted as electronic money and subject to relevant regulations. For example, the Malta Financial Service Authority in the Virtual Financial Assets Act provides for individual regulatory regimes for different types of assets based on distributed ledger technology (DLT assets). Under this regulation, DLT assets may include: virtual tokens, virtual financial assets, electronic money, and financial instruments. In Malta, stablecoins are considered as a type of virtual financial assets (digital assets pegged to the fiat currency of the euro[36]), and their issuers are subject to the regulatory requirements of the Law on Virtual Financial Assets.[37]

The Bank International for Settlements (BIS) has similar views and believes that stablecoins should be considered as a variety of crypto-assets that use various stabilization mechanisms through the provision of benchmark assets in order to minimize fluctuations in their market value.[38] In this case, the prudential regulation of stablecoin issuers should not fundamentally differ from the regulation of other types of crypto-assets that can be used as a means of exchange or payment. The Financial Stability Board G20 (FSB) shares similar views and indicates that stablecoins are a type of crypto-asset (in a broader sense, a type of digital asset) that maintain a stable value relative to a specific asset, pool or basket of assets. The Financial Security Council emphasizes that digital assets do not include digital forms of fiat currencies.[39]

In our opinion, the direct application of the interpretive construction of electronic money in relation to stablecoins (even those backed by fiat currencies) does not seem to be sufficiently justified. The definition of electronic money, in the second EU Directive on electronic money, does not consider the functional and technological features that characterize the release of modern stablecoins as a new type of digital assets based on distributed ledger technology.

In particular, electronic money is widely regarded as a digital alternative to cash, whereby the key purpose of issuing and using it is to make ongoing payments. On this very purpose they are issued as non-interest bearing obligations of the issuer. Electronic money does not represent any tangible asset, but is the electronic equivalent of fiat currency of the corresponding value. On the contrary, most stablecoins are backed by underlying assets, therefore their primary function is to store value, while the functions of a means of exchange and/or payment are derived functions.

A typical feature of electronic money is their circulation failure, since now they are issued in closed circulating systems.[40] Each transaction using electronic money requires mandatory monetary intermediation, since after each payment, electronic money must be returned to the issuer for the verification and destruction, leading to the final settlement [15]. Issuing electronic money in openly circulating systems that provide for their circulation is only possible if the issuer is the central bank or another monetary regulator, but in this case, it is about central bank digital currencies (Central Bank Digital Currencies — CBDC).[41] Unlike electronic money, stablecoins are issued

[35] Guidance on Cryptoassets. Financial Conduct Authority. Policy Statement. 2019;(22). 55 p.

[36] EURS: Euro-backed stablecoin. STATIS. URL: https://eurs.stasis.net/ (accessed on 16.08.2020).

[37] Virtual Financial Assets Act. *Malta Financial Services Authority (MFSA)*. 2018. 59 p.

[38] Designing a Prudential Treatment for Cryptoassets. Bank for International Settlements, Basel Committee on Banking Supervision. Discussion Paper. 2019. 18 p.

[39] Addressing the Regulatory, Supervisory and Oversight Challenges Raised by "Global Stablecoin" Arrangements. *Financial Stability Board (FSB)*. 2020. 62 p.

[40] The electronic money issuer is not required to keep the full amount of funds raised during the issue as collateral (partial reservation is applied). In the case of fiat-backed stablecoins, the collateral is voluntary, but generally complete.

[41] For more details, see: [16].

as tradable financial instruments that can change hands, since using blockchain technology eliminates the need for monetary intermediation in exchange and payment transactions.[42] This allows stablecoins to trade on the exchange market and generate income for their owners.

Table 1 presents major characteristics of stablecoins backed by fiat currencies, compared to electronic money and cryptocurrencies.

Table 1 demonstrates that, on the one hand, stablecoins can have a number of characteristics of cryptocurrencies, on the other hand, some stablecoins have characteristics of electronic money. In most cases, stablecoins use the same distributed ledger issuing technology as cryptocurrencies. As in the case of cryptocurrencies, stablecoins are denominated in new units of account (albeit tied to underlying assets), which, by analogy with traditional cryptocurrencies, implies the need to establish the market rate during exchange trading. Unlike cryptocurrencies, they represent a requirement for a clearly identified issuer or for the underlying assets that underlie the issue of stablecoins. Thus, most stablecoins differ from traditional cryptocurrencies, but at the same time, they are not a complete counterpart of electronic money on the blockchain platform.

In our opinion, stablecoins represent a new, hybrid type of digital assets, which combines innovative mechanisms for direct value exchange and management of financial transactions without intermediaries with centralized issue mechanisms and the use of various methods to ensure the price stability of financial assets. In general, *stablecoins are crypto-assets that: 1) are issued by an identified issuer on the blockchain in the form of tradable digital obligations or depositary receipts; 2) maintain the stability of the exchange rate by linking to the base low-volatility cash or commodity security or by using algorithmic technologies; 3) can be used as a store of value, as well as a means of exchange and/or a means of payment for persons other than the issuer.*

CLASSIFICATION OF STABLCOINS AND THEIR FUNCTIONAL FEATURES

Stablecoins are not homogeneous. They differ in various ways, according to which they can be classified. One of the main criteria for classifying stablecoins is the mechanism to ensure the stability of their exchange rate. The stability of the stablecoin market rate can be achieved in various ways (*Fig.*).

Fig. demonstrates that according to the exchange rate stabilization mechanism, stablecoins can be subdivided into collateral (secured) and algorithmic (unsecured).

Collateral stablecoins

Collateral (secured) stablecoins are the most popular. They can be divided into two types: 1) backed by traditional assets (pegged to fiat currencies or backed by goods and other assets); 2) backed by crypto-assets. To provide the first type of collateral stablecoins, the following are used: fiat currencies (as a rule, freely usable currencies — US dollars, euros, etc., or a basket of such currencies); goods (usually gold and other precious metals); commodity-money security (equity security with fiat money and precious metals); other assets (securities, real estate, etc.). As collateral for the second type of collateral stablecoins, the following are used: cryptocurrencies (Ethereum, Wave, etc., as well as baskets of cryptocurrencies or stablecoins); fiat-cryptocurrency collateral (equity collateral with fiat money and cryptocurrencies).

In general, collateralized digital assets use the most traditional way to achieve exchange rate stability, which is that the stablecoin issuer undertakes to exchange it for

[42] It is currently possible for stablecoin issuers to change their guarantee obligations (if any) to back up stablecoins. In addition, there are no regulatory requirements for stablecoin issuers, with the exception of specific regulations such as mandatory customer identification and anti-money laundering requirements.

Table 1

Major economic and functional characteristics of stablecoins backed by fiat currencies

Characteristics	Electronic money*	Stablecoins**	Cryptocurrencies***
Demand			
Intrinsic value	No	No	No
Issuer requirement	Yes	Yes	No
Means of exchange	Yes	Yes (limited)	Limited
Means of payment	Yes	Limited	Limited
Unit of account (at the state level)	Yes	No	No
Store of value	Yes, but with inflationary and liquidity risk	Yes, but with the credit risk of the issuer and the inflationary risk of the underlying asset	Yes, but with great volatility
Accrual of interest income	No	No, but there is a possibility of getting insignificant speculative income	No, but there is an opportunity to receive significant speculative income
Supply			
Issue procedure	Centralized	Centralized	Decentralized
Issue source	Private	Private	Private
Issue volume	Flexible	Relatively flexible	Non-flexible
Issue rules	Issue based on equivalent exchange for other forms of money	Issue based on the collateral of the underlying fiat asset	Issue is determined by a computer protocol with established limits
Change in terms of issue	Yes, subject to regulatory changes	Yes, subject to change in issuer's policy	Possible, subject to reaching a consensus with major miners
Issue cost	Low	Relatively low	High (driven by electricity costs for computing)
Possibility of circulation	No	Yes	Yes
Availability of monetary intermediation	Yes, both at the is sue and payment levels	No, at the payment level. Yes, at the issue level	No, both at the issue level and at the payment level

Note: * – electronic money as defined in EMD2; ** – the example of stablecoin backed by the fiat currency Tether; *** – the example of Bitcoin

Source: compiled by the author.

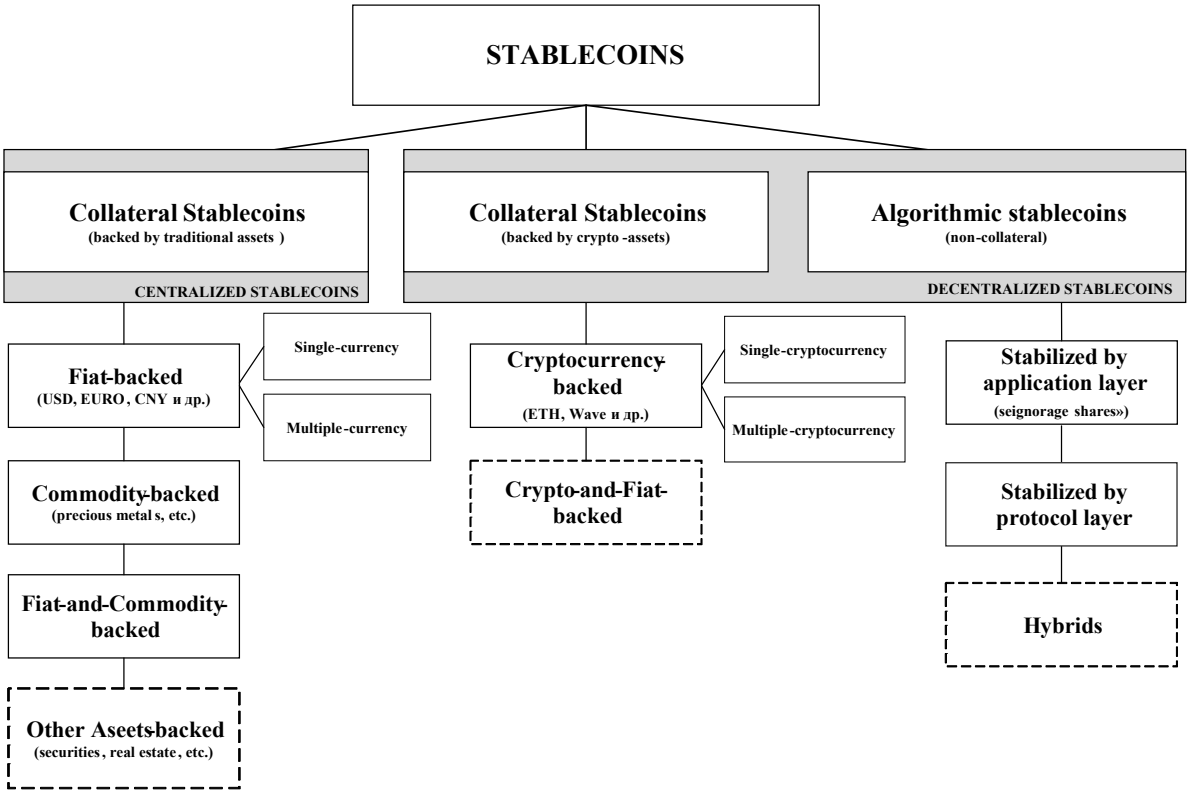

Fig. **Modern classification of stablecoins by the exchange rate stabilization mechanism**

Note: the dotted line marks the varieties of stablecoins, whose issue is possiblein theory, but currently is not widespread.

Source: compiled by the author based on [17]; Guidance for Enquiries Regarding the Regulatory Framework for Initial Coin Offerings (ICOs). Swiss Financial Market Supervisory Authority (FINMA). 2018. 11 p.; The State of Stablecoins. Blockchain Luxembourg S.A. 2019. 140 p.

the underlying asset at a fixed rate. Therefore, debt obligations are not only issued centrally, but also centrally repaid, which implies trust in the issuer who controls the issue of stablecoins and their collateral. To build user confidence, the issuers of such stablecoins develop various schemes to confirm that their debt obligations are fully backed by appropriate reserves. However, the strongest evidence of collateral is regular audits of reserves, which should be performed by independent, reputable audit firms.

Collateral stablecoins backed by fiat currencies can be exchanged for a fixed amount of local currency at any time, because their issuer undertakes to redeem them in freely tradable currency at a fixed rate (usually 1:1). For this, the issuer provides 100% issue of stablecoins with a reserve in freely usable currency, which is stored in its bank account. The main advantages of stablecoins backed by fiat currencies are: high stability of the market rate; easy issue and operation of the stabilization mechanism, as well as low cyber risks. The latter advantage is due to the fact that the collateral for securing the stablecoin is not stored on the blockchain.

One of the main disadvantages of fiat-backed stablecoins is their centralized issue. Ensuring a stable exchange rate for digital coins requires a financial institution for reliable storage and competent management of reserve funds. The idea of centralized issue goes against the classical concept of crypto-assets, based on the fact that the use of distributed ledger technology allows

for the decentralized storage of all financial information related to assets without intermediaries.[43] In theory, centralized storage cannot guarantee digital coin holders against managerial errors and abuses by the issuer. Moreover, the process of destroying stablecoins when exchanging them for fiat money is rather expensive and slow. It is also necessary to carry out regular independent audits of the issuer's activities to ensure the financial transparency of the issuer for market participants. The most famous examples of fiat-backed stablecoins are: Tether USD (USDT), TrueUSD (TUSD), USD Coin (USDC), etc.

Collateral stablecoins backed by commodities (precious metals) certify the ownership of the holder of the stablecoin to one ounce of gold held in the bank's depositories of the issuing company. They do not represent a debt obligation of the issuer to provide a fixed amount of precious metal to the holder of the secured digital asset.

Currently, among the precious metals, gold is used in most cases to provide stablecoins. Although the price of gold as an underlying asset is more volatile than the exchange rates of freely usable fiat currencies, gold is a commodity, not a debt instrument, and has a value that does not depend on the actions of monetary authorities. Similar to the interpretation of classical banknotes as warehouse receipts[44] or special certificates of deposit [19], which represent a property right rather than a promissory note of the issuer, gold-backed stablecoins can be viewed as a digital counterpart of such certificates of deposit. The most prominent examples of such stablecoins are PAXOS Gold (PAXG), Tether Gold (XAUT), Digix Gold Token (DGX), etc.

Stablecoins backed by cryptocurrencies are designed to solve the main problem of centralized stablecoins. The use of fiat-backed stablecoins carries credit risk. Backing of such stablecoins is outside the blockchain where they circulate. It is controlled by the issuer, which, in case of unfavorable circumstances, may be unable to repay its debt obligations. Stablecoins backed by gold or other commodities are not associated with credit risk. However, even in this case, it is necessary to trust the company that provides storage services for the underlying asset, as well as its delivery to the owner. To mitigate credit risk as well as the risk of holding backing assets, stablecoins can be backed by cryptocurrencies. Unlike the stablecoins discussed earlier, here the collateral is on the same blockchain as the stablecoins. Due to this, stablecoins backed by cryptocurrencies are controlled by a code and obligations are canceled automatically.

The main advantages of stablecoins backed by cryptocurrency are as follows: they are more decentralized; there is a possibility of a quick and inexpensive exchange for the basic cryptocurrency in the blockchain; high transparency makes it easy to check the security of the stablecoin. The disadvantages of crypto-backed stablecoins are: less stable price of the secured digital asset than in the case of fiat collateral; the possibility of automatic liquidation of stablecoins during the depreciation of the base cryptocurrency and technological failures[45]; inefficient use of capital to support the stablecoin; it is more complicated to maintain a stable exchange rate for digital coins than

[43] The study by Coin Metrics revealed that in September 2019, 80% of the Tether USD stablecoin issue was stored in 318 wallets. Each of these addresses had more than $1 million. For comparison, there are more than 20,000 wallets with such balances in the network of virtual currency Bitcoin (see: [18]). According to the analytical company Intotheblock, in November 2019, 2.8 billion USDT were concentrated on 104 e-wallets, which was 70% of the stablecoin turnover. See: Intotheblock news. URL: https://twitter.com/intotheblock/status/1184044492107714560 (accessed on 16.08.2020).

[44] See: [20, 21].

[45] A similar case occurred to holders of DAI stablecoins during the financial crisis on March 12, 2020. Back then, due to the sharp drop in the price of Ethereum, used as the underlying digital asset for collateral for dollar-pegged DAI stablecoins (MakerDAO), thousands of collateralized debt positions by stablecoins held by investors were liquidated.

collateral with fiat money or gold. Representatives of such stablecoins are Single-collateral DAI (MakerDAO), bitUSD (BITUSD), Neutrino Dollar (USDN), etc.

To diversify the risks associated with fluctuations in the market rate of a fiat currency or the market price of a commodity, the stablecoin can be fully backed not by one currency (fiat or crypto) or one commodity (precious metal), but by a basket of these assets. Stablecoins of this type are at various stages of development and do not yet have a long history. For example, Multi-collateral DAI (MakerDAO), USDx stablecoin, etc.

Algorithmic stablecoins

Unlike secured stablecoins, the market rate of algorithmic (unsecured) stablecoins is not directly supported by fiat currencies, commodities, cryptocurrencies, or other assets. In this case, it is assumed to use a trust model for ensuring the value of stablecoins, similar to that used to issue modern fiduciary money, but with specific using algorithmic technologies to regulate the volume of their supply. Currently, there are three main mechanisms for stabilizing unsecured stablecoins: 1) at the application level; 2) at the level of protocols; 3) hybrid (combining elements of the first two mechanisms).

In general, almost every crypto-asset operates at the protocol and application levels [17]. A protocol is a set of rules for the entire cryptocurrency system. For example, one of the rules of the Bitcoin protocol is that the maximum block size must be 1 MB. Changing the Bitcoin protocol level requires the consent of the majority of users, which is rather complicated. Therefore, making changes at the application level seems to be easier.

Stablecoins regulated at the application level. Today, the concept of so-called "seignorage shares", proposed by Robert Sams in 2014 [22], has become popular among proponents of unsecured stablecoins regulated at the application level. It is based on the idea that a smart contract can be created on behalf of the issuer (the prototype of the central bank in this system), and the monetary policy of this smart contract will be to perform only one authority, i.e. to issue a currency that will be traded at a price of $1. To control the rate of this currency, it is necessary to control its issue volume. Let us assume that the stablecoin is trading at $2. It means that the price is too high due to very low supply. To compensate for the insufficient supply of stablecoins, a smart contract could initiate the issue of new digital coins and then sell them in the market, increasing the supply until the stablecoin price returns to $1.

Due to using smart contracts in the stabilization mechanism, the issuer would receive some additional profit, the seignorage income. If digital coins would be trading at a very low rate, for example, 0.5 USD, the smart contract should initiate the purchase of coins on the market to reduce the volume of coins in circulation. Since the accumulated seignorage might not be enough to buy digital coins with a stable exchange rate, the seignorage shares concept suggests that instead of distributing seignorage income, the issuer may issue certificates of entitlement to receive a share of future seignorage income. Thus, equity holders will expect an increase in the price and demand in stablecoins. This will ultimately help them receive a larger seignorage income that will be paid to the share owners. This will reduce the supply of stablecoins, and the digital coin can stabilize again at the level of $1.

One of the main disadvantages of the seignorage shares concept is that we cannot accurately analyze the functionality of such systems. This can provoke significant fluctuations in the market rates of unsecured stablecoins. Moreover, a reason for the slow development of unsecured stablecoins regu-

Table 2

Classification of stablecoins

Classification feature	Type	Examples of stablecoins
Exchange rate stabilization mechanism (collateral form)	Backed by fiat currency	TrueUSD (TrustToken), USD Coin (CENTRE), Binance USD (Paxos Trust Company, Binance), STASIS EURO (STASIS), Steem Dollars (Steemit project), StableUSD (Stably), *Swiss franc — DCHF (Sygnym)* etc.
	Backed by goods (precious metals, etc.)	Digix Gold Token (DigixDAO), PAX Gold (Paxos Trust Company), DigixDAO (DigixDAO), Tether Gold (Tether Limited) etc.
	Backed by a basket of fiat currencies	*Libra (Facebook & Libra Association)* etc.
	Mixed collateral (fiat currency, commodities, securities, etc.)	Tether USD (Tether Limited), STASIS EURO etc.
	Cryptocurrencies	Neutrino Dollar (USDN); bitUSD (BITUSD); Single-collateral DAI (MakerDAO) etc.
	Backed by a basket of cryptocurrencies	USDx stablecoin (dForce Network), Multi-collateral DAI (MakerDAO), Saga (SGA) etc.
	Unsecured (regulated at the protocol level)	BitBay (BAY) etc.
	Unsecured (regulated at the application level)	There are currently no well-known examples
Direction of use (category of users)	For retail payments	Tether USD, TrueUSD, Paxos Standard (Paxos Trust Company), *Libra*
	For wholesale payments	Signet (Signature Bank); JPM Coin (JPMorgan Bank); USC — *Utility Settlement Coin (UBS, Deutsche Bank, Santander, BNY Mellon, ICAP and the other 11 banks), Swiss franc — DCHF* etc.
Exchange rate	Fixed	Signet, JPM Coin, *USC* etc.
	Floating	Tether USD, TrustUSD, Paxos Standart, BitBay, *Libra* etc.
Scale of circulation	Local	Tether USD, TrueUSD, Paxos Standard, USD Coin, Binance USD, Gemini Dollar (Gemini Trust Company LLC) etc.
	Global	JPM Coin, *Wells Fargo Digital Cash (Wells Fargo Bank), USC — Utility Settlement Coin, Libra* etc.

Note: Stablecoins that are currently in design or development are marked in italics.

Source: compiled by the author based on Coinmarketcap.com. URL: https://coinmarketcap.com/currencies/ (accessed on 16.08.2020); official websites of stablecoin issuing companies.

lated at the application level is the inability to realize the main benefits of unsecured stablecoins under existing regulations. As a result, a number of promising projects such as Basecoin (Basis) and Havven have been closed.

Stablecoins regulated at the protocol level. An important direction in the development of unsecured stablecoins is using various stabilization methods at the protocol level. Japanese researchers Kenji Saito and Mitsuru Iwamura [10] proposed a stabilization mechanism that includes three instruments to regulate the market price of stablecoins. The first tool involves an algorithm for the issuer to timely automatically response to the changed level of demand for stablecoins by an equivalent increase in the supply of digital coins in the market. The second tool for regulating the market price of stablecoins provides for the variability of the reward for mining or forging, depending on the volume of supply of digital coins in the system. The third tool is to charge negative interest on digital coin storage in e-wallets to prevent the accumulation of stablecoins and to encourage consumers to pay by stablecoins.

The main advantages of unsecured stablecoins are the following: no collateral; complete decentralization of the issue of coins; independence from exchange rate fluctuations of cryptocurrencies or fiat currencies. The disadvantages of unsecured stablecoins include: the need for permanent growth of the system and exposure to a decrease in demand for digital coins; the difficulty of analyzing their security and stability; the complicated implementation of the stabilization mechanism. Currently, unsecured stablecoins are less well known and less widespread than secured stablecoins due to the lack of transparency in the mechanism for maintaining their value and trust from a wide range of users.

Stablecoins can share some characteristics with digital tokens, and sometimes even be identified as tokens.[46] Like tokens, stablecoins are usually issued not on the original, but on the pre-existing blockchain, and represent a requirement for an identifiable issuer or collateral assets.[47] This approach does not seem entirely justified. While digital tokens are issued with very specific functions or for specific purposes (for example, to provide their owners with ownership and/or the right to receive dividends, or to grant the right to access a certain product or service), stablecoins are typically do not provide these functions. Stablecoins are to be used as a universal means of exchange in the purchase and sale of goods or services provided by any organization or individual other than the issuer. Therefore, stablecoins must be distinguished from digital tokens according to their economic nature.

Table 2 presents the main examples of modern stablecoins, classified by various classification criteria.

Table 2 indicates that besides the classification by the rate stabilization mechanism, we can distinguish two more key features of stablecoin differentiation: by the direction of use (the level of users who can hold and make transactions with stablecoins) and by the exchange rate regime.

In terms of use, secured digital assets can be retail or wholesale. The term "retail stablecoins" refers to stablecoins that can be used universally by any user (both individuals and legal entities). The term "wholesale stablecoins" [23], on the contrary, denotes stablecoins with limited access and use. As a rule, only specialized financial institutions or individual clients of such institutions are entitled to access them. For example, Facebook and the Libra Association have pro-

[46] For example, the largest information Internet portal Coinmarketcap.com identifies Tether and DAI stablecoins as tokens.

[47] Usually, such tokens are issued as a result of the Initial Coin/Token Offering (ICO/ITO) mechanism. Currently, the term ICO/ITO is widely used by economists to refer to the processes where companies issue tokens to a wide range of people to raise funds for their innovative projects.

posed making their Libra stablecoin available to all users, so it can be considered a retail stablecoin. At the same time, the Utility Settlement Coin (USC) stablecoin, developed by a group of banks — UBS, Deutsche Bank, Santander, BNY Mellon, etc. — is intended for use only by financial institutions that are part of the USC consortium. Therefore it can be considered as a wholesale stablecoin (*Table 2*).

Exchange rate for stablecoins can be either fixed or floating. Wholesale stablecoins, which fall under the depositary receipt model, are the tokenized asset underlying the issuer's obligations (typically a bank deposit). Consequently, such stablecoins have fixed exchange rates and are not listed on exchanges. This means that such stablecoins are purchased and redeemed at their par value. The price of other stablecoins, even 100% fiat-backed coins, can fluctuate relative to the base currency. Stablecoins Tether, TrueUSD, Paxos, etc. are quoted on cryptocurrency exchanges and have exchange rates that fluctuate against the US dollar or other collateral fiat currency (*Table 2*). Today, we can only think of wholesale stablecoins with a fixed exchange rate and retail stablecoins with a floating exchange rate. Since wholesale stablecoins are created primarily to replace or supplement existing settlements using bank or central bank money, wholesale floating exchange rate stablecoins cannot be serve this purpose. Retail stablecoins with a fixed exchange rate seem only a matter of time, but at the moment there are no such examples.

By the scale of their use, stablecoins can be divided into local and global. Local stablecoins (LSC) are usually issued by financial or fintech companies directly or indirectly associated with large cryptocurrency exchanges such as Bitfinex, Binance, Gemini, and others that trade crypto-assets. The use of local stablecoins is currently limited to the digital asset market, so they are predominantly an exchange-traded product. Global stablecoins (GSC) are stablecoins issued by large investment banks and banking consortia, for example: JPM Coin (JPMorgan Bank), Signet (Signature Bank), USC — Utility Settlement Coin (UBS, Deutsche Bank, Santander, BNY Mellon, ICAP and others). Moreover, global stablecoins are now developed by multinational technology companies and associations such as Libra (Facebook and Libra Association), etc.

Currently, local stablecoins are listed on more than 120 cryptocurrency exchanges, with the Tether stablecoin having the largest number of common individual exchange listings, namely: Tether USDT — 149; USD Coin — 92; DAI — 67, TrueUSD — 60; Paxos Standard — 60, Gemini Dollar — 19, etc.[48] The same was with currency pairs for stablecoins. At the beginning of 2020, Tether USDT was trading against over 400 different cryptocurrencies, while stablecoins USD Coin and TrueUSD had 149 and 119 currency pairs, respectively.[49] *Table 3* presents the comparative data of the most famous retail local stablecoins, which are quoted on cryptocurrency exchanges.

Table 3 shows that in October 2020, secured stablecoins are the leaders among retail stablecoins in terms of capitalization. The overwhelming share of the market (about 95%) was occupied by stablecoins backed by fiat currencies, such as Tether USD (USDT), USD Coin (USDC), Paxos Standard (PAX), Binance (USD), TrueUSD (TUSD), etc. Stable coins backed by gold and crypto-assets played a significantly smaller role (about 5%).

The capitalization of most local stablecoins has increased significantly against the backdrop of the economic crisis that began in 2020, exacerbated by the COVID-19

[48] Data of Crypto Exchanges. *CoinCodex*. URL: https://coincodex.com/crypto/tether/exchanges/ (accessed on 25.10.2020).

[49] Data of Crypto Exchanges. CoinCodex. URL: https://coincodex.com/crypto/true-usd/exchanges/ (accessed on 18.04.2020); The State of Stablecoins. *Blockchain Luxembourg S.A.* 2019. 140 p.

Table 3

Comparative data of leading local stablecoins

No.	Stablecoin name (sign)	Issuer (launch year)	Issue model (blockchain)	Provision method (unit)	Circulation volume, mln	Capitalization, USD mln
1	Tether USD (USDT)	Tether Limited (2015)	Centralized (Bitcoin, Ethereum, EOS, TRON, Algorand)	Fiat (USD)	15 721.47	15 738.39
2	USD Coin (USDC)	CENTRE (2018)	Centralized (Ethereum)	Fiat (USD)	2855.23	2857.03
3	Multi-Collateral DAI (DAI)	MakerDAO (2019)	Centralized (Ethereum)	Ethereum-based crypto assets approved by Maker token holders	869.32	877.65
4	Binance USD (BUSD)	Paxos Trust Company, Binance (2019)	Centralized (Ethereum ERC-20)	Fiat (USD)	672.74	672.74
5	TrueUSD (TUSD)	TrustToken (2018)	Centralized (Ethereum)	Fiat (USD)	365.71	367.37
6	Paxos Standard (PAX)	Paxos Trust Company (2018)	Centralized (Ethereum)	Fiat (USD)	244.95	245.11
7	HUSD (HUSD)	Stable Universal (2019)	Centralized (Ethereum)	Fiat (USD)	139.14	139.21
8	STASIS EURO (EURS)	STASIS (2018)	Centralized (Ethereum)	Fiat (Euro)	31.98	38.80
9	USDK (USDK)	OKLink, OKEx (2019)	Centralized (Ethereum ERC-20)	Fiat (USD)	28.60	28.66
10	Neutrino USD	Neutrino Protocol Volunteers (2019)	Centralized (Waves)	Waves cryptocurrency based on a smart contract	26.41	26.28

Source: official websites of stablecoin issuing companies. URL: https://coinmarketcap.com/currencies/bitcoin/ (accessed on 10.10.2020).

coronavirus pandemic. In March 2020, the trading volume of Bitcoin/Tether USDT (BTC / USDT) reached 21.6 million Bitcoin, which is over 280% more than the trading volume in this pair in February 2020. The total volume of stablecoins in circulation in early April 2020 exceeded $7.5 billion and amounted to more than 3.7% of the total market value of all crypto-assets. As a result, the total volume of transfers of funds from cryptocurrencies to stablecoins reached a historic record of $444.2 million,[50] and the total volume of transactions with stablecoins exceeded $90 billion.[51] In the context of the global COVID-19 coronavirus pandemic and the significantly increased volatility of cryptocurrency rates in 2020, the market capitalization of major stablecoins increased more than twice, amounting to 6.5% of the Bitcoin capitalization.

While local stablecoins have a limited target audience and are not currently used as a universally accepted means of payment, global stablecoins could, in theory, be issued both nationally and internationally. Also, they could potentially be a universally available means of payment or a specialized settlement tool for clients of financial institutions around the world. Switching from a financial instrument as a store of value and exchange, as well as a tool to increase dollar liquidity in the crypto-asset market to a widely used means of payment at the international level, represents a paradigm shift in the development of stablecoins. Due to the network effect among millions of users, global stablecoins, primarily from transactional technology companies such as Facebook,[52] are able to stimulate competition in international payment services, increasing the speed of cross-border payments and reducing their cost. Also, global stablecoins can provide a wider level of financial accessibility to numerous users without bank accounts in different countries of the world [24].

The potential benefits of stablecoins can only be realized if to eliminate the main legal, regulatory and supervisory issues and risks associated with their wide circulation. The main problems and risks of using stablecoins include: the need for legal certainty of their turnover; rational management of the ecosystem of stablecoins and investment rules underlying the stabilization of their value; combating money laundering, terrorist financing and other forms of illegal financing[53]; control over the efficiency and integrity of the functioning of payment systems; ensuring cybersecurity, confidentiality and protection of personal data; protection of consumer and investor rights; issues of tax discipline, etc. Global stablecoins can create risks for the conduct of monetary policy, ensuring financial stability and the stability of the international monetary system.[54] All these issues are subject to close supervision by organizations such as the FATF, BIS, etc., and can be the subject of another scientific study.

Most modern stablecoin systems are characterized by a high level of centralization. Therefore, such systems are easier to regulate as opposed to decentralized cryptocurrency systems. This opens up the op-

[50] State of the Network Report. Coin Metrics. URL: https://coinmetrics.io/coin-metrics-state-of-the-network-issue-42-data-shows-cryptoasset-sell-off-was-driven-by-short-term-holders/ (accessed on 18.04.2020).

[51] The Block Research Report March 2020. The Block. URL: https://www.theblockcrypto.com/genesis/61451/the-block-research-report-march-2020 (accessed on 18.04.2020).

[52] The infrastructure of social network Facebook is more than 2.5 billion people. Also, the company owns a number of other social applications and instant messengers (Instagram, WhatsApp, etc.).

[53] For more details, see: Virtual Assets and Virtual Asset Service Providers. Guidance for a Risk-based Approach. *The Financial Action Task Force (FATF)*. 2019. URL: https://www.fatf-gafi.org/media/fatf/documents/recommendations/RBA-VA-VASPs.pdf (accessed on 20.10.2020); Report to the G20 Finance Ministers and Central Bank Governors on So-called Stablecoins. *The Financial Action Task Force (FATF)* 2020. URL: https://www.fatf-gafi.org/publications/fatfgeneral/documents/report-g20-so-called-stablecoins-june-2020.html (accessed on 20.10.2020).

[54] For more details, see: Investigating the Impact of Global Stablecoins. *Bank for International Settlements. G7 Working Group on Stablecoins Research*. 2019;(187). 37 p.

portunity for financial regulators to exert legal and administrative influence on stablecoin issuers and to minimize financial risks both in national jurisdictions and on the international level.

CONCLUSIONS

The research results lead to the following conclusions. Currently, there is no unified interpretation of stablecoins due to the great variety of their forms and methods to ensure the stability of their market value, as well as due to their specific issue. Therefore, stablecoins have multiple interpretations in developed countries: electronic money, deposits, securities and derivatives, secured crypto-assets, etc. When interpreting stablecoins, the main attention should be paid to identifying the economic purpose of such stablecoins, as well as the functional and technological features of their issue and circulation.

In general, stablecoins should be viewed as a new hybrid type of crypto-assets that combines innovative mechanisms for direct value exchange and management of financial transactions without intermediaries with centralized issuing mechanisms and the use of various methods to ensure price stability. In practice, stablecoins can be interpreted as a subtype of virtual currencies, whose main purpose is to perform the functions of a store of value and payment in the financial market. For the circulation of stablecoins it is advisable to be regulated within the framework of unified regulatory and legal norms that ensure their coordinated monetary, investment and tax regulation at the international level.

The suggested classification of stablecoins made it possible to draw more clear distinctions between economic differences in the mechanisms of issue and collateral, as well as the scale of circulation of collateral and algorithmic stablecoins. Today, local stablecoins are the most common, with the largest share belonging to centralized secured digital assets. Stablecoins backed by fiat currencies remain dominant both in terms of capitalization and the number of transactions. Secured cryptocurrencies dominate among decentralized stablecoins. Unsecured stablecoins have not gained widespread acceptance due to a lack of massive user confidence and regulatory concerns, despite a number of technological innovations that underlie their stabilization mechanism.

The ability of stablecoins to maintain their market value almost unchanged determines the widespread use of local stablecoins as a safe place in the crypto-asset market during periods of downward volatility in cryptocurrencies, caused by both temporary market fluctuations and large-scale economic crises. Wider use of local stablecoins can positively influence the development of the crypto-asset market by increasing its liquidity and stimulating the use of more stable forms of digital financial assets.

Stablecoins as a universal means of payment may be most popular at the global level. Global stablecoins can increase the speed of cross-border payments and reduce their cost, as well as provide a wider level of financial inclusion for a large number of users without bank accounts. Using stablecoins at the global level may lead to increased competition in the payment services market by increasing the number of multinational companies and investment banks issuing their own stablecoins. The realization of potential benefits of stablecoins requires addressing the underlying legal, regulatory and supervisory challenges posed by the ability of stablecoins to be used anonymously in both domestic and cross-border transactions.

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Cross-Border Capital Flows in Russia: Prospects for Changing their Internal and Geographical Structure

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ABSTRACT

***The* relevance** of the study is due to the growing influence of external factors on the structure of cross-border capital flows associated with Russia. The **aim** of the study is to identify the main changes in the internal and geographical structure of international capital flows in Russia, trace their connection with the state economic policy and make practical proposals for improving their internal and geographical structure in Russia. The author uses statistical **methods** related to the calculation of individual indicators and the analysis of statistical data, the study of international experience. The analysis of the calculated structure of flows and stocks of foreign investment in 2007–2019 proves that the internal structure had an increase in the importance of direct investments in the composition of liabilities and a decrease in the role of reserve assets in the composition of assets. Offshore and related jurisdictions dominate in the geographic structure of direct investment, while the structure of reserve assets has shifted from the United States to Asian countries (China and Japan). International experience indicates the development of new approaches to the regulation of international capital flows, including measures of macroprudential policy. The author made a **conclusion** about the ineffectiveness of the current economic policy in regulating the internal and geographical structure of cross-border capital flows in Russia and about the prevailing influence of administrative measures by the external players. To improve the structure of international capital flows in Russia, the author suggests using separate currency restrictions, macroprudential policy measures, deoffshorization policy, as well as targeted insurance of external risks for Russian investors.

Keywords: international capital flows; direct, portfolio and other investments; reserve assets; offshore; pandemic COVID-19; currency restrictions; macroprudential policy

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INTRODUCTION

Starting with the global economic and financial crisis of 2008–2009, the period of economic development in Russia was marked by significant changes caused by both internal and external economic factors. The internal economic development model was characterized by the crisis recessions (2009, 2015 and 2020), as well as a general slowdown in dynamics: in 2010–2013, the average annual growth rate of real GDP was 3.8%, while in 2017–2019, it was 1.9%.[1]

Our previous research showed that individual components of cross-border capital flows in Russia depend on internal factors: the dynamics of direct investment liabilities depends on the growth of final consumption of households, as well as, along with liabilities and portfolio investment assets, on changes in interest rates [1, p. 46–49].

As for external factors, the period under review was marked by an increased impact of negative external shocks on the Russian economy. The main shocks include the impact of the global economic and financial crisis (2008–2009); a significant drop in oil prices (2008, 2014–2015 and 2020); sanctions imposed by Western countries against Russia in 2014; pandemic coronavirus COVID-19 in 2020. We assessed the impact of external factors and found out that the most significant one was the dynamics of oil prices (for direct investment liabilities and portfolio investment assets), as well as the global stock index (for portfolio investment assets) [1, p. 46–49].

The impact of both internal and external factors during this period contributed to an overall reduction in cross-border capital flows associated with Russia. If at the peak of their dynamics in 2007, the total cross-border capital flows[2] associated with Russia amounted to 25.3% of GDP, and in 2019, they decreased to 5.4% of GDP.[3] In 2014–2019, this reduction was sustainable. On the one hand, this was due to the influence of economic sanctions, which directly limit the possibilities of attracting external financing; on the other, due to a slowdown in economic growth and, accordingly, a decrease in the attractiveness of the Russian economy as an object for external investments.

STRUCTURAL TRANSFORMATIONS OF THE OF CROSS-BORDER CAPITAL FLOWS IN RUSSIA IN 2007–2020

To analyze the internal capital structure in Russia, we will use the flow indicators (based on the balance of payments) and stock (based on the international investment position). In the case of flow indicators, we calculate the indicators of the main components of international capital flow (assets and liabilities of direct, other and portfolio investments) in relation to GDP (*Fig.*). In relation to the stock indicators, the analysis is based on the calculated structure of assets and liabilities of the international investment position (*Table 1*).

Significant changes took place in the structure of cross-border capital flows (*Fig.*). Before the main source of inflow of funds into the Russian economy was the global economic and financial crisis other investments. However, since 2008, this have been direct investments. Only twice (in 2015 and 2018) the main source of the inflow of funds was the reduction in assets for other investments. It should also be noted the "reversal" of the flows of other investments since 2014. Since then, throughout the years, there has been a net reduction in liabilities on other investments, while in 2015–2018, there was also a net reduction in their assets. Such trends could be explained primarily by the effect of the sanctions. On the one hand, foreign markets were closed to attract short-term capital to certain segments

[1] Calculations based on World Economic Outlook as of October 2020. URL: https://www.imf.org/en/Publications/WEO/weo-database/2020/October (accessed on 16.11.2020).

[2] By aggregate cross-border capital flows, we understand the sum (excluding the transaction sign) of assets and liabilities of direct, portfolio and other investments associated with Russia.

[3] Calculations based on the data from the balance of payments of the Russian Federation.URL: http://cbr.ru/statistics/macro_itm/svs/ (accessed on 16.11.2020).

Table 1

Structure of Russia's international investment position in selected years (end of the year, in %)

	2007	2009	2013	2015	2017	2019
Assets	100.0	100.0	100.0	100.0	100.0	100.0
Direct investments	33.9	27.8	32.6	31.4	35.0	33.1
Portfolio investment	1.8	3.5	3.7	5.8	5.5	5.3
Derivative financial instruments	0.1	0.2	0.4	1.0	0.4	0.4
Other investments	20.3	28.2	28.6	30.3	26.8	24.6
Reserve assets	43.8	40.3	34.7	31.5	32.3	36.6
Liabilities	100.0	100.0	100.0	100.0	100.0	100.0
Direct investments	39.5	38.4	42.2	41.5	49.6	50.8
Portfolio investment	29.6	22.0	20.4	16.9	21.6	26.2
Derivative financial instruments	0.1	0.5	0.3	1.1	0.4	0.5
Other investments	30.8	39.0	37.2	40.6	28.3	22.5

Source: calculated by the author based on data from the Central Bank of the Russian Federation. URL: http://cbr.ru/statistics/macro_itm/svs/ (accessed on 16.11.2020).

of the private sector, and on the other hand, the reduction in accumulated foreign assets made it possible to solve some internal problems (including the payment of external debt). Portfolio investment flows have traditionally played a relatively smaller role in the international capital flow compared to direct and other investments, although in some periods there was a relatively significant inflow (for example, in 2012 and 2019) or an outflow of funds previously invested by non-residents (in the crisis 2008 and 2014–2015).

It is not yet possible to assess the 2020 coronavirus pandemic impact on the structure of cross-border capital flows. However, data for the first two quarters of 2020 indicate a relative increase in the importance of portfolio investment flows. The role was played by the reduction in liabilities and an increase in portfolio investment assets, typical for each crisis, as well as the relatively smaller impact of new restrictions on financial instruments. Direct investments experienced a short-term shock (in the 1st quarter), but in the 2nd quarter they resumed their normal dynamics. Other investments continued the trends of the previous model (reduction of assets and liabilities).[4]

Due to these changes in capital flows, there have also been changes in the structure of their accumulated values (*Table 1*). As one would expect, in the structure of liabilities based on the dynamics of flows, the share of direct investment was growing steadily, increasing from 2007 to 2019 by more than 10 percentage points. The share of other investments decreased most significantly (by 8.3 percentage points) and somewhat less of portfolio investments (by 3.4 percentage points). The ratio between the dynamics of other and portfolio investments changed after 2015, while before, the share of other investments was growing against the background of a significant drop in the share of portfolio

[4] The analysis for 2020 is based on balance of payments for the first two quarters of the current year. URL: http://cbr.ru/statistics/macro_itm/svs/ (accessed on 16.11.2020).

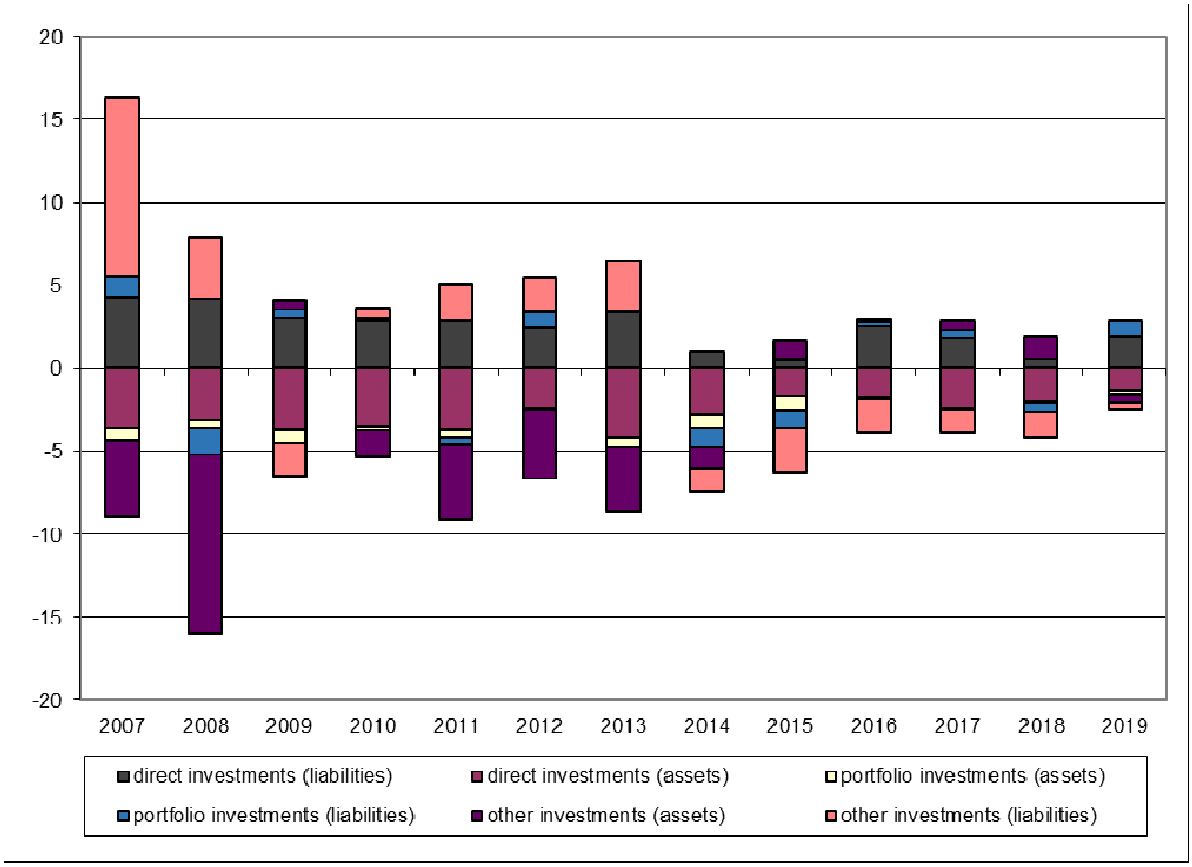

Fig. **Structure of cross-border capital flows in Russia in 2007–2019 (% to GDP)**

Source: calculated by the author based on Russia's balance of payments data. URL: http://cbr.ru/statistics/macro_itm/svs/ (accessed on 16.11.2020).

investments. Here, an important role could be played by the sanctions, which equally negatively affected both of these components of international capital flow, but did not affect government securities, where non-residents have been investing since 2016.

The changes in the structure of Russian assets abroad were less obvious. The main role was played by reserve assets associated with the state capital flow. The share of direct investment in Russian assets was generally relatively stable, except for a slight drop in the crisis year of 2009 (there was a significant capital outflow in the form of other investments). The share of other investments grew until 2015, but then began to decline, since the return of funds to the country began through this channel.

Derivative financial instruments have not yet played such a significant role in the accumulated capital flow. However, they were significantly increasing until 2015 and reached their maximum (most likely, due to the need to insure currency risks in the midst of a currency crisis).

Carried out since 2006, the liberalization of Russian currency legislation presupposes the unavailability by currency restrictions to manage the structure of cross-border capital flows. Nevertheless, certain measures of economic policy allow influencing this structure. The increase in reserve requirements for foreign currency deposits in 2018 provokes capital outflow into the instruments of foreign issuers, i.e. could stimulate the growth of portfolio investment assets [2, p. 48]. In our opinion, there are more explicit measures of the Central Bank aimed at limiting the growth of liabilities of other investments — increasing the reserve requirement for liabilities to

Table 2

Structure of outward foreign direct investment from Russia by country (mln USD)

	2013	2014	2015	2016	2017	2018	2019	2007–2019
Total outward FDI from Russia	86 507	57 082	22 085	22 314	39 049	31 377	21 923	592 372
Cyprus	7671	23 546	4249	9827	21 352	10 681	14 344	199 342
British Virgin Islands	62 223	718	3301	1795	1401	885	665	91 685
Bermuda	571	2997	–261	480	279	–39	–561	11623
Bahamas	560	756	1054	1205	1300	1258	223	7785
Netherlands	–3022	2132	461	841	–6023	3025	–189	36 812
Switzerland	1358	6927	203	1433	2281	794	–2152	22 024
Luxembourg	1314	639	786	–1633	1856	2000	727	13 569
Ireland	264	91	479	1139	634	2032	832	7785
United Kingdom	1294	1935	–439	755	192	2626	2454	20 493
Austria	5265	1135	746	258	6739	221	369	18 070
Germany	1334	1016	738	393	724	1078	1420	14 694
France	449	523	74	121	310	–65	263	4956
USA	739	1654	819	873	126	653	–577	17 532
Singapore	304	817	383	888	6136	1566	1923	13 454
Turkey	1447	1183	1475	1184	557	534	–2107	10 766
Belarus	863	609	736	629	494	646	588	12 004
Kazakhstan	671	657	643	476	727	366	187	6482
Ukraine	496	–493	595	822	–92	213	240	6059
Share of countries — explicit offshore (%)	79.0	51.9	48.0	57.8	61.9	42.3	70.3	54.4
Share of countries — explicit offshore and sparring jurisdictions (%)	81.7	75.6	56.9	72.8	74.9	81.6	87.0	74.4

Source: calculated by the author based on data from the Central Bank of the Russian Federation. URL: http://cbr.ru/statistics/macro_itm/svs/ (accessed on 16.11.2020).

non-resident legal entities from 4.25% (at the end of the 1st quarter of 2016) to 4.75% (as of mid-2019) for liabilities in roubles and from 4.25 to 8% (for the same period) for liabilities in foreign currency.

Changes in the share of reserve assets in the structure of the international investment position (*Table 1*) reflected changes in Russia's monetary policy. Until 2014, the policy of targeting the exchange rate was carried out. It was associated with the conduct of foreign exchange interventions (however, the intensity of the interventions themselves after the global economic and financial crisis gradually decreased). In 2014–2016, there was a transition to a free floating rouble. Another change in monetary policy took place in early 2017. It was associated with the start of purchases of foreign currency by the Ministry of Finance, which consequently played an active role in regulating the rouble exchange rate. The result of this policy was the renewed buildup of foreign exchange reserves. Hence, there was the increase in reserve assets in the structure of assets from the end of 2015 to the end of 2019. The most large-scale interventions in the period after 2014 were carried out in 2019 [3, p. 11, 12], when the net increase in reserve assets amounted to USD66.5 billion.

CHANGES IN THE GEOGRAPHICAL STRUCTURE OF CROSS-BORDER CAPITAL FLOWS

The geographical structure of both investments from Russia and foreign investments coming to Russia continues to be dominated by offshore and offshore countries.[5] Detailed statistics by country are provided by the Central Bank of the Russian Federation only for direct investments. According to our calculations, the share of explicit offshore countries in the direct investment flows from Russia in 2007–2019 was 54.4%, and together with offshore countries[6] — 74.4%. For foreign direct investment in Russia, the share of these groups of countries for the specified period was 36.4% and 71.8%, respectively. That is, more than 70% of direct investment flows to and from Russia are associated with offshore jurisdictions.

The decline in the share of offshore and related jurisdictions usually occurs during a crisis, as evidenced by data for 2015 (a similar situation took place in 2009). After the crisis, their use is restored. For the period of 2014–2019, the specifics was the changes in the geographic structure of foreign direct investment flows. For example, in some years there was an outflow of direct investments from European jurisdictions to Russia (primarily from Cyprus, as well as from Ireland and Luxembourg), while maintaining a significant inflow of funds from the Bahamas and Bermuda.

Since 2012 deoffshorization policy was applied to combat the use of offshore companies, which basically should have changed the geographical structure of the international capital flow in Russia. This includes innovations in the Tax Code of the Russian Federation on transfer pricing (introduced on January 1, 2012), a law on controlled foreign companies,[7] several stages of tax amnesties carried out since 2015, the creation of "internal offshore companies" (special administrative regions) [6]. However, as evidenced by statistics (*Tables 2* and *3*), there is no steady, significant decrease in the use of offshore and offshore countries in foreign direct investment in and from Russia in recent years.

The next stage of the deoffshorization policy began in 2020. By direction of the President of the Russian Federation, the government

[5] Here we use the term from work [4]. B.A. Kheyfets, for example, uses the term "sparring-offshore jurisdictions" [5, p. 7].

[6] Ireland, Luxembourg, Switzerland, Singapore, the Netherlands, Great Britain were also classified as offshore countries in the case of direct investments in Russia. In the case of direct investments from Russia, they were Ireland, Latvia, Luxembourg, Monaco, the Netherlands, Singapore, Switzerland, and the United Kingdom.

[7] Federal Law No. 376-FZ of November 24, 2014 "On Amendments to Parts One and Two of the Tax Code of the Russian Federation (with regard to taxation of profits of controlled foreign companies and income of foreign organizations)". URL: http://www.consultant.ru/document/cons_doc_LAW_171241/ (accessed on 16.11.2020).

Table 3

Structure of foreign direct investment in Russia by country (mln USD)

	2013	2014	2015	2016	2017	2018	2019	2007–2019
Total FDI inflow	69 219	22 031	6853	32 539	28 684	8785	31 975	484 191
Cyprus	8266	3158	–7069	–436	8693	–10 108	7932	74 214
British Virgin Islands	9379	3123	2374	1010	–826	1223	990	40 353
Bahamas	2791	3638	5108	5802	6211	1009	1143	33 486
Bermuda	404	1777	2239	2551	1336	843	967	31 318
Ireland	10 399	–531	623	–1789	889	–3850	3193	26 859
Luxembourg	11 638	–693	–5770	–939	3378	–506	–2814	27 642
Netherlands	5716	1102	–246	165	–1427	7846	6393	58 056
United Kingdom	18 927	120	1112	478	2102	2522	4686	35 478
Switzerland	1086	2472	203	1842	1511	1690	23	12 851
Austria	–326	841	407	1071	–174	884	924	9528
Germany	335	349	1483	224	470	341	245	25 061
France	2121	2224	1686	1997	854	1134	2044	18 707
Sweden	–1203	166	122	530	20	372	–250	9219
USA	485	708	209	402	495	376	–105	9884
Singapore	–502	162	185	16274	2703	1587	530	21 596
China	597	1271	645	345	140	–13	136	4327
Japan	369	295	447	140	83	345	116	3780
Kazakhstan	208	357	433	350	205	159	130	2436
Share of countries — explicit offshore (%)	23.5	50.1	68.8	29.7	56.8	–	35.1	36.4
Share of countries — explicit offshore and sparring of jurisdictions (%)	91.8	62.1	12.0	79.0	88.7	32.9	72.7	71.8

Source: calculated by the author based on data from the Central Bank of the Russian Federation. URL: http://cbr.ru/statistics/macro_itm/svs/ (accessed on 16.11.2020).

proposed to Cyprus, Luxembourg, the Netherlands and Malta, and then to Hong Kong and Switzerland, to amend agreements to avoid double taxation. It is proposed to increase the tax rate on dividends and interest on loans granted to 15%.[8] Cyprus, Luxembourg and Malta reportedly agreed to revise the agreements.[9]

Among the countries that make direct investments in Russia that do not belong to offshore and related jurisdictions, we will find that the peak of the inflow of investments from European countries[10] fell in the crisis years 2014–2016, and then after a sharp decline in 2017, the growth of investments from these countries resumed. Direct investment from Northeast Asian countries[11] was significantly lower than investment from the four leading European investor countries, and steadily declined after 2014. Simply based on official data,[12] we see no reason to replace European investments with Asian ones in the Russian economy.

Russia's partners in the integration association, which proclaims the freedom of capital flow, the member countries of the Eurasian Economic Union (EAEU) make a very insignificant contribution to investment in the Russian economy. Their share in total direct investment in Russia has sharply decreased since 2015 (with the exception of 2018, when there was generally a small inflow of foreign direct investment to Russia).

Kazakhstan has been and remains the main investor in the Russian economy among the EAEU countries. On the contrary, the EAEU countries keep playing a significant role in outgoing Russian direct investments. According to official statistics, from 2014 to 2018, Russian direct investments in the EAEU countries exceeded investments in Germany and France. In the total foreign direct investments in Russia, in 2017–2019 their share was at the level of 3.6–3.9%.[13]

Special mention should be made of the investment structure of official assets. It can be tracked based on statistics on the fund allocation from the foreign exchange reserves of the Central Bank of the Russian Federation by country. For the first decade after the global economic and financial crisis, this structure did not have significant changes [8, p. 21]. In the period from the beginning of 2018 to the beginning of 2020, these changes took place. The share of investments in Chinese assets rose sharply (from 2.6% at the beginning of 2018 to 13.8% at the beginning of 2020), with a significant decrease in investments in the United States (from 29.9% to 7.9%) and a slight change of the share of the euro area countries — France and Germany (from 23.7 to 23.4%). The share of investments in Japanese instruments also increased significantly (from 1.5% to 13.2%).[14] On the one hand, the share of investments in countries applying sanctions against Russia decreased, on the other hand, within this group of countries, investments were partially redistributed from the United States to Japan. This strategy allowed to reduce the potential risks of expropriation of assets, but reduced their profitability (investments in Japan) and reliability (investments in China).

Keeping the trends that took place until 2019 would hardly have allowed for an increase in cross-border capital flows associated

[8] Makeev N. Russia closes international offshores for business. Moscow's comsomolets. 26 August 2020. URL: https://www.mk.ru/economics/2020/08/26/rossiya-zakryvaet-dlya-biznesa-mezhdunarodnye-ofshory.html.

[9] Mavrina L. The government will raise taxes on capital outflow to Switzerland and Hong Kong. Vedomosti. 11 August 2020. URL: https://www.vedomosti.ru/economics/articles/2020/08/11/836417-pravitelstvo-nalogi.

[10] We are considering the largest European investor countries: Germany, France, Sweden and Austria.

[11] China, Japan, Republic of Korea.

[12] Asian and European investments can also be made through offshore and related centers, but their origin can only be identified through detailed analysis of individual transactions.

[13] Due to the use of offshore jurisdictions, the direct investments flows between Russia and the EAEU countries are underestimated. For this region (for all CIS countries) from 2011 to 2016, there were alternative estimates of mutual direct investment. See: [7, p. 23].

[14] Annual Report 2018. M.: Bank of Russia, 2019, p. 95; Annual Report 2019. M.: Bank of Russia; 2020.P. 109.

with Russia. The sanctions combined with low economic growth and the absence of prospects for a significant increase in oil prices, create an unfavorable combination of internal and external factors for Russia. The coronavirus pandemic that began in 2020 and the corresponding global economic crisis are leading to another global halt in capital flows, which will also affect Russia. Given the existing low level of Russia's participation in the international capital flow, one should hardly expect its significant reduction.

In the structure of cross-border capital flows, further growth in the share of reserve assets is highly likely, as the Ministry of Finance continues to pursue a conservative policy in the absence of significant exchange rate support. Uncertainty in the economy is likely to lead to a decrease in direct investment (both inbound and outbound), while portfolio investment in government securities may be favorable with some reduction in the overall level of risk and maintaining positive interest rates by the Central Bank at the background of the policy of zero interest rates in the leading developed countries. The resumption of the inflow of other investments was observed in the second quarter of 2020 and may continue in the near future. Thus, the internal structure of cross-border capital flows may again begin to shift towards speculative capital flows.

In the absence of an effective deoffshorization policy, offshores and related jurisdictions will continue to dominate the geographic structure of international capital flows in Russia. The revision of double taxation agreements with individual jurisdictions will lead to the use of other jurisdictions, as it happened after 2014. The strengthening of the position of Asian countries in cross-border capital flows associated with Russia is unlikely, although the Chinese and a number of other Asian economies will strengthen their positions in the global economy after the current crisis.

Whilst Russia does not lead an active policy to regulate the international capital flows, one can hardly expect positive changes in its structure.

MEASURES TO REGULATE CROSS-BORDER CAPITAL FLOWS AND THEIR STRUCTURE: INTERNATIONAL EXPERIENCE AND PROPOSALS FOR RUSSIA

From the second half of the 1980s, before the global economic and financial crisis of 2007–2009, marked by the active financial globalization processes, it was characterized by the predominance of a theoretical approach emphasizing the advantages of free cross-border capital flows. Among its main advantages were the expansion of the possibilities of borrowers to attract additional resources and those of lenders to diversify their portfolios. For national economies, the opportunities for smoothing aggregate consumption and the development of national financial markets increased over time.

The global economic and financial crisis revealed shortcomings of free capital flows, including: "contagion effects" between countries, where international capital flows act as the main channel for transferring negative external shocks, as well as significant macroeconomic effects from a sudden stop of capital flows to emerging markets. Some empirical studies have not found the alleged positive effects of free cross-border capital flows [9, p. 12, 13]. The internal structure of international capital flows was also important. Their negative impact is traditionally associated with speculative capital, which is mainly reflected in "portfolio investments" and "other investments" in the balance of payments. Whereas direct investment is traditionally associated with positive effects for national economies.

This arises a question about the opportunity or even the need to apply measures to regulate cross-border capital flows. It is about a fairly wide range of measures: from standard economic policy instruments with a wide range of impacts (primarily, monetary and fiscal policy) to targeted measures to regulate

cross-border capital flows (primarily, currency restrictions and individual macroprudential policy measures). We will only analyze measures directly aimed at regulating international capital flows.

There are usually two main reasons for applying the measures to regulate cross-border capital flows by countries with emerging markets, including Russia: managing aggregate demand and achieving financial stability [10]. In terms of managing aggregate demand, restricting free capital flows gives freedom to choose the goals of monetary policy in the context of the "impossible trinity". Financial stability is possible as a result of the fact that the financial systems of countries with emerging markets, usually largely depend on attracting external financing, which can threaten systemic problems in a crisis situation [11, p. 11].

Another argument for the introduction of measures to regulate international capital flows is the increased impact of external shocks after the global economic and financial crisis. In particular, under the influence of the outbreak of the COVID-19 pandemic in March 2020, capital outflow from emerging markets amounted to more than US $100 billion [10].

The countries with emerging markets and developing countries, as evidenced by B. Erten and J. Ocampo [12], have indeed increased the number of measures aimed at regulating cross-border capital flows since 2005.

Although Russia uses certain measures to regulate the structure of cross-border capital flows (the management policy for the exchange rate by the Ministry of Finance, regulation of the structure of international reserves, mandatory reserve requirements for external liabilities, the policy of deoffshorization of the economy, and some others), their effectiveness is very limited. As shown above, external administrative regulatory measures in the form of sanctions and partially the measures to combat offshores and illegal incomes taken by other countries have a significant impact on the internal and geographical structure of cross-border capital flows in Russia.[15]

Based on the tasks facing the economic policy of Russia as a whole, wide use of the possibilities to regulate cross-border capital flows in line with changing approaches in international practice seems important:

1. Switching to extensive use of certain restrictions on cross-border capital transactions is necessary. Besides the urgent Russian problems of increasing independence of monetary policy in an open economy and ensuring financial stability, these restrictions could further consolidate positive changes in the structure of cross-border capital flows if they are introduced in relation to speculative capital flows, but do not affect direct investments.

Concerning the structural changes of cross-border capital flows, measures of macroprudential policy can also be used. They have now being applied in Russia, but not in full. We have already mentioned one of the existing mechanisms associated with increased reserve requirements for banks when attracting external financing (in fact, limiting the growth of liabilities of other investments). The range of relevant instruments can be expanded to limit speculative capital inflows.

Our previous research [1] allows us to conclude that the structure of cross-border capital flows can also be changed by standard economic policy measures. Thus, a stimulating policy aimed at increasing the final consumption of households will facilitate the inflow of foreign direct investment. The impact of interest rate policy is less obvious, since rising interest rates stimulate both direct investment and speculative capital inflows. In this case, selective measures are needed to regulate the internal structure of capital flows.

The deleveraging program proposed by E.A. Zvonova [13, p. 138] basically represents measures to reduce Russia's participation in international capital flows (reducing liabilities by reducing assets, including official ones).

[15] For example, [5, p. 23, 24].

Besides a general reduction in accumulated capital flows, implementing this program will lead to changes in their structure regarding a decrease in debt instruments and an increase in direct investments. The effective implementation of this program requires replacing external financing of economic agents with internal ones.

2. Regarding the geographical structure of international capital flows, the priority direction, in our opinion, is to continue deoffshorization policy. It is still premature to assess the results of this policy undertaken in 2020 (revision of agreements to avoid double taxation with a number of countries). In any case, it could be supplemented by the state interventions to the banks and companies under control, in terms of limiting their use of offshore jurisdictions. The current sanctions regime is the deterrent, which narrows the possibilities of accessing the capital markets of the leading developed countries. Restrictive measures in the course of the deoffshorization policy should be combined with measures to increase the attractiveness of investment in the Russian economy.

The possibilities to expand the geography of sources of attracting investment at the expense of emerging markets are still limited by both the indirect effects of sanctions and the relatively low attractiveness of investments in the Russian economy amid a significant slowdown in its growth during the recovery from the crisis of 2014–2016. In these conditions, the use of internal sources of investment leads. A possible source of funds is reducing official external assets (spending the funds of the National Wealth Fund[16] within the country).

3. The geographical structure of investments can also be expanded by agreements aimed at developing the processes of mutual investment with individual countries. There are significant prospects for advancing the formal process within the EAEU. It makes sense to expand agreements on a free trade zone that are currently being negotiated between the EAEU and third countries, and add clauses to promote mutual investments. A promising direction for developing investment cooperation could be enhanced cooperation with the BRICS countries.

Many experts[17] suggest that insuring non-commercial risks of legal direct investments from Russia to countries that are objectively characterized by higher risks, but at the same time play an important role in Russia's foreign economic strategy, can provide support for changing the internal and geographical structure of cross-border capital flows.

CONCLUSIONS

The period after the global economic and financial crisis of 2007–2009 is marked by changes in the domestic and geographic structure of cross-border capital flows associated with Russia. In the structure of capital inflow, the share of foreign direct investment increased against the background of a decrease in the share of other and portfolio investments. In the structure of external assets, the share of reserve assets decreased against the background of the transition to a floating exchange rate of the rouble. However, active interventions by the Ministry of Finance in the foreign exchange market in 2017 rectified this trend.

Offshore and related jurisdictions are still dominating in the geographical structure of cross-border capital flows. However, the role of such jurisdictions from some European countries has slightly decreased and flows have reoriented to the Caribbean islands and Singapore. Among the jurisdictions not related to offshores, there was no significant switch of direct investment sources from European to Asian countries, while the structure of outgoing direct investment diversified (mainly due to investments in certain periods in the EAEU countries and Turkey).

[16] During the economic crisis of 2020, the volume of the National Wealth Fund in USD increased from February 1 to October 1, 2020 by 38.6%. URL: https://minfin.gov.ru/ru/perfomance/nationalwealthfund/statistics/ (accessed on 16.11.2020).

[17] For example, [14, p. 113].

Without a proactive policy aimed at regulating cross-border capital flows, one can hardly expect positive trends in the structural changes of these flows in Russia. Due to the 2020 crisis and the reaction to it within the current model of economic policy, the role of speculative capital flows, as well as reserve assets, may increase. Within the geographic structure, the use of offshore and related jurisdictions will continue, as well as dependence mainly on developed European countries as an external source of capital.

In this regard, we have proposed new additional measures to enhance the regulation of cross-border capital flows. For instance, to return certain restrictions on the cross-border capital flows to the economic policy measures, since they also allow regulating its internal structure; to intensify deoffshorization policy measures, including the state interventions to the companies and banks under control; to expand investment cooperation with the EAEU countries, BRICS and some other countries with emerging markets using state policy measures on risk insurance when investing in these countries. Nevertheless, significant changes in the volume and structure of cross-border capital flows cannot occur without Russia's transition to a model of economic growth with higher rates, which will make it an attractive target for external investment and expand opportunities for effective external investment.

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Analysis of the Causes of Long-Term Changes in Economic Inequality in the Global Economy

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ABSTRACT

The author examines long-term changes in economic inequality in the global economy. **The aim** of the article is to update, analyze and systematize the long-term causes of changes in economic inequality in the global economy and identify its country specifics. The author used the **methods** of analysis and synthesis, systematization, classification and categorization of information from various scientific and statistical sources and databases. To illustrate the trends in economic inequality, the author applied the indicator of the share of national income among different groups of the population. The study revealed the cyclical nature of economic inequality in accordance with Kondratieff innovation waves lasting 50–60 years. Based on the data analysis of economic inequality for the period 1900–2018, the author **concluded** that technological progress is the priority factor in changing economic inequality. Together with the country specifics of the financial mechanism for redistributing income and wealth and various regimes of international cooperation and trade, it affects the changes in cross-country and domestic economic inequality. Understanding the nature of changes in inequality will allow for effective long-term strategies for economic development and the corresponding state regulation policy in the context of faster digitalization and robotization of the global economy.

Keywords: economic inequality; poverty; economic growth; Kondratieff innovation cycle; economic cycles; taxes; government regulation

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INTRODUCTION

Inequality is among the greatest challenges of modernity. This is confirmed not only by numerous scientific studies, but also by obvious multiple aspects of this problem in the current UN sustainable development goals until 2030.[1] Over the past few years, the problem of inequality has often stepped forward and became leading in the international economic agenda in any economic conditions.[2]

Most scientists think that inequality really exists, which is confirmed by various data (*Fig. 1*). They also believe that with the current global financial system, economic inequality is increasing, which is a threat to the world community in the long term.

However, some scientists believe that the problem of growing global inequality is exaggerated and requires more thorough research [1]. Possible inaccuracies in assessing the dynamics of economic inequality may be caused by insufficient quality data, since this information is collected differently for various groups of the population in terms of income. Moreover, there is still a problem of identifying the ultimate beneficiary of depository and brokerage accounts [2].

According to modern macroeconomic goals, many scientific works seek to solve economic inequality in the context of economic growth and poverty. Poverty reduction is possible by accelerating economic growth, which, however, can accelerate the growth of inequality if redistributing of income and wealth in the country is ineffective [3].

Economic growth, growing income inequality and overproduction, which creates environmental problems for the Earth and risks to sustainable development, are the prime interest for the scientific community [4]. These issues are difficult to solve due to the fact that the available tools and methods will slow down economic growth, which is totally unacceptable for its main beneficiaries, since it will become a challenge to the stability of the global financial system.

Analysis of the causes of long-term changes in economic inequality in the global economy aims to develop a comprehensive view of state regulation of economic inequality, reassess the analysis of the causes of long-term changes in economic inequality in the global economy and prioritize the importance of various factors that influence economic inequality. The practical importance of systematization, analysis and clarification of the reasons for developing economic inequality is to allow state regulation bodies to better understand this problem and to apply science-based approaches in building optimal socio-economic and financial policies.

R. I. Kapelyushnikov [1] assumes that the risks of primitivization of the problem of growing economic inequality are quite high and we should examine the reasons for its change more carefully. The author provides a critical analysis of various points of view on the causes of rising economic inequality and shows their weaknesses, emphasizing the relevance and the need to continue research on this issue. In this regard, a new look at this problem that considers the long-term factors of changes in economic inequality, as well as the importance of considering its cyclical nature of development are relevant.

MATERIALS AND METHODS OF RESEARCH

Economic inequality refers to the differences in indicators of economic well-being between individuals or groups of individuals. The most common classification in the scientific literature is cross-country and domestic economic inequality. To illustrate trends in economic inequality, we applied the indicator of the share of national income among various groups of population. Trends in the share of national income of 1% of the richest people in the coun-

[1] UN. 17 Goals to Transform Our World. 2020. URL: https://www.un.org/sustainabledevelopment/sustainable-development-goals/ (accessed on 20.07.2020).

[2] WEF. Challenges and Opportunities in the Post-COVID-19 World. 2020. URL: http://www3.weforum.org/docs/WEF_Challenges_and_Opportunities_Post_COVID_19.pdf (accessed on 20.07.2020).

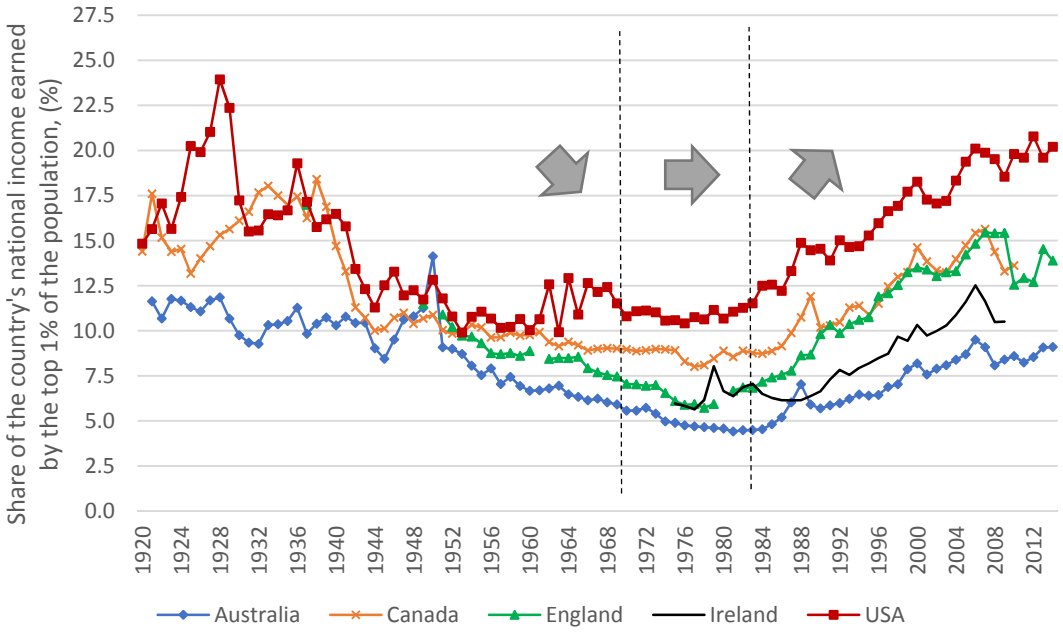

Fig. 1. **Trends in the share of income of the top 1% of the population by share in national income in different countries***

Source: compiled by the author based on World inequality report 2018.

* To illustrate this, we have marked the generally accepted trends in inequality, highlighting the period from the 1970s to the 1980s as reversal and the beginning of the growth of economic inequality in the world. Note that the graph clearly shows how the process of decreasing inequality slows down first in the United States, and then in other countries. In fact, in the United States, the reversal of inequality took place in the 1950s–1960s. In other countries, it happened later, closer to 1978.

try over a long period of time clearly shows how economic inequality is changing.

To identify the causes and factors affecting long-term trends in economic inequality, we used the methods of analysis and synthesis, systematization, classification and categorization of information from various scientific and statistical sources and databases.

The major source of information for the research base is the World Inequality Database.[3]

LITERATURE REVIEW

R. I. Kapelyushnikov [1, p. 10] classifies the drivers of changes in inequality into general and specific. Common reasons of global nature that have a large-scale impact on the standard of living, include the following:

1. Fundamental changes in the political regime, manifested in the revitalization of socialism, which resulted in a number of relevant reforms for a more equitable distribution of income in society.

2. Heterogeneous technological progress and production rates of the corresponding highly skilled labor force.

Particular causes and drivers of changes in economic inequality include:

1. Weakening of trade unions, traced in a significant loss of their ability to defend workers' rights.

2. Globalization of the global economy.

3. Fast development of financial markets and the "financialization" hypothesis.

4. Labor migration.

A lot of foreign research is devoted to inequality. In the fundamental work on inequality, S. Kuznets [5] explored the hypothesis that inequality changes nonlinearly during the economic growth cycle, increases fast at the initial stage of GDP growth and decreases at its later stages. Thus, the inequality change

[3] World Inequality Database. URL: https://wid.world/summary-table/ (accessed on 10.06.2020).

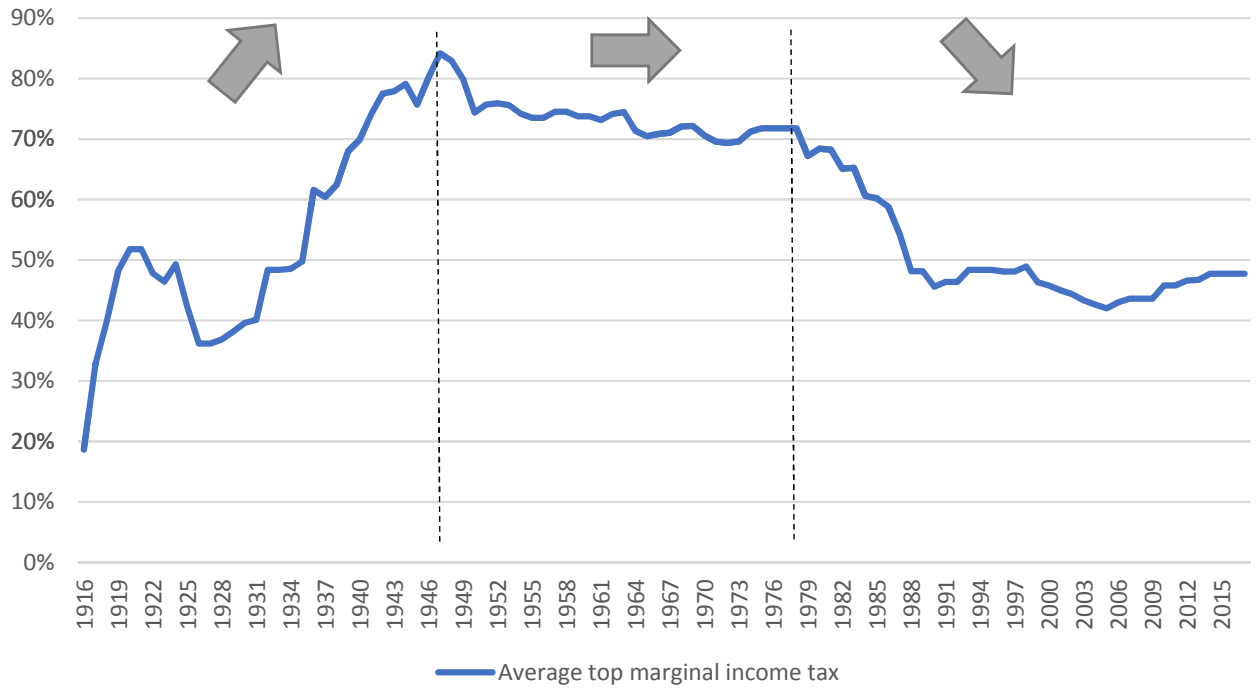

Fig. 2. **Marginal income tax and wealth tax of the top 1% of the population, averaged for the group of rich countries (USA, England, Germany, France, Japan) for the period 1916–2017**

Source: compiled by the author based on [2].

cycle can be divided into two stages relative to economic growth. S. Kuznets presented the economic inequality development at different stages of economic growth as a U-shaped function.

The most comprehensive and fundamental foreign works include the periodic World Inequality Report 2018 [2] and the work by P. Tridico [6]. The conclusions in these works differ, since both works note the complexity and multifactorial nature of changing economic inequality.

The World Inequality Report 2018 describes the dynamics of economic inequality in a number of developed and developing countries over more than 100 years. In this context, it shows two distinct periods of development of the global economy, lasting about 50–60 years.

The first period lasts from about 1910–1920 to 1970–1980. During this time, most countries experienced a steady decline in inequality. The period was characterized by powerful political, economic and social shocks that influenced the dynamics of inequality in almost all these countries. The reasons for the change in trends in economic inequality were world wars and financial crises, which led to a significant deterioration of production factors.

To finance the two world wars, the tax burden was sharply increased in many countries, especially on the wealthy strata of the population (*Fig. 2*).

After the two world wars, tax rates on the income of the richest strata of the population and on the bottom 90% of the population started to converge. For the poor and middle strata of the population, the tax burden during this period grew with a delay. Super high tax rates for the wealthy began to decline immediately after World War II.

We will supplement the idea of capital market regulation with a monetary policy factor, which has not been considered as detailed as the issues of income and inheritance taxation.

- After the outbreak of World War I, interest rates of the central banks of developed countries (USA, England, etc.) were reduced

to historical lows (about 2%) as a measure to tackle crises and great uncertainty in the global economy.

• After World War II, acceleration of inflation began, which led to a sharp increase in interest rates of central banks [7]. At the time of reaching the peak tax rates on income and inheritance for the richest strata of the population, interest rates were at the minimum values.

• After uncertainty reduction in the world and exhaustion of the need to finance military spending, the tax burden on the rich peaked and stopped growing, but inflation and interest rates started rising. In the period from 1939–1945 to 1970–1980, interest rates in the world grew almost seven times, reaching about 14% (in the United States and England). Then inflation stopped growing and allowed for easing of interest rate and monetary policy of central banks.

The second period (from the 1970s — 1980s to the present) is associated with totally opposite shocks, characterized by state regulation of inequality turning towards liberalization and supporting the idea of accelerating economic growth. During this period, the policy of strict control of capital turnover broke up, asymmetric practices for motivating top managers were introduced, as well as tax cuts for the rich and the equalization of the average tax burden on all groups of the population. The global economy focused on the concept of value maximization, which is still fundamental in the theory of corporate finance [8].

Note that economic growth has affected the development of countries in different ways. The main reason for the unequal changes in inequality was differences in adjusting the financial mechanism in different countries for redistributing national income, associated with the specifics of the political system and the terms of the social contract.

We will support this explanation with the conclusions interesting in this context [9]. Cross-country differences in a country's social mentality largely determine the rigidity of its state economic policy adjustment. The authors argue that the United States, following the spirit of the free market and equal opportunity, believe that if a person is poor, it is his/her fault. The European mentality sticks to the idea that a poor person is most likely unlucky and needs help, since the whole society as a whole will benefit from this. In richer and more developed countries, inequality is comparatively lower, since as wealth accumulates, society becomes more tolerant and changes its attitude towards the poor, pursuing appropriate policies of social support and equalizing economic inequality.

We should also mention the more rare country features of economic inequality growth specific for some developing countries. For instance, South Africa is among the countries with the greatest economic inequality.

For a long time, the main driver of economic inequality in South Africa was class inequality (apartheid), abolished in 1994. The aftershocks of apartheid appear in the fact that today 10% of the country's population, including predominantly white people, earns more than 60% of the total national income of Africa and receives income comparable to that of the European Union [2]. Accordingly, the bottom 90% of the South African population by income earns quite little and lives in extremely poor conditions.

The fairest income distribution in the USSR was the period of de-Stalinization of the economy after 1958, when massive investments in infrastructure and education took place. However, after the 1970s-1980s, it is not quite right to assess economic inequality in the USSR only by monetary indicators. In the context of a significant commodity deficit and a number of economic difficulties in the 1980s [10], non-monetary economic inequality boomed in the USSR. It consisted in unequal access to scarce goods and services for the political elite, the richest people and the rest of the population. According to the World Inequality Report 2018, the standard of living of the top 1% of the

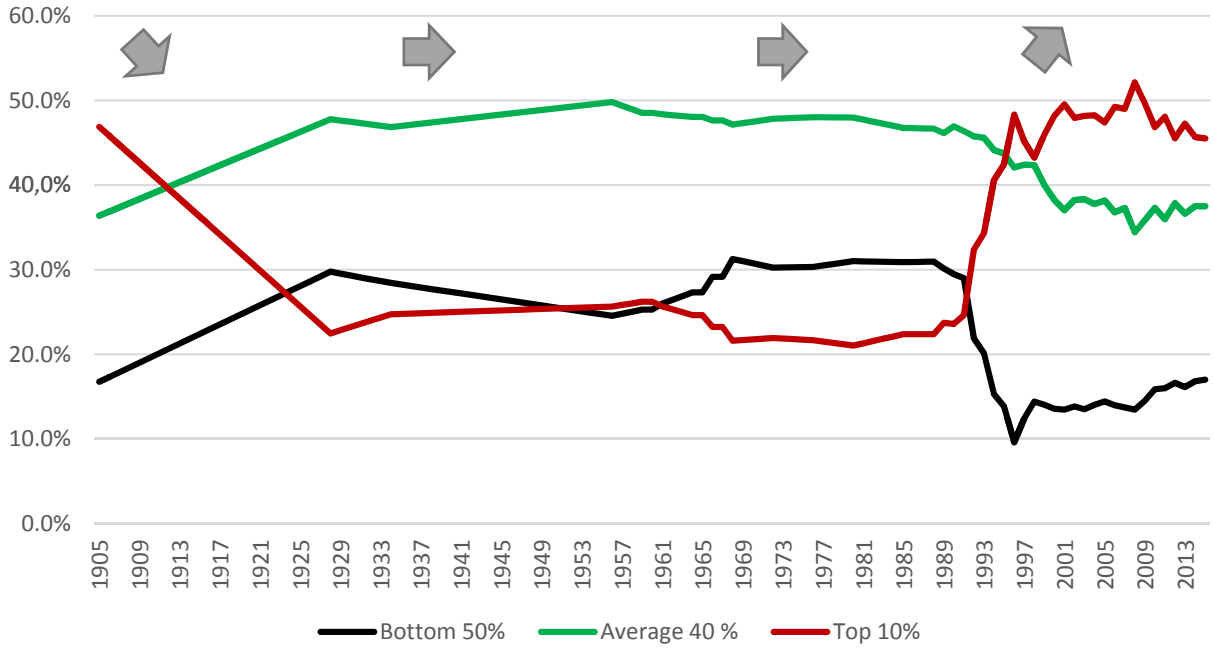

Fig. 3. **Inequality in Russia in the share of the rich (top 10%), middle class (average 40%) and the poor (bottom 50%) in the distribution of national income of the country. The period from 1905 to 2016**

Source: compiled by the author based on [2].

population in the USSR was 4–5 times higher than their annual income [2].

After the collapse of the USSR in 1991, the shock therapy policy and a series of economic reforms, there was a sharp increase in wealth of the top 10% of the population in terms of income. Due to unequal opportunities of the super-rich and the poor non-monetary factors of economic inequality were converted into monetary ones, which is still discussed in the context of the introduction of countervailing taxes on unfair privatization [11]. The current inequality in Russia is comparable to that of tsarist Russia before the February Revolution of 1905 [12] (*Fig. 3*).

The Middle East region, along with South Africa, is a territory with a very high level of inequality, its country specifics and the reasons for its formation. According to the World Inequality Report 2018, labor migrants played a significant role in the income stratification [2].

The share of foreign workers in the labor force of the Gulf group countries (UAE, Kuwait and Qatar) in the period 1990–2016 grew to almost 80%. For a long time, working conditions for labor migrants in this region were incomparably worse than for the indigenous population. The adjustment of the national income distribution system in these countries was and remains asymmetric in favor of the indigenous population. As a result of this country specifics, indigenous citizens have many economic benefits, while labor migrants do not. There is a special term to characterize labor relations in these countries — the kafala system, which is an analogue of labor slavery [13].

RESULTS AND DISCUSSION

The analysis of the World Inequality Report (2018) allowed for a key conclusion that long-term changes in inequality are affected by a combination of political, economic and social shocks leading to changes in public attitudes, expectations and behavior of investors, as well as responses and corresponding reforms of regulators, which generally changes adjusting the financial mechanism for redistributing national income and wealth and leads changing long-term trends in economic inequality.

By adjusting the financial mechanism, we understand a system of methods, tools, levers, information and legal systems that affect the processes of financial redistribution in the economy. Changes in adjusting the financial mechanism for redistributing national income and wealth affect the growth rate of income and wealth of various groups of the population and, in our opinion, are the main long-term factor in changing trends in economic inequality.

The most important elements of the financial mechanism affecting the dynamics of economic inequality are:

1. Fiscal adjustments of the economy, such as marginal tax rates on income, wealth and inheritance of various groups of the population.
2. Interest rates of central banks and monetary policy parameters that determine the cost of borrowing, exchange rates, inflation, real incomes, propensity to save households [14] and prices in the financial market.
3. Tariffs, terms of international trade, the rigidity of anti-offshore regulation and cross-country cooperation to control the practice of tax avoidance.
4. The share of government spending on social security and transfers for social support of the population as a percentage of total spending is a very important factor and leverage for influencing the lower strata of the population in terms of wealth. Expenditures on education and health play a great role, since the potential of human capital depends on their size in the early development.

To illustrate the change in adjusting the financial redistribution mechanism, we will consider the economic inequality reduction in the world in the period 1910–1970. The first half of this period showed a progressive increase in the tax burden on the rich to finance military spending. World War II was followed by a tightening of monetary policy in response to a strong global inflation increase. Readjusting the financial redistribution mechanism in the form of a tightening of economic policy primarily affected the growth rates of the wealthiest strata of the population, since most of their wealth and income was generated in rental income, income from investments in financial markets and from shares in business. During the same period many countries carried out important social reforms to support the poor, and started large-scale investments in social spending (education, health care, etc.), which, in turn, accelerated the welfare growth rate of the lower strata of the population in terms of income and wealth [15]. All these factors led to a significant adjustment of redistributing labor and capital incomes of various groups of the population, as well as to the inequality decline up to the 1970s — 1980s.

The changes took place differently for various countries, since their socio-economic models differ and determine the domestic specifics of adjusting the financial mechanism for redistributing income and wealth [6, p. 78]. The impact of this factor on developing the political structure and the conditions of the social contract is great. For instance, differences in values and attitudes towards the poor in the United States and Europe lead to different adjustments of the financial mechanism for redistributing and supporting the lower income groups and are important non-economic reasons that cause differences in economic inequality in these countries [9]. However, the country specifics did not significantly affect the trend of inequality in the long-term. For the countries opposite in their approach to progressive taxation of income, wealth and inheritance, inequality is still changing, as evidenced by the data of the World Inequality Report (2018).

We now come back to the cyclical nature of economic inequality as the most complex reason for describing the dynamics of this phenomenon. Considering the available data on economic inequality for the period 1900–2018, we conclude that the development of economic inequality in the long term occurs within long-term cycles similar in duration to Kondratieff innovation waves. To prove this

Table 1

Approximate dates and characteristics of economic inequality cycles (1400 — present)

Key events at the beginning of the inequality cycle	Beginning	Cross-country inequality	Domestic inequality	Reason for change	International trade regime	End	Total duration, years
1. Venetian trade and conquests, financial sector development in Florence, Spain, Republic of Genoa	1400			New technologies, transport, large ships	Protectionism	1600	200
2. Peace of Westphalia	1600			New technologies, transport, large ships	Protectionism	1750	150
3. Thirty Years' War / industrial revolution	1750			Differentiation of labor resources by income due to the emergence of new professions	Development of international trade and globalization	1900	150
4. 1890 financial crisis / two world wars	1900			New technologies	Protectionism	1970	70
5. 1970 oil shock / boom in financial markets	1970			Differentiation of labor resources by income due to the emergence of new professions	Development of international trade and globalization	2050	80
Maximum						200	200
Median						150	150
Mean						130	130
Minimum						70	70

Source: compiled by the author based on [7, p. 29–32].

hypothesis empirically we need representative data over a longer period, which we do not have.

In this regard, one should consider the study by P. Tridico concerning the cycles in inequality dynamics. The author suggests [6, p. 27–29] that inequality should be classified into two types: (1) global cross-country economic inequality and (2) domestic economic inequality.

Global inequality is taking off following technological reforms that create new complex and long value chains around a key geographic area (country). This leads to capital

Table 2

Duration of Kondratieff innovative cycles (1771 — present)

Innovation cycles	Beginning	Initiation and implementation of technology		Peak formation	Aging of the technology		End	Total duration, years
		Phase 1	Phase 2		Phase 3	Phase 4		
1. Industrial revolution	1771	10	12	2	14	16	1829	58
2. Steam engines and railways	1829	11	8	2	7	16	1873	44
3. Metallurgy, electricity and heavy industry	1875	9	9	2	12	10	1918	43
4. Oil, automobiles and mass production	1908	12	9	4	26	14	1974	66
5. Information and telecommunication technologies	1971	16	14	2	12	15	2020-2037*	50-60
Maximum		16	14	4	26	16		66
Median		11	9	2	12	15		51
Mean		12	10	2	14	14		53
Minimum		9	8	2	7	10		43

Source: compiled by the author based on [17].

flows and differences in economic growth rates between countries. During this process, the leading country and its main competitor are far away from the catching-up countries in economic development, the national income of the leading countries is growing at a higher rate, which ultimately leads to an increase in cross-country inequality.

During this period, domestic economic inequality goes in antiphase and decreases, while international trade and cooperation are going through a period of protectionism. For a certain time, the leading country maintains high growth rates. However, over time, other countries catch up with it, and the corresponding cyclical changes occur. They and reduce cross-country and increase domestic economic inequality (*Table 1*).

Domestic inequality tends to grow after technological shifts in the exploitation of human capital, labor resources, skills and competencies in the country. Better educated and skilled citizens gain advantages in the domestic labor market, which leads to an increase in income polarization within the country. Domestic inequality grows naturally due to

the fact that the leading country exhausts opportunities for growth within the country, expands into foreign markets, intensifies international trade, opens markets, and relaxes for production factor movements and other processes of globalization.

The analyses of the materials presented in [6] and in *Table 1* raises questions about the data sources. First, the author indicates round dates, which speaks of a superficial assessment of the cycle durations. Second, in [6] has no references to the original sources.[4] Third, the author's concept of changes in inequality, a leitmotif in P. Tridico's book, is presented as a working hypothesis, according to which economic inequality has been changed in five or six stages since the 1970s to the present time. *Table 1* presents only the last stage, which is considered and analyzed in sufficient detail.

Based on the World Inequality Report 2018 and the work by P. Tridico [2, 6], we believe that Kondratieff innovation waves are the best description of cyclical processes in economic inequality.[5] At the same time, the theory of dividing economic inequality into cross-country and domestic and the description of the logic of cyclical changes proposed by P. Tridico complement it well to form a conceptual description of the cyclical development of economic inequality.

Table 2 shows the dates of the key stages of Kondratieff innovation cycles, grouped into four phases (not considering the formation period of the peak of innovative development): (1) introduction of technology, (2) rapid development of innovations, (3) formation of bubbles and slowdown in growth, (4) stagnation of technology and formation of prerequisites and conditions for changing to a new innovative technological order.

According to *Table 2*, the average duration of an innovation development cycle is about 53 years. Comparing these data with the materials of the World Inequality Report 2018 confirms the hypothesis of a cyclical change in economic inequality with cycles lasting 50–60 years for the period from 1900 to the present.

CONCLUSIONS AND RECOMMENDATIONS

To summarize, we can explain the reasons for the change in trends in the economic inequality dynamics as follows.

The review of scientific discussions on the causes and drivers of the economic inequality dynamics has led us to conclude that this is a complex and multifactorial process. Therefore, individual reasons and drivers do not allow for its sufficient justification and characterization.

Long-term changes in inequality are affected by a combination of political, economic and social shocks. They lead to changes in public attitudes, expectations and behavior of investors, as well as the response and corresponding reforms of regulators, which generally changes adjusting the financial economic mechanism and national income redistribution, and leads to a turning point of the long-term trend in inequality.

By adjusting the financial mechanism of the economy and redistributing national income, we understand the parameters of economic policy (tax and monetary components), as well as other conditions (priorities of government spending) that affect the rate of change in income and wealth of various groups of the population.

Among the other reasons, one can distinguish primary (various external and internal shocks) and secondary (reactive actions of regulators to reconfigure the financial mechanism for redistributing income and wealth between groups of the population).

Based on the analyzed data on the long-term dynamics of inequality and the theories of cyclicality, we developed a hypothesis about the cyclical nature of this process. According to the available data, the dynamics of inequality for 120 years can be best described by Kon-

[4] A footnote below the table confirms that the table is compiled by the author and does not specify the sources of data on economic inequality.

[5] To test this hypothesis empirically, a reliable information for a period of 500–600 years is required, that we, unfortunately, do not have. Therefore, we took the databases on inequality for the past 100–120 years.

dratieff innovation cycles. This theory is well complemented by the concept of the cyclical development of cross-country and domestic inequality, proposed by P. Tridico, with the corresponding changes in international cooperation and globalization of the global economy.

Considering this conclusion, one can also prioritize the list of factors affecting the change in economic inequality. Based on the idea of cyclical innovation development, we assume that the main driver of changes in economic inequality is innovation and technological progress.

Heavy regulations of cross-country inequality can have negative affect on the technology development and slow down the development of humanity. Thus, to address the main problems of economic inequality that today concern society, regulators should focus primarily on domestic economic inequality. To do this, it is necessary to work with adjusting and increasing the efficiency of the financial mechanism for redistributing income and wealth within the country, which is complicated by the country socio-economic specifics.

A reasonable supplement to the above is the strengthening of cross-country cooperation to tackle the shadow economy, impersonal accounts and offshores. This will enable countries to better address the problem of domestic economic inequality, as far as their mentality and socio-economic structure let them do this.

Works [18–23] reveal the idea of developing the institution of global regulation, increasing control over the blind spots of the global financial system that allow transnational corporations and super-wealthy individuals to significantly optimize and legally avoid taxes. We suppose that this area of scientific knowledge has not yet been sufficiently developed in scientific works on economic inequality and requires further research using economic, mathematical and econometric research methods.

The key directions for developing a global strategy for sustainable development of the global economy, considering the specifics of economic inequality, are the ideas described in Part V of the World Inequality Report 2018 [2]:

(1) development and adjustment of progressive taxation of income, wealth and inheritance;

(2) creating a global financial register of assets to control the reallocation of property rights, tackle offshore and more effectively address the problem of tax avoidance;

(3) creating a balanced global regulatory body to tackle global (cross-country) inequality;

(4) review of the priorities of the state allocation policy and greater investment in education and educational technologies, as well as in medicine and biotechnology, including those based on public-private partnership.

These ideas can be supplemented by the idea (5) of developing the market and instruments of green bonds, creating a special section to tackle cross-country economic inequality, creating a global fund to tackle cross-country inequality, allowing for a coordinated global countercyclical financial policy at all stages of the economic growth cycle of the global economy.

Most scientists believe that since the 1970s the level of economic inequality has reached very high values and, with the current settings of the global economy, economic inequality will be growing.

Long-term changes in inequality are affected by a combination of political, economic and social shocks leading to changes in public attitudes, expectations and behavior of investors, as well as responses and corresponding reforms of regulators, which generally changes adjusting the financial mechanism for redistributing national income and wealth and leads changing long-term trends in economic inequality.

The reason for the increase in domestic inequality since the 1970s is ineffective and

insufficient government regulation of the financial mechanism for redistributing national income within countries. In our opinion, this problem could be solved by readjusting the parameters of state economic policy. However, cross-country competition, open markets, insufficient cooperation in the joint regulation of inequality problems create certain obstacles, since the blind spots of the international financial system for regulators still remain an unresolved problem.

Another important conclusion is the idea of the cyclical development of economic inequality. We suppose, it supplements the theory of Kondratieff innovation cycles very well.

In general, tackling economic inequality is a difficult task that may require all countries to cooperate more closely and search for new approaches to developing and agreeing on a global strategy for the sustainable development of the global economy.

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