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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 | | | Government control | Non-financial corporations | Households | The rest of the world |
|---|---|---|---|---|---|---|---|---|
| | | Central Bank | Banks | Other financial organizations | | | | |
| 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 | | | Govern-mentcontrol | 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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