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# Debt Sustainability Assessment of Regional Budgets

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## ABSTRACT

The **aim** of the paper is to assess the debt sustainability of the budget system of the regions of the Northwestern Federal District (NWFD) of Russia and establish differentiated values of the budget constraints. The author uses **methods** of comparison and grouping, correlation and cluster analysis. The author's methodology based on the methods of multivariate statistical analysis made it possible to include indicators that have the nature of leading indicators in the assessment, evaluate the integral indicator of debt sustainability, and determine the limit values of these indicators. Approbation of the author's methodology for assessing the debt sustainability of the budget system on the statistics of the NWFD regions allowed dividing the regions into three clusters according to the types of debt sustainability and determining the threshold values of indicators for each cluster. The research results substantiate the need to reduce the high debt burden for 70% of the NWFD regions. The results indicate that the regions with a high level of debt sustainability include St. Petersburg, Leningrad and Kaliningrad regions. The integral indicator of debt sustainability of these regions is greater than one and the regions are well grouped according to six indicators of debt sustainability into a group that is homogeneous in terms of characteristics. The Republic of Komi, the Republic of Karelia, and the Arkhangelsk and Pskov regions have a low level of debt sustainability: the standard limiting values for the "debt-to-GRP ratio" indicator of the regions is less than 5%, and the "debt-to-revenue ratio" indicator — less than 42%, the value of all indicators of debt sustainability exceeds the values of the cluster centroids. For these regions, the author recommends pursuing a targeted budget policy with a mandatory debt reduction to the level of threshold values for the indicators of the regions of this cluster. The paper **concludes** that it is necessary to reduce the debt burden of most regions of the NWFD, as well as to establish differentiated values of budget constraint on public debt, taking into account the indicators of socio-economic development of these regions.

***Keywords:*** debt sustainability; budget system; public debt; indicators; debt burden limit; econometric methods; GDP; economic growth; the Northwestern Federal District

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## INTRODUCTION

The issues of managing the debt burden by imposing budgetary restrictions are relevant for different countries. The use of debt financing, on the one hand, increases investment activity and social and economic objectives, on the other hand, inevitably increases credit risk and the likelihood of default. Therefore, issues of assessment of debt sustainability of the budget system of the Russian Federation are a subject of discussion and are actively discussed by the world scientific community. In Russia, the volume of public debt has been steadily increasing over the past ten years, while the statistical validity of the limits of the debt burden indicators of the budgets of the constituent entities of the Russian Federation remains open. The limits of the state internal debt of the budgets of the constituent entities of the Russian Federation are regulated by the Budget Code of the Russian Federation, but this practice does not take into account the differentiation of indicators of socio-economic development. In this regard, the justification of limits of indicators of debt burden of the budget system of regions on the basis of systematization and processing of statistical data on subjects of the Russian Federation using classification methods seems to be an interesting, promising and relevant task.

## ANALYSIS OF THE STATUS AND TRENDS OF THE DEVELOPMENT OF THE STATE DEBT OF THE RUSSIAN FEDERATION AND REGIONS OF THE NORTHWESTERN FEDERAL DISTRICT

According to the data of the Ministry of Finance of the Russian Federation and the Federal Service of State Statistics, the volume of external and internal public debt tends to increase. This dynamic is well evident in the use of debt financing in the form of securities *(fig. 1)*.

The *figure 1* show that the Ministry of Finance of the Russian Federation borrowed significantly over the last 20 years, with the second decade growing faster than the first. The strongest growth occurred between 2012 and 2020. The increase in the issue of government securities is a consequence of the liberalization of the debt market, modernization of market infrastructure, increased market transparency, simplification of the mechanism for the acquisition of securities, etc. The increased informativeness of securities transactions has made the Russian debt market more attractive and accessible to both domestic and foreign investors. A gradual decline in the yield of the government bond portfolio, which, on the one hand, means an increase in the issuer's debt rating and, on the other hand, a reduction in the cost of debt servicing.

The size of the Russian government's domestic debt also tends to increase [1]. The composition of the state internal debt of the constituent entities of the Russian Federation is dominated by credits of special organizations and international financial organizations, as well as other budgets of the budget system of the Russian Federation, the volume of government securities in the debt structure is insignificant.

At the same time, the main direction of the use of domestic public debt is to cover the deficit of regional budgets. The regional budget deficit is a consequence of the decline in budget revenues as a result of the 2014 crisis, after the introduction of the policy of economic sanctions. In addition, experts cite changes in the tax legislation of the Russian Federation with regard to the payment of taxes by taxpayers in the consolidated group as the reason for the decline in revenues, which reduced the income of many regions [1, p. 97]. The regional budget deficit is also the result of the increase in social expenditures related to the implementation of the May decrees of the President of the Russian Federation. All this has encouraged regional authorities to resort to a policy of borrowing money, which contributes to the growth of the public debt as well as the cost of its servicing. At the

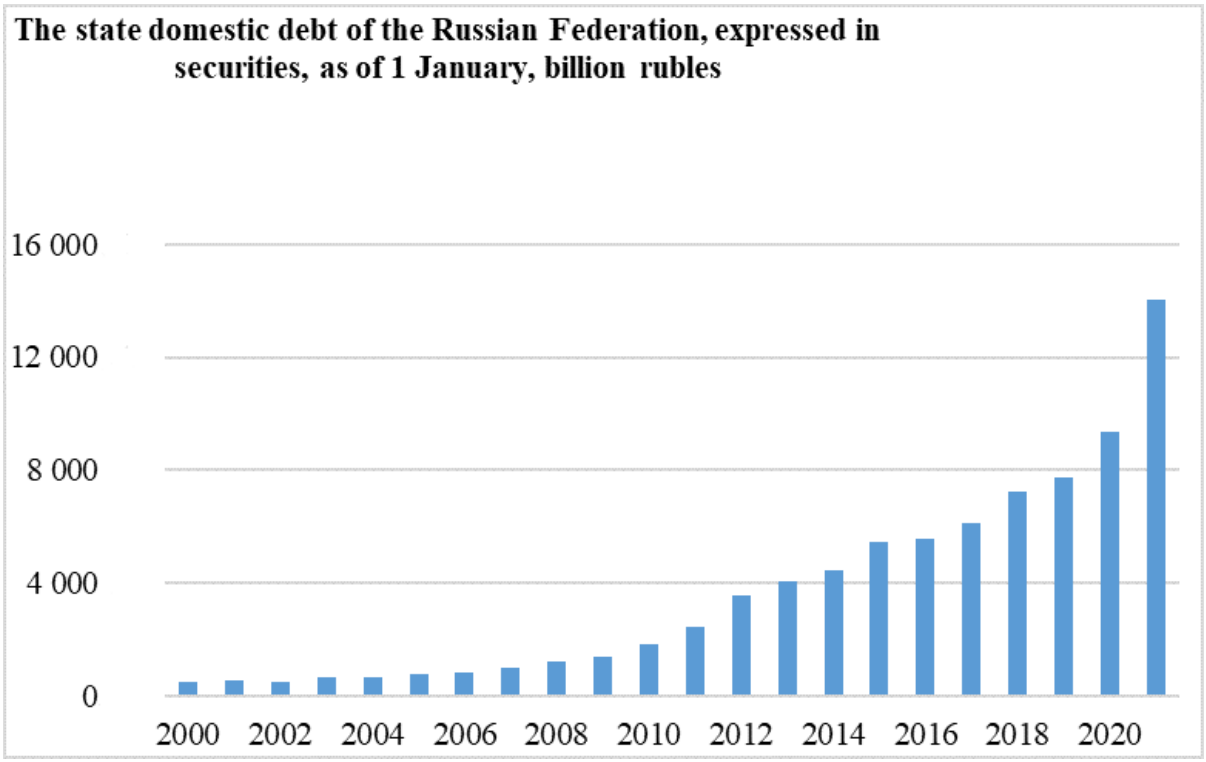


*Fig. 1.* **Dynamics of the volume of the government internal debt of Russia expressed in government securities**

*Source:* compiled by the author based on the Ministry of Finance of the Russian Federation. URL: https://minfin.gov.ru/ru/perfomance/public_debt/internal/structure/duty/ (accessed on 20.04.2021).

same time, it is important to note that the regional policy provides for the refinancing of loans of the constituent entities of the Russian Federation through the use of the federal budget (budget credits) at the rate of 0.1% (according to the Ministry of Finance of the Russian Federation in 2020, 31% of the budget deficit was financed).[1]

The use of indicative approach in assessment of the state and dynamics of the development of the public debt of the Russian Federation showed the growth of values of key indicators (*table 1*). The selection of key indicators is based on the results of analysis of previous research of Russian and foreign scientists [2–5]. *Table 1*.

One of the world's main indicators 'debt-to-GDP ratio', calculated on the internal debt of the constituent entities of the Russian Federation, increased to 3.92% in 2020, and on the gross debt of the Russian Federation increased to 25.18%. Note that the calculations made by the author on the indicator of GDP at comparable prices show a high debt burden in comparison with official data of the Ministry of Finance of the Russian Federation. At the same time, analysis of the level of the debt burden for the countries of the world allows us to assert that, despite the growth of debt dependence, Russia has a sustainable level of public debt in GDP.

Japan, the US, the Eurozone stand out for traditionally high public debt. Since the country's GDP is one of the basic macroeconomic indicators and is used for international comparisons of the level of welfare of different countries, the indicator 'debt-to-GDP ratio' is the main global indicator of the state's debt burden. Looking at the evolution of country borrowing over the past twenty years, it is safe to say that

[1] The rules for granting budget loans to the regions have been clarified: press centre of the Ministry of Finance of the Russian Federation. 2021. URL: https://minfin.gov.ru/ru/press-center/?id_4=37435-utochneny_pravila_predostavleniya_regionam_byudzhetnykh_kreditov (accessed on 05.06.2021).

*Table 1*

**Indicators of the financial system's debt sustainability of the Russian Federation (as of the end of the year)**

| Indicator | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Share of public debt of constituent entities of the Russian Federation in GDP, % | 1.78 | 1.86 | 2.35 | 2.84 | 3.51 | 3.54 | 3.94 | 3.61 | 3.52 | 3.92 |
| Share of the state domestic debt of the Russian Federation. expressed in government securities in GDP*, % | 5.88 | 6.50 | 6.97 | 8.55 | 8.92 | 9.79 | 13.34 | 13.13 | 15.55 | 25.18 |
| The volume of public debt of the Russian Federation in GDP **, % | – | – | 10.6 | 13.2 | 13.5 | 13.2 | 14.6 | 14.9 | 15.3 | 19.1 |
| The volume of public debt of the Russian Federation in GDP ***, % | 5.86 | 7.54 | 11.87 | 11.78 | 16.49 | 17.57 | 20.44 | 21.49 | 22.61 | 36.55 |
| Share of public and municipal debt servicing costs in GDP,% | 0.44 | 0.51 | 0.57 | 0.65 | 0.83 | 1.00 | 1.30 | 1.37 | 1.22 | 1.40 |
| Share of debt servicing costs in the total amount of domestic debt of the Russian Federation, % | 5.69 | 6.12 | 6.08 | 5.70 | 6.68 | 7.48 | 7.55 | 8.16 | 6.39 | 4.83 |
| Ratio of the state debt of the subject of the Russian Federation to the annual volume of budget revenues, % | 9.43 | 9.06 | 11.46 | 12.57 | 16.04 | 16.41 | 14.19 | 10.95 | 10.47 | 11.68 |
| The ratio of public domestic debt expressed in government securities to the export of goods and services, % **** | 21.80 | 24.82 | 26.25 | 28.01 | 26.13 | 31.36 | 34.63 | 27.27 | 34.81 | 59.37 |
| Ratio of public domestic debt expressed in government securities to international reserves, % | 16.31 | 22.78 | 23.57 | 22.13 | 22.87 | 22.21 | 24.10 | 24.56 | 22.02 | 22.38 |

*Source:* compiled by the author based on the Federal State Statistics Service and Ministry of Finance of the Russian Federation.

*Notes:* * government securities;

** based on data from the Ministry of Finance (The main directions of the state debt policy of the Russian Federation for 2017–2019, Ministry of Finance of the Russian Federation. 2017. 63 p.);

*** based on the author's calculations of GDP in 2011 prices;

**** the export volume is calculated in rubles at the exchange rate at the end of the corresponding year.

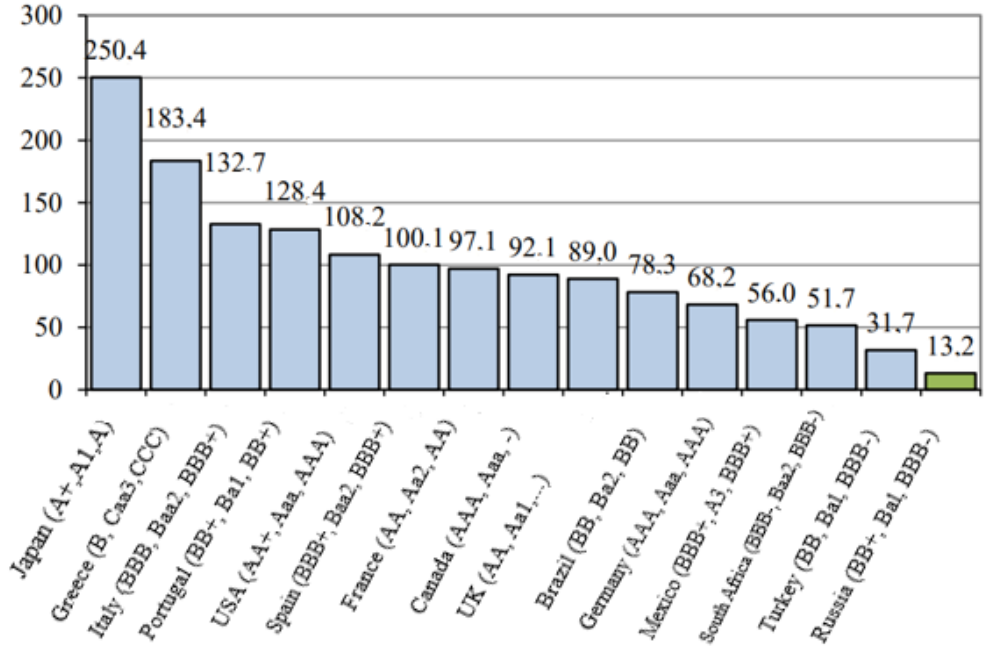


*Fig. 2.* **Debt burden and credit ratings of countries in 2016**

*Source:* The main directions of the state debt policy of the Russian Federation for 2017–2019, Ministry of Finance of the Russian Federation. 2017. 63 p.

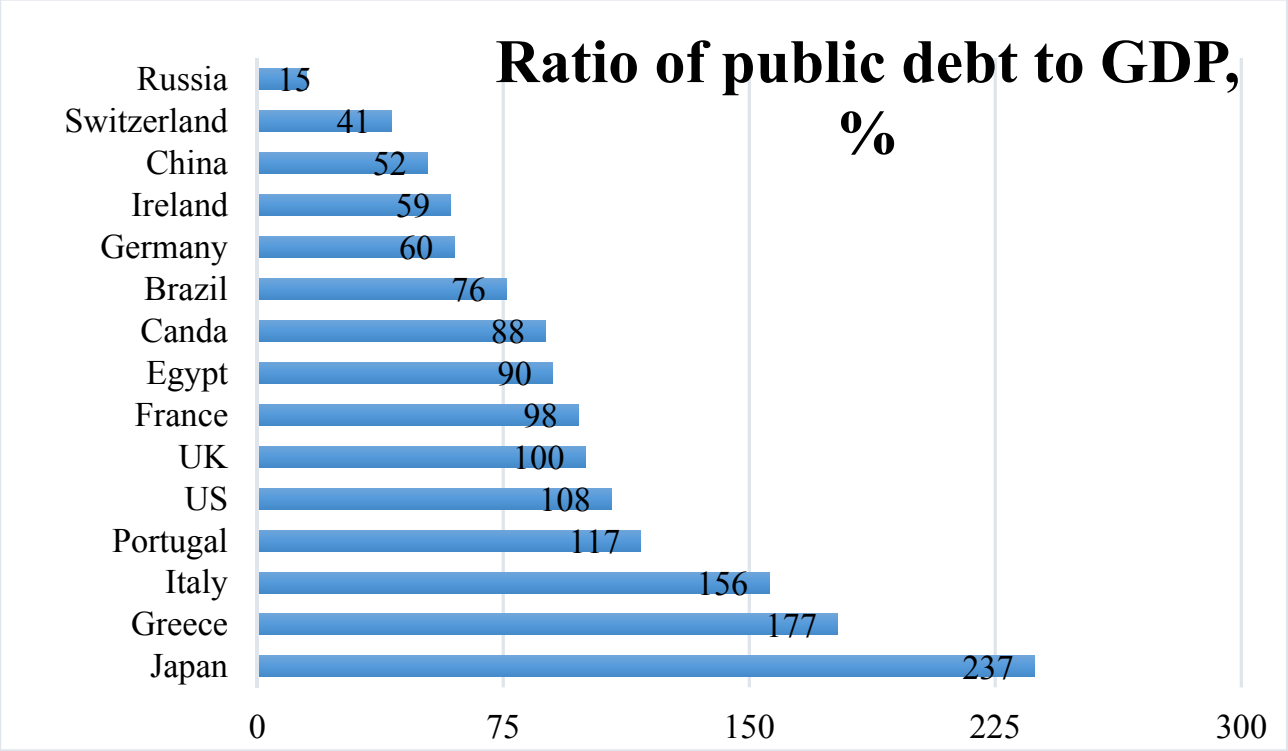


*Fig. 3.* **Debt-to-GDP ratio by countries in December 2020**

*Source:* compiled by the author based on Trading Economics. URL: https://ru.tradingeconomics.com/country-list/government-debt-to-gdp (accessed on 01.05.2021).

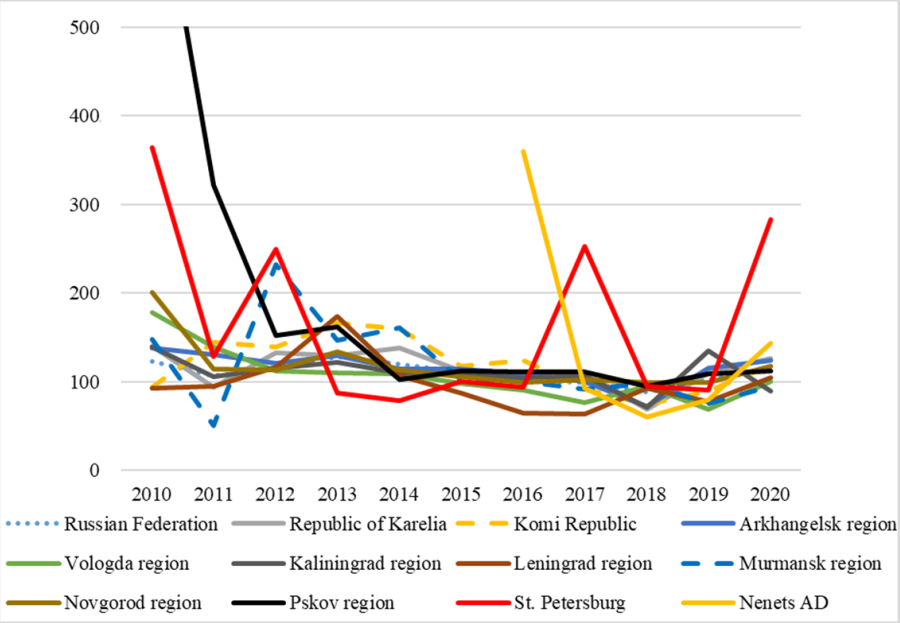


*Fig. 4.* **Growth rates of the government debt of the subjects of the Northwestern Federal District and Russia**

*Source:* compiled by the author based on the Ministry of Finance of the Russian Federation. URL: https://www.minfin.ru/ru/perfomance/public_debt/subdbt (accessed on 25.04.2021).

global debt has increased. Thus, in 2012, the Japanese government's gross debt to GDP was 361%, Italy — 258%, U.S. — 252%, Brazil — 129%, Greece — 150%, India — 73%, France — 284%, Russia — 65%. In 2015, debt accounted for 365% of Japan's GDP, and Greece — 299%, Italy — 270%, U.S. — 249%, France — 292%, Mexico — 76%, Russia — 89%.[2] Some countries' borrowings in 2016 can be found at *fig. 2*.

In 2021, as a result of the economic crisis caused by the COVID-19 epidemic, global debt rose to 89.6 trillion USD, from 83.5% to 97.6% of global GDP. Japan, Greece, Italy, Portugal, and U.S. became the leading countries in terms of public debt to GDP in 2020 (*fig. 3*).[3]

More serious concerns about the growth of debt dependence should be related to the increase in the indicator' debt in exports. This indicator is often used in studies of domestic and foreign scientists to characterize the processes of debt financing of the economy, because it demonstrates a country's relative long-term ability to accumulate foreign exchange earnings without pressure on its balance of payments balance [2, p. 127]. After a slight decline to 27.3% in 2018, the indicator increased to 38% in 2019, this may be due to a decline in export volumes due to the prolongation of the agreement between the OPEC+ countries to limit oil production on the background of an increase in borrowing by the Ministry of Finance of the Russian Federation. The growth of the indicator in 2020 occurred due to the global world lockdown in the spring of 2020, this significantly reduced the volume of not only Russian exports, but also global trade turnover in general. World trade, according to one UN organisation (ESCAP), decreased by 14.5%, exports to Russia fell by 27%.[4]

The regions of the North-Western Federal District (NWFD) also show a rising trend in public domestic debt. At the same time,

[2] According to the research centre McKinsey Global Institute. URL: www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/visualizing-global-debt (accessed on 23.05.2021).

[3] According to the information and analytical portal 'World Finance'. URL: http://global-finances.ru/gosdolg-mira-2021 (accessed on 20.03.2021).

[4] According to financial and analytical news portal Investing.com. URL: https://ru.investing.com/news/economy/article-2024987 (accessed on 20.03.2021).

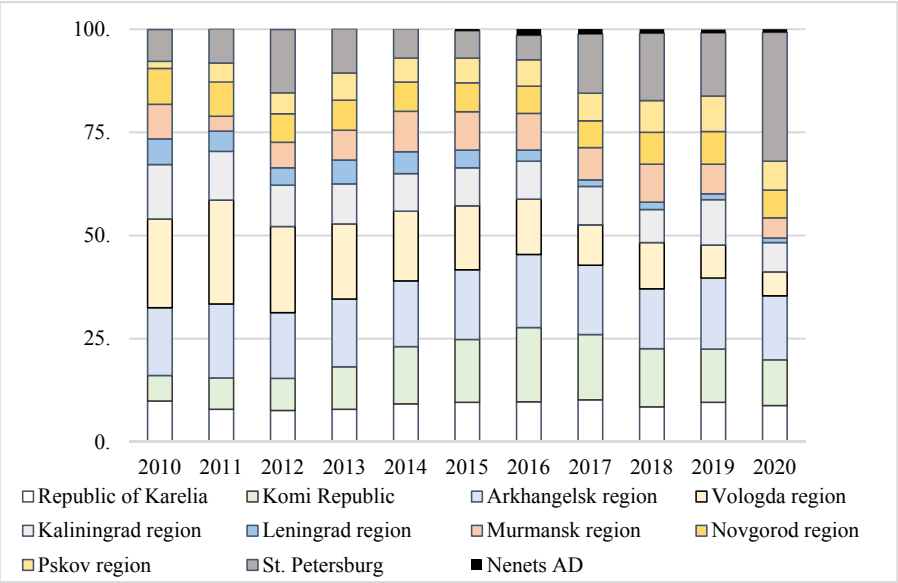


*Fig. 5.* **Structure of the government debt by the subjects of the Northwestern Federal District**

*Source:* compiled by the author based on the Ministry of Finance of the Russian Federation. URL: https://www.minfin.ru/ru/perfomance/public_debt/subdbt (accessed on 25.04.2021).

the level of the debt burden of the North-Western regions is growing more rapidly: the average growth rate for the last ten years, including 2020, is 112.2%, compared to the value of the indicator in the Russian Federation — 108.4% (*fig. 4*).

The Pskov oblast and the city of St. Petersburg (average growth rate for the last 10 years is 29%), as well as the Republic of Karelia (18.9%) and the Arkhangelsk oblast (10.8%) use debt financing more actively than other regions. In two North-Western regions there is a small trend of debt reduction: Vologda and Leningrad oblasts (growth rates of 98.4 and 94.3%, respectively).

Analysis of the dynamics and structure of debt by Northwestern regions allows us to assert that Pskov, Arkhangelsk, Vologda regions, Komi Republic, as well as the city of St. Petersburg are more active in raising public debt. In 2020, St. Petersburg became the leader in the volume of public debt (31.2%) among the regions, the second and third place are the Arkhangelsk region and the Komi Republic. At the same time, extrapolation of the results leads to the conclusion that regions with a high growth rate of public debt do not always have a greater share in the structure of district debt. This confirms once again the need to study in detail the debt sustainability of the budgetary system of regions, as well as the relevance of defining safe lines of the debt burden according to statistics.

## ANALYSIS OF APPROACHES TO DEBT SUSTAINABILITY ASSESSMENT

A number of works of domestic and foreign authors are devoted to debt sustainability of systems [6–9]. Among foreign researches, the relationship between economic growth and public debt is of great importance. Such works are based on extensive empirical data from different countries (China, Eurozone countries, BRICS countries, Great Britain, Malaysia, etc.) for a period of 20 to 50 years and have high scientific validity of the results obtained [10–12]. Indeed, there are a number of scientific works that prove the significant impact of public debt on sustainable economic growth [10, 11, 13]. At the same time, there are works that claim that there is no evidence of such regularity [14], as well as works where the level of debt burden is statistically substantiated, in which there is a negative correlation between public debt and the country's GDP [15, 16].

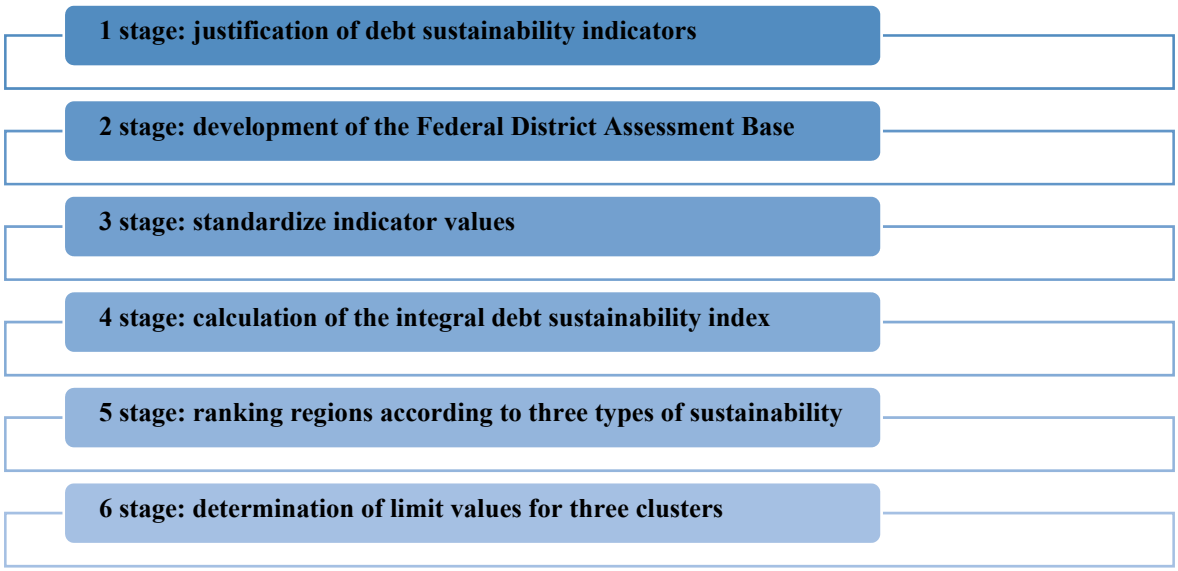


*Fig. 6.* **Methodology for the debt sustainability assessment of Russian regions**
*Source:* compiled by the author.

In this context, the results of the study on the sustainability of the budget policy of Austrian municipalities, which proved the effectiveness of using municipal debt limits to reduce the budget deficit on the basis of an adaptive version of the Bon stability testing method [9]. In study by A. Chudik, K. Mohaddes et al. statistically significant thresholds of the debt burden of budgets for countries with growing debt were obtained and the need to reduce the country's debt burden to a sustainable level was confirmed [17].

A comparative analysis of scientific articles by Russian scientists shows that a set of indicators (relative indicators) on the basis of which such an assessment is carried out plays a paramount role in issues of debt sustainability. At the same time, researchers systematized indicators and their criteria values. Thus, in the work of E.V. Rogatenyuk is given description of indicators of debt security of the Russian Federation based on the analysis of different sources of scientific literature [2, c. 125]. In total, about 20 indicators have been allocated, the concepts of the indicator of debt sustainability and debt security of the country have been defined, the importance of indicative analysis of debt security of Russia and the need for statistical evaluation of thresholds has been emphasized. In the work of A.V. Kalina, I.P. Savelieva noted that the "optimal approach to diagnostics of economic security is the use of the method of indicative analysis" [18, c. 15]. The indicators are grouped by production, financial and socio-demographic factors of regional development. In total, 47 indicators with thresholds are given in the work. At the same time, A.A. Kurilova, A.N. Kiryushkina notes that «parameters for optimising the structure of public debt are not widely represented in the literature» [19, p. 157], and S.N. Soldatkin emphasises the need to expand the debt sustainability indicators of Russian regions [20, 21]. Other authors emphasise the need to assess debt sustainability through the indicators established in the Budget Code of the Russian Federation, which significantly narrows the set of indicators [2, 22]. The methodology of the Ministry of Finance of the Russian Federation is based on these indicators.[5] According to the developed classification, the regions of the Russian

[5] Rules for the assessment of debt sustainability of the constituent entities of the Russian Federation: approved by the Decree of the Government of the Russian Federation from 04 March 2020 No. 227.

*Table 2*

**Correlation matrix of indicator values**

| | Public debt | Budget revenues | Export | Budget expenditures | Debt repayment | Population size | GRP |
|---|---|---|---|---|---|---|---|
| Public debt (Y) | 1.0000 | | | | | | |
| Income (X1) | 0.9991 | 1.0000 | | | | | |
| Export (X2) | 0.9989 | 0.9999 | 1.0000 | | | | |
| Costs (X3) | 0.9990 | 1.0000 | 0.9999 | 1.0000 | | | |
| Repayment (X4) | 0.9971 | 0.9976 | 0.9970 | 0.9976 | 1.0000 | | |
| Population(X5) | 0.9995 | 0.9998 | 0.9998 | 0.9998 | 0.9969 | 1.0000 | |
| GRP(X6) | 0.9989 | 0.9999 | 1.0000 | 0.9999 | 0.9970 | 0.9998 | 1.0000 |

*Source:* compiled by the author.

*Note:* the null hypothesis is rejected for the significance level $\alpha = 0.05$; $t_r > t_{tabl}$.

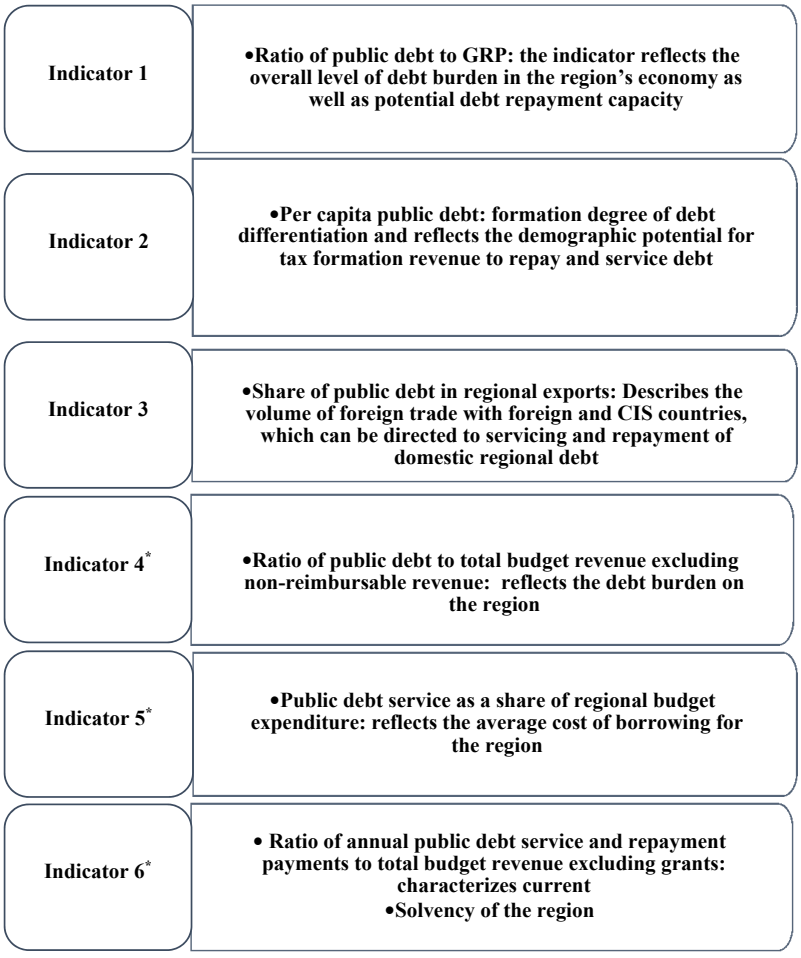


*Fig. 7.* **Composition of the region's debt sustainability indicators**

*Source:* compiled by the author.

*Note:* * referred to indicators of debt sustainability of the Budget Code of the Russian Federation.

*Table 3*

**Partial research results: Indicative analysis of debt sustainability of the Northwestern Federal District**

| Period | Регионы СЗФО / NWFD Regions | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NWFD | RKA | RKO | AO | VO | KO | LO | MO | NO | PO | SPB | NAO |
| **Indicator 1:** Ratio of public debt to GRP, % | | | | | | | | | | | | |
| 2016 | 3.08 | 10.04 | 6.39 | 9.36 | 7.17 | 5.82 | 1.12 | 5.15 | 6.6 | 9.84 | 0.44 | 0.44 |
| 2017 | 3.01 | 9.92 | 6.7 | 8.76 | 4.68 | 5.41 | 0.41 | 4.29 | 6.24 | 10.81 | 0.91 | 1.28 |
| 2018 | 2.25 | 6.15 | 4.3 | 5.71 | 3.89 | 3.5 | 0.33 | 3.86 | 5.98 | 9.48 | 0.79 | 0.66 |
| 2019 | 2.1 | 5.82 | 3.53 | 6.08 | 2.49 | 4.19 | 0.23 | 2.28 | 5.68 | 8.64 | 0.59 | 0.48 |
| **Indicator 2:** The amount of public debt per capita. rub./people | | | | | | | | | | | | |
| 2016 | 16.7 | 36.1 | 49.2 | 36.6 | 26.2 | 21.8 | 34.6 | 27.1 | 24.9 | 22.9 | 2.63 | 81.8 |
| 2017 | 17.50 | 39.99 | 45.58 | 36.65 | 20.19 | 22.80 | 2.17 | 25.12 | 25.85 | 25.61 | 6.55 | 75.63 |
| 2018 | 14.5 | 27.8 | 34.2 | 26.5 | 19.3 | 16.2 | 1.9 | 24.8 | 26 | 24.6 | 6.2 | 45.54 |
| 2019 | 14.1 | 30.7 | 30. 9 | 31 | 13.5 | 21.6 | 1.5 | 18. 9 | 25.9 | 27.1 | 5.6 | 36.4 |
| **Indicator 3:** Share of public debt in regional exports, % | | | | | | | | | | | | |
| 2016 | 12.03 | 51.9 | 87.97 | 30.44 | 18.58 | 27 | 2.02 | 12.68 | 27.43 | 409.12 | 1.48 | 0 |
| 2017 | 11.35 | 41.74 | 79 | 30.59 | 14.74 | 32.26 | 1.28 | 9.61 | 28.01 | 491.86 | 3.13 | 0 |
| 2018 | 9.01 | 160.13 | 241.63 | 218.23 | 64.85 | 3.21 | 1.46 | 90.59 | 61.74 | 94.46 | 2.43 | 0 |
| 2019 | 6.81 | 31.08 | 46.3 | 22.15 | 6.76 | 26.08 | 0.71 | 5.41 | 16.7 | 277.42 | 1.93 | 4.01 |
| **Indicator 4:** Ratio of public debt to total budget revenue excluding budget expenditures, % | | | | | | | | | | | | |
| 2016 | 23.92 | 79.35 | 63.14 | 67.4 | 54.44 | 50.91 | 4.83 | 31.2 | 55.34 | 74.91 | 2.98 | 27.53 |
| 2017 | 23.55 | 90.41 | 50.44 | 61.88 | 37.94 | 50.98 | 3.11 | 28.89 | 59.12 | 78.3 | 6.95 | 17.98 |
| 2018 | 14.72 | 37.32 | 37.35 | 35.99 | 171.68 | 13.98 | 2.27 | 25.58 | 66.04 | 131.87 | 5.63 | 8.6 |
| 2019 | 15.21 | 53.91 | 28.17 | 41.65 | 18.67 | 39.02 | 1.71 | 15.88 | 51.01 | 71.58 | 4.85 | 7.63 |
| **Indicator 5:** Share of state and municipal debt servicing expenses in regional budget expenditures, % | | | | | | | | | | | | |
| 2016 | 1 | 2.9 | 2.6 | 1.37 | 1.63 | 0.38 | 1.42 | 1.34 | 3.3 | 3.02 | 0.1 | 1.8 |
| 2017 | 1.06 | 2.52 | 6.1 | 1.89 | 1.06 | 0.29 | 1.52 | 0.8 | 1.57 | 2.8 | 0.04 | 1.55 |
| 2018 | 1.22 | 1.77 | 3.75 | 1.41 | 0.61 | 0.23 | 3.51 | 0.77 | 1.08 | 2.23 | 0.4 | 2.83 |
| 2019 | 1.37 | 1 | 4.61 | 0.67 | 0.16 | 0.21 | 5.5 | 0.9 | 0.97 | 2.22 | 0.35 | 2.57 |
| **Indicator 6:** Ratio of annual payments for servicing and repayment of public debt to total budget revenues excluding budget expenditure, % | | | | | | | | | | | | |
| 2016 | 14.6 | 25.6 | 55.47 | 51.8 | 21.03 | 28.57 | 1.53 | 26.09 | 22.3 | 59.25 | 0.32 | 28.16 |
| 2017 | 17.66 | 50.54 | 55.87 | 69.01 | 17.36 | 23.49 | 2.72 | 34.91 | 20.57 | 69.88 | 1.85 | 20.16 |
| 2018 | 20.35 | 47.46 | 44.87 | 102.51 | 134.46 | 22.98 | 3.52 | 65.38 | 42.88 | 162.67 | 1.2 | 26.84 |
| 2019 | 19.36 | 64.77 | 14.71 | 108.78 | 15.79 | 24.19 | 6.02 | 68.93 | 16.69 | 80.67 | 0.37 | 7.12 |

*Source:* author's calculations.

*Note:* RKA – Republic of Karelia, RKO – Komi Republic, AO – Arkhangelsk Region, VO – Vologda Region, KO – Kaliningrad Region, LO – Leningrad Region, MO – Murmansk Region, NO – Novgorod Region, PO – Pskov Region, SPB – Saint Petersburg, NAO – Nenets Autonomous Okrug, BP – gratuitous receipts.

*Table 4*

**Results of the debt sustainability assessment for the Northwestern Federal District**

| NWFD | Standardized values of indicators | | | | | | | | | | | | Debt Sustainability Index, $I_{DS}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | | | | 2018 | | | | | | | | | |
| | I2 | I3 | I3 | I4 | I5 | I6 | I2 | I2 | I3 | I4 | I5 | I6 | 2019 | 2018 | 2017 | 2016 |
| Republic of Karelia | 0.04 | 0.05 | 0.02 | 0.06 | 0.16 | 0.01 | 0.05 | 0.07 | 0.01 | 0.06 | 0.13 | 0.03 | 0.24 | 0.27 | 0.22 | 0.19 |
| Republic of Komi | 0.07 | 0.24 | 0.02 | 0.04 | 0.03 | 0.03 | 0.08 | 0.06 | 0.01 | 0.06 | 0.06 | 0.03 | 0.32 | 0.23 | 0.19 | 0.18 |
| Arkhangelsk oblast | 0.04 | 0.12 | 0.03 | 0.09 | 0.24 | 0.01 | 0.06 | 0.07 | 0.01 | 0.06 | 0.16 | 0.01 | 0.36 | 0.28 | 0.26 | 0.25 |
| Vologda oblast | 0.09 | 0.09 | 0.11 | 0.04 | 1 | 0.02 | 0.08 | 0.10 | 0.02 | 0.01 | 0.38 | 0.01 | 0.88 | 0.42 | 0.45 | 0.32 |
| Kaliningradskaya oblast | 0.05 | 0.12 | 0.03 | 1 | 0.76 | 0.02 | 0.09 | 0.12 | 0.45 | 0.16 | 1.00 | 0.05 | 1.55 | 1.36 | 1.32 | 0.53 |
| Leningradskaya oblast | 1 | 0.44 | 1 | 0.11 | 0.03 | 0.06 | 1.00 | 1.00 | 1.00 | 1.00 | 0.07 | 0.34 | 2.20 | 3.78 | 3.45 | 2.53 |
| Murmansk oblast | 0.1 | 0.16 | 0.13 | 0.03 | 0.18 | 0.01 | 0.09 | 0.08 | 0.02 | 0.09 | 0.30 | 0.02 | 0.44 | 0.42 | 0.45 | 0.41 |
| Novgorod oblast | 0.04 | 0.13 | 0.04 | 0.02 | 0.16 | 0.02 | 0.06 | 0.08 | 0.02 | 0.03 | 0.21 | 0.03 | 0.29 | 0.32 | 0.32 | 0.27 |
| Pskov oblast | 0.03 | 0.69 | 0.01 | 0.35 | 0.07 | 0.005 | 0.03 | 0.08 | 0.02 | 0.02 | 0.10 | 0.01 | 0.82 | 0.20 | 0.55 | 0.19 |
| St. Petersburg | 0.39 | 1 | 0.37 | 0.22 | 0.46 | 1 | 0.42 | 0.32 | 0.60 | 0.40 | 0.58 | 1.00 | 3.22 | 2.97 | 3.41 | 5.70 |
| Nenets AO | 0.48 | 0.04 | 0.18 | 0.01 | 0.06 | 0.05 | 0.50 | 0.04 | 0.00 | 0.26 | 0.08 | 0.04 | 0.68 | 0.74 | 0.37 | 0.41 |
| Average value | 0.21 | 0.28 | 0.18 | 0.18 | 0.29 | 0.11 | 0.22 | 0.19 | 0.2 | 0.2 | 0.28 | 0.14 | 1.00 | 1.00 | 1.00 | 1.00 |

– Three maximum values of indicators;

– Three minimum values of indicators

*Source:* author's calculations.

*Table 5*

**Scale of values of the regional debt sustainability index**

| Value range by year | | | | Type of sustainability |
|---|---|---|---|---|
| 2016 | 2017 | 2018 | 2019 | |
| ⩾ 1 | ⩾ 1 | ⩾ 1 | ⩾ 1 | Higher |
| < 1; ⩾ 0.32 | < 1; ⩾ 0.32 | < 1; ⩾ 0.42 | < 1; ⩾ 0.44 | Medium |
| < 0.32 | < 0.32 | < 0.42 | < 0.44 | Low |

*Source:* author's calculations.

Federation, based on the values of indicators, are in one of three groups by the type of debt sustainability: with a high, medium and low level. Since the procedure for assessing the debt sustainability of budgets of regions, established in the framework of the legislation, presupposes the same thresholds for all subjects of the Russian Federation, that definition of allowable limits on the debt burden of regional budgets by systematising and processing statistical data using classification methods is an interesting, promising and urgent task.

## ASSESSMENT OF DEBT SUSTAINABILITY OF THE BUDGET SYSTEM OF THE NORTHWEST REGIONS

Assessment of debt sustainability of the budget system of the regions of the Russian Federation is carried out using the author's methodology, which includes several stages (*fig. 6*). The developed methodology is a set of stages and methods of estimation, as well as a certain algorithm of their application: involves the selection and systematisation of debt sustainability indicators, standardisation of their values based on the Euclidean distance method, calculation of the integral indicator of debt sustainability and its ranking using the formula of multidimensional average, and the division of regions into three debt sustainability groups with the definition of limit values (threshold values, limits) for each group.

At the first stage, indicators of debt sustainability were systematized, as well as their selection using the method of correlation analysis were substantiated. Initially, about 15 indicators were selected, which are the most common in the scientific literature, and are also among the indicators of the Budget Code of the Russian Federation. Further, on the basis of data from statistical indicators for North-West regions for the period from 2010 to 2019, a correlation analysis was carried out in order to establish a close relationship between the amount of public debt and macroeconomic indicators characterizing the state of the budgetary system of the region (*table 2*).

According to the results of the correlation analysis, a strong link between the amount of public debt of the Russian Federation entities and absolute indicators, which in most cases are included in the calculation of indicators of debt sustainability, which allows to substantiate their composition (*fig. 7*).

In the second phase of the study, based on open data from the Federal Service of State Statistics and the Ministry of Finance of the Russian Federation, six debt sustainability indicators were calculated for 11 North-Western regions from 2010 to 2019. A fragment of the results obtained is given in *table 3*.

Analysis of indicator values suggests that the two regions stand out from the other low level of indicators, which allows them to be previously classified as regions with high debt sustainability: St. Petersburg and Leningrad Oblast. High values of indicators

for the analyzed period are most often observed in the Republic of Karelia, the Republic of Komi, Vologda, Arkhangelsk and Pskov regions. Therefore, in the future it can be expected that these entities of the Russian Federation will be classified among the regions with a low level of debt sustainability.

In the third stage of the study, the values of the indicators were standardized. The Euclidean distance method was used to account for the degree of difference of each indicator for federal districts. The procedure of the chosen method is widely described in the scientific literature [23]. Since all six indicators are inverse, standardization has been applied to the minimum value of the corresponding year indicator. This resulted in a set of standardized values for six indicators for the period from 2010 to 2019, which in the fourth phase of the research was averaged over a dynamic series using the multivariate mean formula. This approach made it possible to identify regions with low/high debt sustainability for each indicator and to reflect in the integral assessment the level of each region in comparison with the average value of NWFD (*table 4*).

Standardised values of indicators reflect the high level of stability of St. Petersburg, Leningrad and Kaliningrad regions, which naturally affects the value of the integral stability rating of these regions. Regions with a low level of debt sustainability include the Republic of Karelia, the Republic of Komi and the Pskov region. The remaining regions of the NWFD at this stage of the research can be classified as regions with medium debt sustainability.

At the fourth stage of the study, the integrated debt sustainability index for the regions of the NWFD was calculated. The use of the multidimensional average formula, which is often used to assess the level of investment potential and takes into account not only the ranking of feature values, but also correlates it with the average by region in the estimated year, allows you to determine regions whose level of stability is above average. St. Petersburg, Leningrad and Kaliningrad regions have been steadily in such regions for four years. In order to gradate the regions under study by three types of debt sustainability, it is necessary to set intervals for such an assessment: regions whose debt sustainability index is greater than or equal to one are classified in a group with high debt sustainability; the subsequent gradation was carried out taking into account the differentiation of annual values within the two groups (*table 5*).

As can be seen from the results obtained for the period from 2016 to 2018, the group of regions with low debt sustainability consistently includes the Republic of Karelia and the Republic of Komi, as well as the Pskov region, which allows us to conclude about the high risk of insolvency and the need to establish targeted budget restrictions on debt obligations. Novgorod and Arkhangelsk regions are also in a credit risk zone, as they fall into a group of regions with low debt sustainability in 2019 and 2017.

In order to determine borrowing standards (upper limits of restrictions) for each region of the Northwestern Federal District, a hierarchical cluster analysis was carried out at the fifth stage of the study, as it is one of the methods of multidimensional classification, which allows you to distinguish areas of accumulation of objects from this population and combine them into homogeneous groups (segment) [24, p. 9]. Using the distance matrix of indicators by Northwestern Federal District for each analysed period, it is necessary to divide the data set into three clusters, and then define cluster centroids for each indicator. This will confirm the results obtained at the previous stage of the study, as well as solve the problem of targeted statistical justification of the norms of budgetary restrictions on the debt burden. The method of intergroup communication was used as a clustering method, as a measure of similarity between objects — Euclidean distance. The analysis

*Table 6*

**Agglomeration schedule and cluster membership by Debt-to-GRP ratio to regions**

**Order of agglomeration (clusters)**

| Stage | Unified cluster | | Rate | Cluster first appearance stage | | Next stage |
|---|---|---|---|---|---|---|
| | Cluster 1 | Cluster 2 | | Cluster 1 | Cluster 2 | |
| 1 | 7 | 11 | 2,915 | 0 | 0 | 2 |
| 2 | 7 | 12 | 5,615 | 1 | 0 | 11 |
| 3 | 2 | 4 | 6,446 | 0 | 0 | 6 |
| 4 | 6 | 9 | 12,821 | 0 | 0 | 8 |
| 5 | 3 | 8 | 18,167 | 0 | 0 | 7 |
| 6 | 2 | 10 | 28,969 | 3 | 0 | 10 |
| 7 | 1 | 3 | 39,715 | 0 | 5 | 9 |
| 8 | 5 | 6 | 40,297 | 0 | 4 | 9 |
| 9 | 1 | 5 | 81,158 | 7 | 8 | 10 |
| 10 | 1 | 2 | 140,984 | 9 | 6 | 11 |
| 11 | 1 | 7 | 311,931 | 10 | 2 | 0 |

was carried out using the SPSS software product. The results of clustering by one of the indicators are presented in *table 6, 7.*

When performing cluster analysis, three clusters are forcibly specified, the value of the agglomeration order coefficient shows that this number coincides with the difference in the number of observations and the number of steps, after which the coefficient increases abruptly. Thus, it can be concluded that the observation array is well clustered into three groups. At the same time, the cluster belongs to a particular type of stability can be judged on the basis of the values of cluster centrifuges.

*Table 7* shows that the value of cluster centroids is changing, but the amplitude of oscillations is low. This indicates a change in the cluster centroids of the indicator over the years under the influence of the macroeconomic situation in the country, which determines the level of income and expenditure parts of regional budgets. The importance of the indicator is also affected by fiscal policy in terms of debt management.

**Clustering**

| Monitoring | Cluster 3 |
|---|---|
| 1: North-West DF | 1 |
| 2: Republic of Karelia | 2 |
| 3: Komi Republic | 1 |
| 4: Arkhangelsk region | 2 |
| 5: Vologda region | 1 |
| 6: Kaliningrad region | 1 |
| 7: Leningrad region | 3 |
| 8: Murmansk region | 1 |
| 9: Novgorod region | 1 |
| 10: Pskov region | 2 |
| 11: St. Petersburg | 3 |
| 12: Nenets AD | 3 |

*Source:* author's calculations.

*Table 7*

**Cluster centroids by Debt-to-GRP ratio for the period from 2011 to 2019**

| Average Linkage (Between Groups) | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.9750 | 4.5000 | 5.5850 | 6.2550 | 5.7017 | 5.6300 | 5.0550 | 3.9633 | 3.3783 |
| 2 | 5.5133 | 6.7500 | 8.8533 | 9.5933 | 9.7467 | 9.8567 | 9.8300 | 7.1133 | 6.8467 |
| 3 | .4267 | .6000 | .7500 | .7000 | .6667 | .8200 | .8667 | .5933 | .4333 |
| Total | 3.4725 | 4.0875 | 5.1933 | 5.7008 | 5.4542 | 5.4842 | 5.2017 | 3.9083 | 3.5092 |

*Source:* author's calculations.

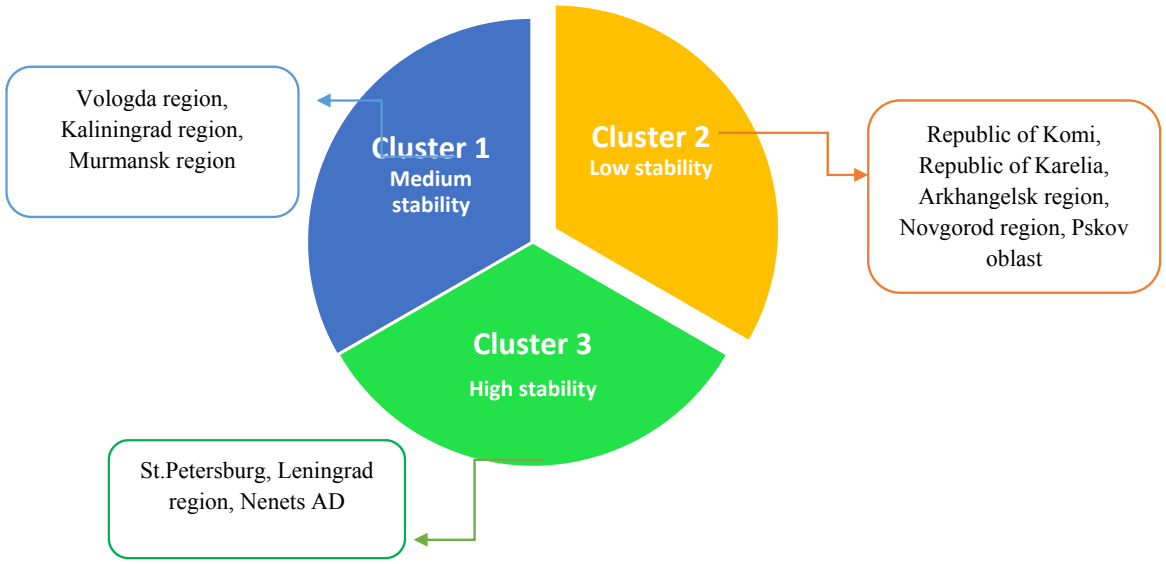


*Fig. 8.* **Clusters by type of debt sustainability**

*Source:* compiled by the author.

Using the data of dispersion analysis and R-square, we can say that all indicators of the table are significant, R-square in 2014, 2015, 2019 is more important, so when determining the boundaries of debt sustainability groups it is necessary to focus more on the values of these years (tables of descriptive statistics are not given due to the cumbersomeness of The values of the centroids of the third cluster determine the lower permissible boundary for the regions of the group, which according to the indicator I1 for the Komi Republic, Vologda, Leningrad Murmansk and Novgorod regions is no more than 10%.

In the same way, the results of clustering according to other indicators were analysed. Analysis of the agglomeration order, cluster membership, cluster centroid report, dispersion table allows us to conclude that the results of clustering regions for each indicator are heterogeneous, and regions change their belonging to clusters depending on the year being analysed.

*Table 8*

**Results of the study of clusters by regions of the Northwestern Federal District and volume of budget constraints**

| Low debt sustainability cluster | Budget constraints for regions with low debt sustainability |
|---|---|
| **Indicator 1: ratio of public debt to GRP, %** | |
| **2019** | |
| Komi Republic, Republic of Karelia, Arkhangelsk region, Novgorod region, Pskov region, Nenets AO | > 5.04 |
| **2018** | |
| Komi Republic, Karelia Republic, Arkhangelsk Region, Murmansk Region, Pskov Region | > 5.01 |
| **Indicator 2: the amount of public debt per capita, rub./people** | |
| **2019** | |
| Komi Republic, Republic of Karelia, Arkhangelsk Region, Novgorod Region, Pskov Region, Nenets AO | 30 337 |
| **2018** | |
| Nenets AO | 45 544 |
| **Indicator 3: share of public debt in regional exports, %** | |
| **2019** | |
| Komi Republic, Republic of Karelia, Arkhangelsk Region, Novgorod Region, Pskov Region, Nenets AO | 66.28 |
| **2018** | |
| Komi Republic, Karelia Republic, Arkhangelsk Region, Murmansk Region, Pskov Region | 104.87 |
| **Indicator 4: ratio of public debt to total budget revenue excluding BE, %** | |
| **2019** | |
| Komi Republic, Republic of Karelia, Arkhangelsk Oblast, Novgorod Oblast, Pskov Oblast, Nenets AO | 42.33 |
| **2018** | |
| Komi Republic, Karelia Republic, Arkhangelsk Region, Murmansk Region, Pskov Region | 59.39 |
| **Indicator 5: share of state and municipal debt servicing expenditures in regional budget expenditures, %** | |
| **2019** | |
| St. Petersburg, Leningrad region | 2.92 |
| **2018** | |
| Komi Republic, Karelia Republic, Arkhangelsk Region, Murmansk Region, Pskov Region | 2.83 |
| **Indicator 6: ratio of annual payments for servicing and repayment of public debt to total budget revenues excluding BE, %** | |
| **2019** | |
| Komi Republic, Republic of Karelia, Arkhangelsk Region, Novgorod Region, Pskov Region, Nenets AO | 48.79 |
| **2018** | |
| Nenets AO | 51.5 |

*Source:* compiled by the author.

Therefore, the identification of types of debt sustainability and determination of threshold values of debt obligations of Northwestern Federal District regions was based on the results of clustering indicators for 2019 and 2018. Generalisation of the results of cluster analysis made it possible to determine the current affiliation of the regions to the three clusters (*fig. 8*) and assess the type of debt sustainability, as well as to determine the marginal debt burden standards (*table 8*).

Analysis of the data of *table 8* allows us to draw two important conclusions: firstly, the results of clustering are consistent with the results of the assessment of the integral debt sustainability index; secondly, belonging to clusters of regions changes over the years. *Table 8* also shows that regions such as the Republic of Karelia, the Komi Republic, Arkhangelsk and Pskov regions are combined into a cluster with high indicators, which allows them to be classified as regions with low debt sustainability. Of particular interest are the values of indicators I4, I5, I6, as the upper limits of these indicators are regulated by the Budget Code of the Russian Federation.

## CONCLUSION

The analysis of the state and development of debt financing of the budget system of the Russian Federation showed that over the past ten years the volumes of internal public debt of the constituent entities of the Russian Federation tend to moderately increase (7.4%). At the same time, the main direction of use of domestic public debt is the coverage of the deficit of regional budgets, which is due to changes in tax legislation, the policy of economic sanctions against Russia, the growth of social expenditures for the implementation of May' Presidential Decrees. Analysis of one of the main indicators of the country's debt security 'debt-to-GDP ratio' showed that Russia's debt policy is restrained compared to world borrowing practises. Traditionally, Japan, the United States and Eurozone countries are characterised by high public debt. Nevertheless, the relevance of the assessment of the debt sustainability of the budgets of the Russian regions is confirmed by the results of the indicative analysis, which showed a high heterogeneity of the values of six indicators for the regions of the Northwestern Federal District.

The application of the author's methodology using the standardisation of indicator values and the multidimensional average formula for the calculation of the integral index made it possible to rank regions by the level of debt sustainability, and the use of hierarchical cluster analysis allowed to group regions by three types of debt sustainability with the definition of threshold values (permissible boundaries) of debt sustainability indicators of each.

As a result of approbation of the methodology on the basis of open data of the Federal State Statistics Service and the Ministry of Finance of the Russian Federation for the regions of the Northwestern Federal District, the group of regions with low debt sustainability included the Republic of Karelia and the Republic of Komi, as well as the Pskov region, which allows us to conclude about the high risk of insolvency and the need to control the level of debt burden using the thresholds obtained in the study by region clustera. Novgorod and Arkhangelsk regions are also in a credit risk zone, as they fall into the group of regions with low debt sustainability in 2019 and 2017.

The proposed methodology for assessing the debt sustainability of the budget system of the region is universal and can be applied to data on other constituent entities of the Russian Federation for an objective assessment of the permissible level of debt burden and levelling the amount of public debt in case of debt stability reduction. Directions of further research within the framework of a given topic are determined by the need for annual statistical justification of differentiated values of the upper limits of public domestic debt, taking

into account the macroeconomic situation in the country and the priorities of socio-economic development of each subject of the Russian Federation.

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