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# INNOVATIVE DEVELOPMENT OF RUSSIA: REGIONAL ASPECT

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Abstract. Regions of Russia differ significantly by their geographical, climatic, resource and other characteristics as well as by the level of innovative development of their economic systems. Low level of the innovative activity of most subjects of the Russian Federation hampers the solution of the strategic task of ensuring the country's economic growth through technological development. Using the methods of comparative and statistical analysis, this paper assesses the degree of differentiation of Russian regions by key indicators of innovative development as well as the impact of regional differentiation on the innovative results achieved. It has been established that the differences between the subjects of the Russian Federation in terms of their innovative development, as well as the concentration of innovative resources and innovative activity in certain regions of the country continue to be quite significant. No trends towards pronounced regional σ - and β-convergence have been revealed. Meanwhile, the policy of concentration of innovative activity in certain regions that are the generators of innovative transformations has proved unsatisfactory. According to most indicators of the country's innovative development strategy for the period up to 2020, the target values have not been achieved. The results of econometric modeling clearly demonstrate that the high degree of differentiation of indicators of innovative development of Russian regions has a negative impact on the dynamics and the results of innovative activity in the country as a whole. Thus, leveling-off of the level of the innovative development of Russian regions and the formation of a single innovation space of the country are important factors for increasing the innovative level of the Russian economy.

Keywords: innovation, innovative economy, regional economy, innovative development strategy, regional differentiation, Russia.

## 1 Introduction

Innovations stimulate economic development encouraging countries to overcome their resource constraints by intensifying economic growth, the increase in resource productivity and improvement of economic structure.

One of the distinctive features of Russia is abundance of natural resources and at the same time considerable number of unused reserves for extensive economic growth, which definitely slows down the pace of its innovative development. Obviously, the lag in scientific and technological development reduces the level of national competitiveness, which generates the need to create state development strategies and programs to drive innovation.

Many researches have considered trends and problems of innovative development in Russia. The majority of them mention the unsatisfactory results of the implementation of innovative development strategies in Russia. In particular, researches refer to the failure of the implementation of the Strategy for the Development of Science and Innovation in the Russian Federation for the period up to 2015, approved by the Interdepartmental Commission on Science and Innovation Policy (Protocol No. 1 of February 15, 2006) [1, etc.] and the Strategy of Innovative Development of the Russian Federation for the period up to 2020, approved by the Decree of the Government of the Russian Federation No. 2227-p of December 8, 2011 [2, 3, 4, etc.].

Meanwhile, the main reasons for such a situation are:

- instability of the economic, social and political situation and the global economic downturn [3, 5, 6];
- anti-Russian sanctions [3];
- low domestic demand for innovations and high-tech products in the Russian economy from all economic agents (population, business, state) [2, 4, 5, 6, 7];
- high level of the dependence on the import of high-tech equipment [2, 5, 6];
- unsatisfactory production structure with a predominant focus on the raw materials sector [5];
- high cost of credit [2, 6];
- insufficient personnel and financial support [4, 5], etc.

The authors also point out to the inefficient state management of innovative development of the country that is evidenced by the following:

- insufficient information availability, which does not allow timely making the necessary adjustments to the content of strategic documents [3];
- the lack of a link between the results of the strategy's implementation and the volume of its resource provision, which leads to the continued funding of events that do not provide adequate returns and to an inefficient spending of budgetary and extra-budgetary funds [3];
- the lack of research on the causes of the current situation and the scientific evidence of corrective management measures [3];
- violation of the principle of personal responsibility of managers (lack of a system of correlation between the remuneration of officials and managers and the results obtained or penalties for their failure to achieve them) [3];
- low efficiency of tax regulation of innovative activity where the fiscal component clearly prevails over the stimulating one [1, 2, 4];
- insufficient stimulation of domestic demand for innovations and innovative products, including the volume of purchases of products for state needs [2].

The authors also pay a great deal of attention to the problem of high differentiation of regions by the level of their innovative development and the lack of a single innovation space in Russia (for example, [1]). However, there is no extensive research of this phenomenon in terms of its impact on the results of innovative activity and innovative dynamics.

The purpose of this study is to study the processes of innovative development of Russia in the regional context.

The objectives of the study are to assess the degree of differentiation of key indicators of innovative development among the regions of Russia, to identify the presence of convergence (or divergence) processes in the innovation sphere, as well as to assess the presence (or absence) of the influence of regional differentiation on the innovative results achieved.

2 Materials and methods

The study uses the target indicators presented in the Strategy of Innovative Development of the Russian Federation for the Period up to 2020 approved by the decree of the Government of the Russian Federation from December 8, 2011 № 2227-R (hereinafter referred to as the Strategy) as well as the official statistics presented on the website of Rosstat (www.gks.ru) for 2010-2019 characterizing the outcomes of innovative development of Russia and its regions.

In the course of the research, the methods of comparative and statistical data analysis were used.

To assess the differences in the values of indicators among the regions of Russia, the coefficient of variation (KV) was calculated. If its value is less than 0.33 it indicates the homogeneity of the sample frame for a parameter studied, and if it is more than 0.33, it indicates the presence of pronounced differentiation and heterogeneity of the values of the studied parameter in the sample frame.

To assess the degree of concentration of innovative activity in certain regions of Russia, the Herfindahl-Hirschman Index (HHI) was calculated as well as the shares of three (CR3) largest regions in the aggregate value of the indicator. If the value of HHI is above 2,000 and CR3 is more than 70 %, the degree of concentration is considered high; if the value of HHI is within the range of 1,000 and 2,000 and CR3 is from 45 to 70 %, the degree of concentration is moderate, and at the value of HHI below 1,000 and CR3 less than 45 %, it is low.

To analyze the processes of convergence and divergence of Russian regions from each other by the values of indicators of their innovation sphere, we analyzed the dynamics of the variation coefficient (a decrease in its value indicates the processes of σ-convergence, and an increase indicates the processes of σ-divergence) as well as the value of the β-coefficient (a negative value of which indicates the processes of convergence, and a positive value indicates the processes of divergence).

The β-coefficient was calculated using the regression equation [8]:

$$y = \alpha + \beta \cdot Y_0 + \varepsilon, \quad (1)$$

where y is the logarithm of the average rate of change of the indicator for a period.

Meanwhile, σ-convergence just indicates the fact that the degree of dispersion of the values of the studied regional innovation characteristics decreases over time while β-convergence indicates that the alignment of the innovative space is due to the accelerated pace of development of lagging regions compared to the pace of development of the leading regions.

To assess the degree of regional differences by the level of values of innovative parameters and the level of innovativeness of the national economy as a whole, the method of correlation and regression analysis was used.

3 Results and Discussion

Over the analyzed period, the volume of output of innovative goods, works and services at current prices increased by 291.0 % with an increase in the total gross regional product (GRP) at current prices by 151.6 %. The correlation coefficient between the output of innovative products and the value of GRP for the period increased from 0.42 to 0.76, which indicates the significance of innovation for economic growth.

The values of the HHI and CR3 indices (Table 1) show that the level of concentration of innovative products in the regions of Russia is medium with a slight upward trend. As of 2019, three Russian regions: Moscow, St. Petersburg and the Republic of Tatarstan produced a third of the innovative production volume. The indicators of GRP concentration were approximately similar (HHI increased from 652.5 to 603.6 during the period, and CR3 decreased from 32.3 to 31.6 %, and in terms of GRP volume the Moscow Region entered the top three regions except for the two capitals).

According to the Strategy, the share of innovative products in the total volume of national output by 2020 was supposed to be 25%. However, from 2016 the average Russian indicators were significantly lower than those planned. In 2019, an average Russian value of the indicator reached only 21 % of the planned level, and even the maximum value of the share of innovative products among all regions of Russia did not reach it (Table 1). The median value of the indicator remained consistently below the average level, which indicates an asymmetric distribution of innovative industries across the regions of Russia with a prevalence of low values. At the same time, maximum values are 20 times greater than minimum ones and the value of KV indicates a pronounced differentiation of Russian regions by the share of innovative products in the total output. At the same time, the dynamics indicates a slight equalizing of differentiation (there is a weakly pronounced σ-convergence), and the value of β-coefficient equal to (-0.01) indicates that this slight equalizing occurred due to the outpacing rates of the indicator change in the regions that are innovatively weak compared to the leading regions.

Enterprises active in innovation are mainly concentrated in Moscow (their share according to the criteria of the last Oslo manual is 40-45 %), in St. Petersburg (34-37 %), the Chuvash Republic (34-39%) and the Republic of Tatarstan (27-33%). There is a dynamic increase in the maximum and a decrease in the minimum values of the indicator, the gap between which grew from 11 to 30 times. The median value is much closer to the minimum level than to the maximum, and lower than the average level, which also indicates an asymmetric distribution of the indicator, low values prevailing. The values of the variation coefficient (Table. 1) indicate a significant differentiation of the share of organizations of Russian regions engaged in technological innovation, and their dynamics indicates σ-divergence. The value of β-coefficient was statistically insignificant at the significance level of 0.05. Meanwhile, the actual average Russian share of organizations implementing technological innovations was lower than planned one according to the Strat-

egy of 2013, even though the criteria applied by the Oslo Management to its measurement changed in 2017 (this change caused a sharp increase in the actual values of the indicator in 2019 compared to previous years).

In terms of the number of advanced production technologies used, the leading regions are Moscow, the Moscow Region, Nizhny Novgorod Region, Sverdlovsk Region, and Perm Krai. In this, the dynamics of the HHI and CR3 indices (Table. 1) show a decrease in the degree of concentration of the use of advanced technologies in certain regions of Russia. Per 1,000 people employed in the economy, the most equipped with advanced production technologies in recent years have been the Vladimir Region, Perm Krai and the Yamalo-Nenets Autonomous Okrug. Over the analyzed period, there was an increase in the maximum, minimum, median (close to the lower level of the range) and average values of the indicator, while there was a slight decrease in the high level of regional differentiation (the dynamics of KV indicated a weak σ-convergence). The calculated value of β-coefficient equal to (-0.05) is the evidence of β-convergence.

The number of higher-productivity employment opportunities in the country increased by more than 7 million (Table. 1) but they were mainly created in Moscow, St. Petersburg and the Moscow Region. Their combined share increased from 17 to 24 %, the HHI index also tended to grow, indicating an increase in the concentration of higher-productivity jobs in certain regions of the Russian Federation.

Moscow and the Moscow Region are the leaders by the sum of costs of innovative activities. In 2019, these two regions together accounted for 33.2 % of the total amount of such costs. The growth of the CR3 and HHI indices shows an increase in the processes of concentration of such costs in certain subjects of the Russian Federation.

The total amount of costs for innovative activities in the Russian Federation at current prices increased by 388 % while the volume of production of innovative goods, works and services increased by 291.0 %. The correlation coefficient between the costs of innovative activity and the volume of innovative products output increased from 0.53 to 0.78 over the period. The cost return in the form of the volume of output of innovative products per one ruble of the costs incurred for innovative activities fell from 3.1 to 2.5 rubles.

Table 1 – Characteristics of key innovation indicators: distribution among regions.

| Indicator | 2010 | 2019 | Dynamics |
|---|---|---|---|
| The volume of innovative goods, works and services | | | |
| Amount, billion rubles. | 1 243,7 | 4 863,4 | 3 619,7 |
| CR3, % | 28.0 | 33.3 | +5.3 |
| HHI | 517.0 | 555.8 | +38.8 |
| The volume of innovative goods, works and services, % | | | |
| Max. | 23.1 | 23.8 | +0.7 |
| Min. | 0.0 | 0.0 | 0.0 |
| Medium | 4.8 | 5.3 | +0.5 |
| Planned | 4.9 | 25,0* | +20.1 |
| ToV | 0.96 | 0.87 | -0.09 |
| The share of organizations engaged in technological innovations, % | | | |
| Max. | 26.5 | 45.1 | +18.6 |
| Min. | 2.4 | 1.5 | -0.9 |
| Medium | 7.9 | 21.6 | +13.7 |
| Planned | 7.7 | 25,0* | +17.3 |
| ToV | 0.46 | 0.37 | -0.09 |
| The number of advanced production technologies used | | | |
| Quantity | 203,330 | 262,645 | +59,315 |
| CR3, % | 23.6 | 17.2 | -6.4 |
| HHI | 343.9 | 266.0 | -77.9 |
| The number of advanced production technologies used per 1,000 people employed | | | |
| Max. | 10.6 | 12.3 | +1.7 |
| Min. | 0.0 | 0.2 | +0.2 |
| Medium | 2.8 | 3.7 | +0.9 |
| ToV | 0.78 | 0.70 | -0.08 |
| The number of higher-production jobs | | | |
| Quantity, thousand | 14 521 | 21 947 | +7 426 |
| CR3, % | 17.4 | 23.7 | +6.3 |
| HHI | 250.6 | 329.9 | +79.3 |
| Costs of innovation activity | | | |
| Amount, billion rubles. | 400.8 | 1954.1 | +1 553,3 |
| CR3, % | 22.2 | 41.1 | +18.9 |
| HHI | 396.6 | 956.4 | +559.8 |
| Costs of innovation activity in relation to GRP (%) | | | |
| Max. | 10.6 | 9.6 | -1.0 |
| Min. | 0.0 | 0.0 | 0.0 |
| Medium | 1.1 | 2.1 | +1.0 |
| ToV | 1.40 | 0.82 | -0.58 |

Table 1

| Indicator | 2010 | 2019 | Dynamics |
|---|---|---|---|
| Internal costs of research and development | | | |
| Amount, billion rubles. | 523.4 | 1 134,8 | +611.4 |
| CR3, % | 60.9 | 58.6 | -2.3 |
| HHI | 1 737,5 | 1 614,1 | -123.3 |
| Internal costs of research and development in relation to GRP (%) | | | |
| Max. | 4.8 | 5.5 | +0.7 |
| Min. | 0.0 | 0.0 | 0.0 |
| Medium | 1.4 | 1.2 | -0.2 |
| Planned | 1.3 | 3,0* | +1.7 |
| ToV | 0.67 | 0.69 | +0.02 |
| Number of personnel engaged in scientific research and development | | | |
| Number of people | 736,540 | 682,464 | -54,076 |
| CR3, % | 55.1 | 54.0 | -1.1 |
| HHI | 1 407,8 | 1 311,0 | -96.8 |
| The number of advanced production technologies developed | | | |
| Quantity | 864 | 1 620 | +756 |
| CR3, % | 46.1 | 32.4 | -13.7 |
| HHI | 966 | 548.2 | -417.8 |
| Inventive activity coefficient (the number of domestic patent applications for inventions made in Russia per 10,000 people) | | | |
| Max. | 7.4 | 8.6 | +1.2 |
| Min. | 0.0 | 0.0 | 0.0 |
| Medium | 2,0** | 1,6*** | -0.4 |
| Planned | 2.0 | 2,8* | +0.8 |
| ToV | 0.64 | 0.66 | +0.02 |

Calculated by the author from statistical data
*The planned level is specified in the Strategy for 2020.
** Statistical data are presented for 2012.
*** Statistical data are presented for 2020.

The share of cost of innovative activity in GRP in the Russian Federation increased by 1.0 % on average while the maximum value decreased by 1.0 % (Table 1) too. As a result, the degree of regional differentiation decreased, which is the evidence of σ-convergence. The value of β-coefficient was statistically insignificant at the significance level of 0.05.

Internal research and development costs increased by 117% over the analyzed period, while GRP grew by 151.6 %. Thus, unlike the growth of GRP the outstripping growth of internal costs of research and development stated in the Strategy in comparison was not implemented in practice. The correlation coefficient between internal costs of research and development and GRP over the period exceeded 0.9, which indicates interconnection between the dynamics of these two significant macroeconomic parameters. The values of the HHI and CR3 indices demonstrate a significant degree of concentration of internal costs of research and development in particular regions of the Russian Federation. Over the studied period, Moscow, St. Petersburg and the Moscow Region accounted for about 60 % of the total amount of costs.

The average Russian share of research and development costs in relation to GRP over the analyzed period decreased from 1.4 to 1.2% while its maximum value increased as did the gap between the minimum and maximum levels achieved. The values of the variation coefficient indicate a considerable differentiation of the indicator among the regions of Russia, and its dynamics indicates σ-divergence. Meanwhile, β-divergence was not recorded.

As follows from Fig. 1, in terms of research and development costs there was a shift in funding priorities from basic research to applied research.

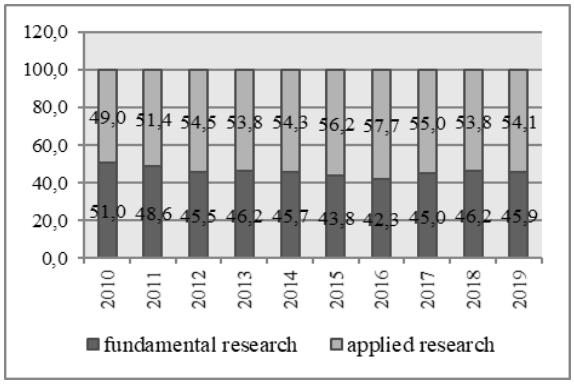


***Figure 1 – Structure of internal research and development costs by type of research (%)***

Calculated by the author from statistical data

The number of personnel engaged in scientific research and development decreased by 54,000 people over the period (Table 1). Notice that more than half of the total number of researchers work in Moscow, St. Petersburg and the Moscow Region. The degree of concentration of research personnel had a slight downward trend.

The number of advanced production technologies developed increased by 88 % over the period. More than a third of all developments (Table 1) were made in Moscow, St. Petersburg, the Moscow and Chelyabinsk regions. However, the dynamics of the HHI and CR3 indices show a decrease in the degree of concentration of the processes of advanced production technologies development in certain regions of Russia.

Table 1 shows that there was a decrease in the dynamics of the average Russian level of inventive activity while its maximum value increased. The median value was much closer to the minimum level than to the maximum, and twice as low as the average level, which indicates an asymmetric distribution of the level of inventive activity of the population in the regions of Russia, low values prevailing. The value of KV indicates a significant differentiation of the coefficient values among Russian regions while its dynamics indicates its increase. The study revealed that the inventive activity of the population is concentrated mainly in three subjects of the federation that are Moscow, St. Petersburg and the Moscow Region. The combined share of these three regions in the total number of submitted applications for inventions increased from 46.3 % in 2010 to 50.5 % in 2020, which indicates a pronounced concentration of inventive activity in certain regions of Russia. The actual value of the indicator in 2020 was only 80 % of the level targetted by the Strategy, and the number of patents granted in Russia over the analyzed period decreased by 10.5 %.

Moreover, the targeted indicators for the share of organizations using broadband Internet access and the organizations having a website, were not achieved. At the same time, according to these indicators, there was a reduction in the gap between their maximum and minimum values, and no significant differentiation between the regions was recorded.

Considering the entire range of indicators of the Strategy, the conclusion is possible that the majority of targetted indicators were not achieved, which indicates unsatisfactory results of its implementation.

Figures 2-6 show the degree of heterogeneity in the distribution of labor resources, costs for innovation activities and its results across the regions of Russia. The differences between the absolute minimum and maximum values are thousands of times (on the volume of innovative products and the number of patents granted) and tens of thousands of times (on the number of personnel engaged in research and development and internal costs of research and development).


***Figure 2 – The number of personnel engaged in research and development (total for 2010-2019, thousand people)***

Made up by the author from statistical data


***Figure 3 – Internal research and development costs (total for 2010-2019, billion rubles)***

Made up by the author from statistical data


***Figure 4 – Innovation costs (total for 2010-2019, billion rubles)***

Made up by the author from statistical data


***Figure 5 – The volume of innovative goods, works, services (total for 2010-2019, billion rubles)***

Made up by the author from statistical data


***Figure 6 – The number of patents granted (total for 2010-2019, units)***

Made up by the author from statistical data

High concentration of labor resources, higher-productivity workplaces, as well as the costs of innovation, research and development in particular Russian regions (in Moscow, St. Petersburg, the Moscow and Nizhny Novgorod Regions, the Republic of Tatarstan) does not make a significant contribution to the accelerated innovative development of the country and achieving its strategic goals in the field of innovation. High concentration of resources in certain regions without paying attention to the returns received reduces the efficiency of the costs incurred. As follows from Figure 7, the

labor productivity of the personnel engaged in research and development in terms of the number of patents received per 1000 employees is much higher in the Murmansk and Bryansk regions, as well as in the Republic of Bashkortostan.


***Figure 7 – The number of patents granted in 2010-2019 per 1000 people engaged in research and development (units)***

Similarly, the increase in the output of innovative goods, works and services as a percentage in response to an increase in innovation costs per one percent (Figure 8) is much higher in the Murmansk and Ivanovo regions, as well as in the Republic of Sakha (Yakutia).


***Figure 8 – The increase in the output of innovative goods, works and services as a percentage in response to an increase in the cost of innovation per one percent***

Made up by the author from statistical data

The highest increase in GRP in the percentage in response to an increase in internal research and development costs per one percent was recorded in the Magadan, Arkhangelsk and Kaluga regions (Fig. 9).

The results obtained convincingly indicate the futility of further concentration of innovative activity in particular regions of Russia.


***Figure 9 – GRP growth as a percentage in response to an increase in internal research and development costs per one percent.***

Made up by the author from statistical data

A correlation and regression analysis was used to test the hypothesis about the negative impact of a high degree of concentration of innovative resources and costs. As a result, a number of regression models were obtained. Two of them are presented below.

Model (2) characterizes the influence of the degree of concentration of innovative activity on the share of innovative products in the total output:

$$\widehat{dIP} = 828 + 5{,}75 \cdot dCI - 6{,}77 \cdot \ln(HHIP) - 1{,}70 \cdot \ln(HHC) - 107{,}5 \cdot \ln(HHL), \quad (2)$$

(99,0)*** (1,08)*** (1,86)** (1,93) (13,8)***

in parenthesis standard errors are indicated;

** - significance level 0.05

*** - significance level 0.01

$dIP$ - the share of innovative goods, works and services as a percentage of the total volume of goods shipped, works and services performed;

dCI – the share of costs for innovative activities (costs of the factors of labor and capital) according to the gross regional product;

ln (HHIP), ln(HHC), ln (HHL) are, respectively, the logarithms of the Herfindahl – Hirschman indices for the following indicators: the volume of innovative goods, works and services; the cost of innovative activities; the number of personnel engaged in research and development.

During the building of the model, robust standard errors were applied. Determination coefficient was 0.96, the RESETtest showed that the specification of the equation is adequate, the value of the dispersion bloat coefficients indicates the absence of multicollinearity. The normal distribution test revealed that the errors were distributed normally, the p-value of the F-criterion was 3.09 e-06. The above allows a conclusion about the statistical significance of the model obtained.

According to equation (2), in order to ensure the growth of the share of innovative products in the total output, it is necessary to reduce the level of concentration of labor resources, cost funding and production volumes in certain regions of Russia. Meanwhile, the greatest negative impact is made by the factor of labor resources whose concentration in the capital regions undermines the human resource capacity in the innovation sphere of other subjects of the Russian Federation.

Model (3) characterizes the influence of the magnitude and degree of concentration of internal costs of research and development on the number of advanced production technologies developed:

$$\widehat{\ln(TL)} = 27.42 + 0.36*\ln(CR) - 3.39*\ln(NNCR) \quad (3)$$

(9,32)** (0,09)*** (1,13)**

in parenthesis standard errors are indicated;

** - significance level 0.05

*** - significance level 0.01

ln (TL) is the logarithm of the number of advanced manufacturing technologies developed;

ln (CR) is the logarithm of internal costs of research and development;

ln (HHCR) is the logarithm of the Herfindahl - Hirschman index for internal research and development costs.

During the building of the model robust standard errors were applied. Determination coefficient was 0.90, the RESET-test showed that the specification of the equation is adequate, the value of the dispersion bloat coefficients indicates the absence of multicollinearity. The normal distribution test revealed that the errors were distributed normally, the p-value of the F-criterion was 0.00008. The above allows a conclusion about the statistical significance of the model obtained.

According to equation (3), in order to ensure the growth of the number of advanced production technologies being created in the country, it is necessary to increase internal costs of research and development and reduce the degree of their concentration in certain regions.

There are many studies proving the positive impact of innovations on the dynamics of key macroeconomic indicators (for example, on the gross domestic product of the Russian Federation [9, 10, 11]),

The results of the study confirm the importance of the factor of regional differentiation as well as the negative impact of a high concentration of innovative resources and costs on the overall results of innovative activity. The high concentration of labor resources, the amount of funding of research and innovation, higher-productivity work places in the leading regions does not provide the effective resource productivity there (similar results were obtained by the author when studying innovative processes on the example of the regions of the North-Western Federal District [12]). An increase in resource availability in the regions having the highest return would ensure higher rates of distribution and implementation of innovations across the country as well as higher national results in the field of innovation. It would also help to reduce the current dependency of the country (Figure 10) on the export of high-tech goods.

Disproportions in the level of innovative development of regions lead to a significant differentiation of the country's economic space, which negatively affects economic relations. As a number of authors rightly point out, the

subjects of the Russian Federation following qualitatively different technological patterns for a long time are gradually losing the basis and incentives to expand their cooperative ties [13, 14].

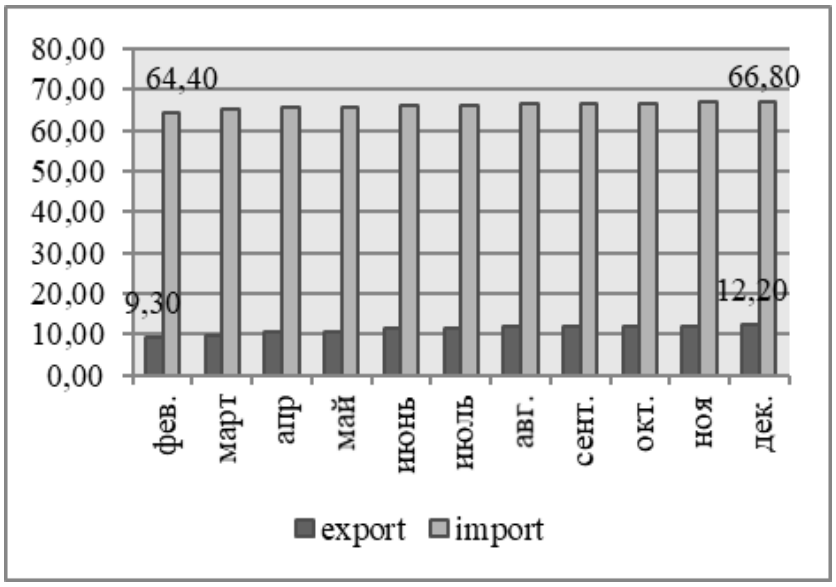


***Figure 10 – The share of high-tech goods in the total volume of exports and imports of the Russian Federation in 2019 (cumulative total,%)***

The chronic stable innovative stagnation of individual regional subsystems of the national economic system inevitably leads to a decrease in the technological level of their production and their gradual elimination from intra- and inter-country economic cooperation, which can result in irreversible consequences such as the loss of scientific, industrial, technological and human potentials, which are key factors of successful economic development in the modern world.

Besides, as E. M. Buchwald rightly notes, the regions with low values of innovative development indicators experience greater financial difficulties as they have a budget deficit and a significant amount of regional public debt [1]. In such regions, there is a low level of material security of the population and effective demand, which has a very negative effect on the internal reserves of the development of the regional economy and can make the current situation even worse. It is important to note that growing financial and economic problems of the regions that are innovative are likely to result in an overload of the federal budget due to financial equalization costs [1] and do not contribute to the implementation of the strategic priorities of the country's development as a whole.

4 Conclusions

The conducted research has allowed a number of important conclusions.

1) The pace of innovative development in Russia is insufficient for solving the strategic goal to ensure economic growth through a technological breakthrough.

2) The policy of concentration of innovative activity in particular regions and in large urban agglomerations as driving forces of innovative transformations has proved unsatisfactory; the results of the implementation of the Strategy of Innovative Development of Russia for the period up to 2020 cannot be considered satisfactory either.

3) The degree of differentiation of regions by the level of their innovative development and the level of concentration of innovative resources and innovative activity in certain regions is still quite high; in terms of innovation, there is no pronounced or effective convergence of regions.

4) The lack of a single innovation space as well as accelerated innovative development of some regione and the degradation of other regions are constraining factors for the sustainable economic development of the country as a whole. The concentration of resources and efforts to develop innovative projects in certain regions of Russia fails to be accompanied by their subsequent diffusion to other regions to accelerate the pace of their innovative and economic development. The growing gap between the leading regions and the outsider regions prevents the strengthening of interregional ties and the deepening of interregional cooperation.

5) Continuing a high degree of differentiation of Russian regions by the level of innovative development has a negative impact on the dynamics and results of innovation activity in the country as a whole.

Thus, narrowing the gap in the level of the innovative development of Russian regions and the formation of a single innovation space of the country are important factors for increasing the innovative level of the Russian economy.

Generalization of the results of theoretical and empirical analysis allows the conclusion about the necessity of:

- systematic, logical and consistent goal-setting by the state [3, 4, 15];
- an adequate system of incentives for innovative behavior for economic agents, including tax regulation [1, 2, 3, 6, 13];
- adequate resource (human and financial) support of innovative development strategies and programs [3, 4; 5, 6, 15];
- maintaining and further development of scientific schools, including those at the regional level [15];

- thorough considering regional strategies, taking into account regional peculiarities and priorities [1, 5, 17, 18, 19], expanding the scope of interregional cooperation [6];

- improvement of institutions of innovation development [1], innovation infrastructure [4, 6] and forms of organization of innovation activity [5];

- active involvement of universities into the processes of innovative development of regions [1, 20];

- support of small and medium-sized innovative entrepreneurship, development of a competitive environment [1, 6];

- increasing the level of well-being of the population to stimulate domestic demand for the final innovative product [15];

- creating an effective system for monitoring and evaluation of the implementation of innovative development strategies and programs, as well as scientific justification of corrective actions at all levels of management [6].

The implementation of these measures will allow for a much-needed structural shift in the national economy in favor of innovative sectors, an increase in the technological level of production, labor productivity and the standard of living of workers, a reduction in the country's import dependency in the high-tech sector and strengthening its international position.

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## DYNAMICS OF AQUATIC RESOURCES CHANGE IN BELARUS IN MODERN CONDITIONS

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**Abstract**

The article addresses the main features of variability and dynamics of different river discharge in Belarus over 1948-2017. It has been found that for the 70-year period in question, the average annual discharge has slightly changed. The most significant changes are observed in the dynamics of the maximum spring discharge and the minimum winter discharge. The performed assessment of changes in the probability of extreme water flow rates of rare recurrence in the conditions of modern climate warming showed that the frequency of dangerous maximum and minimum water flow rates in 1988-2017 significantly decreased compared to 1948-1987.

**Keywords:** river discharge, long-term variability, intra-annual distribution, uniformity, cyclicity, trend.

**Introduction.** One of the priority areas of scientific research for –2021-2025 in the Republic of Belarus is the efficient use and management of water resources [1]. Recently, one of the priority tasks of effective nature management is the issue of preserving the quantity and quality of natural waters. A necessary and important condition for effective management of water use and protection is the availability of timely, reliable and complete information about water resources, their actual use and pollution due to wastewater discharge and other anthropogenic impact.

Global warming observed since the second half of the XX century has a great influence on the dynamics of river hydrology. The ongoing changes in river discharge affect the efficiency of the functioning of water resource systems of river basins, which determine the activities of many sectors of the economy (industry, hydropower, agriculture, fisheries),