# Spatial and functional localisation of innovation development in Russian regions: analysis and forecast

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**Abstract.** Purpose: To identify features of spatial and functional localization of innovation activity of Russian regions, it is necessary to forecast its dynamics, development, and justification of directions and tools of regional innovation policy in the medium term. Research methods: comparative analysis; structuring of the information dataset – virtual clustering method; correlation and regression analysis. Results: we have proposed five indicators characterizing spatial and functional localization of regional innovation development. On the base of them, we formed virtual clusters, including regions with similar values of the parameters under study. We identified the closest representative region to its center for each cluster. Also we used the example of the Yaroslavl Region (region-representative of cluster B) to identify trends by the studied indicators and draw conclusions about the region's forecasting and development prospects in terms of the basic parameters of innovative development.

**Keywords**: cluster analysis, k-means method, virtual clusters, Russian regions, innovation development, representative regions, trends.

**JEL codes:** B41, O30, R11

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## Introduction

The contemporary development of the country and its regions is closely connected with innovation, which is reflected in the relevant normative documents and legislative acts. Thus, the purposes and main directions of modernization and innovative development of the Russian economy are presented in the Decree of the President of the Russian Federation of May 7, 2018 «On the national purposes and strategic objectives of the development of the Russian Federation for the period until 2024». The transition of the Russian economy to an innovative path of development by 2020 was declared as the main objective of the Strategy for Innovative Development of the Russian Federation for the period until 2020 (adopted in December 2014). The «big challenges» to the Russian economy, formulated back in 2016, have not lost their relevance today, and many of them have become significantly more acute. These include:

1) Threats to national security, increased regional as well as global instability; increased problem of import substitution.

2) The need for global economy technological change associated with the fourth industrial revolution and digital transformation.

3) The ageing of the population, causing corresponding changes on the health, social, and labour market.

4) The spread of epidemics, which is linked to economic and social risks.

5) Environmental problems, including climate and environmental change, and the depletion of natural

resources.

6) Provision of safe food products to the population of the country.

7) Radical changes of the energy systems (Center for Strategic Research, 2016).

A constructive response to these challenges is the innovative development of the country and its administrative-territorial entities. At the same time, the regions should try to maximize their development potential, design and use tools appropriate to their position and capabilities to increase the level of innovation activity and innovation performance. For this purpose, it is necessary to identify the spatial distribution of innovation development parameters of the country's regions, which allows us to focus on the study of a limited range of typical administrative-territorial entities, representing large enough groups, so as predict their dynamics.

Numerous studies of the regions innovation development level presented in the modern scientific literature traditionally rely on ranking methods, econometric methods, the use of various indices, and integral analysis techniques.

Nowadays, the following ratings are widely known: Rating of Innovation Development of the Constituent Entities of the Russian Federation (Institute of Statistical Research and Knowledge Economics, National Research University Higher School of Economics, 2012), National Rating of Investment Climate in the Constituent Entities of the Russian Federation (Agency for Strategic Initiatives, 2014), Rating of Innovative Regions of Russia (Association of Innovative Regions of Russia & Ministry of Economic Development of the Russian Federation, 2012), etc.

The authors' approaches to assessing the innovative development of regions are quite diverse. Thus, S.N. Mityakov et al. (2021) conduct a ranking of regions in dynamics and identify the leading and outsider regions based on various criteria of innovation activity.

E.V. Emelyanova and N.V. Kharchikova (Emelyanova & Kharchikova, 2019) allocate the regions of the Central Federal District into five groups, depending on the values of their innovation activity aggregate index. This index is integral. It is calculated on the basis of three indices: innovation activity, innovation products, and costs of technological innovation.

E.A. Polina and I.A. Solovieva (2020) propose an integral index of innovation development. Its partial indices are calculated by categories of innovation environment (climate, potential, activity) for socio-economic, industrial-technological, scientific, financial, human resources, and investment areas of innovation activity, which allowed them to classify regions of the country into four groups: «alpha» and «beta» are high index values, «gamma» is medium one, and «delta» is low one.

Yu.I. Treshchevsky and M.V. Litovkin (2017) define the prospects for regional innovation development depending on the institutional characteristics of socio-economic systems and types of economic behaviour (ascetic and hedonistic).

## Methods

We propose the distribution of regions into virtual groups, including administrative-territorial entities similar by the basic parameters of innovation activity, as a promising research option. The grouping of regions was made by the clustering method. This method was proposed by I. Hartigan and M. Wong (1979) and developed by M. Oldenderfer and R. Blashfield (1989), I. Mandel (1988). The method is now widely used by Russian scientists and allows them to analyze various socio-economic processes at the regional and other levels. It is provided by the development of information and big data technologies.

V.A. Gordeev and M.I. Markin (2022) applied virtual clustering to study regional competitiveness; L.M. Nikitina and V.A. Kurkin (2020) assessed the level of development of the regional digital economy. E.I. Piskun and V.V. Khokhlov (2019) use exploratory factor analysis to assess the regions of the Central, Northwestern, and Southern Federal Districts and identify eight clusters distinguished by the nature of the influence of natural, production factors, and the factor constraining the development of regional economy.

T.I. Gulyaeva and E.V. Takmakova (2021), use the k-means method, estimate the living standards of the population by 13 indicators and group the regions into 5 clusters with living standards from low to high one.

I.G. Abysheva, P.B. Akmarov, E.S. Tretiakova and O.P. Knyazeva (Abysheva et al., 2021) assess the impact of production specialization on the socio-economic development of regions, identifying clusters of highly specialized and multi-specialized regions, and assessing their development potential.

The authors of this paper in co-authorship with other scientists use virtual clustering method to study environmental and economic activity (Treshchevsky et al., 2021), foreign economic activity (Kosobutskaya et al., 2021), spatial and functional differentiation of road infrastructure (Kosobutskaya et al., 2020), and spatial and functional localization of educational subsystems of Russian regions (Endovitsky, 2019), etc.

We suggest that the virtual clustering method has significant research potential for the analysis and forecasting of innovation processes taking place in the country and regions. Therefore, we share the position of L.S. Valinurova and T.R. Tlyavlin (2022) that combining Russian regions into virtual clusters by level of innovation development allows not only comparative assessment and intergroup rankings, but also highlights similar characteristics of regions forming relevant clusters.

The grouping of regions into virtual clusters also allows each group of regions to identify and solve typical problems, intensify socio-economic processes, and improve management efficiency by concentrating resources on priority areas. It is possible to identify model regions (regions – cluster representatives) that have the shortest distance from the centre of their respective clusters, to assess differences in the studied parameters, trace the reasons why individual regions lag behind the leading ones, determine the place and role of individual regions in the innovation system of the country.

In fact, the results of regional clustering can be used to study best regional practices and assist in the development of strategic planning documents, programmes, and regional innovation policies.

Numerous indicators are now being used to assess the innovative development of regions and their innovation activity. For example, the Institute for Statistical Studies and Knowledge Economy (ISSEK) and the Russian Cluster Observatory used 53 indicators aggregated into 16 groups and related to 5 sub-indices: socio-economic conditions of innovation; scientific and technological potential; innovation activity; export activity; and innovation policy quality (Abashkin et al., 2021) to rank Russian regions' innovation development (from 2012 to 2021).

In November 2022, the Ministry of Education and Science released the first national ranking of the regional scientific and technological development, which uses 33 indicators combined into 3 blocks: environment for knowledge-intensive business, environment for the researchers and for the authorities. The indicators were calculated based on official statistical data from Rosstat, the Ministry of Industry and Trade, Rospatent, as well as official internet portals of core organizations and development institutions.

However, when conducting research at the regional level, there is a problem of access to relevant statistical data. For example, for the indicators «Volume of innovative goods, works, services», «Advanced production technologies developed», data for a number of regions are not published in some periods in order to ensure the confidentiality of primary statistical data. The indicator «Specific ratio of innovative goods, works and services in the total volume of goods shipped, works performed and services rendered by organizations» does not provide data for all periods studied.

Statistical data from different sources (e.g. federal and regional statistics) may not correspond, and in some cases the discrepancies may be substantial.

There is also a loss of cross-period comparability as a result of changes in the methodology for calculating the relevant indicators, making comparative analysis impossible and making it difficult to assess the dynamics of the socio-economic process under study.

In order to eliminate the influence of cost factors on innovation performance of this study, we have proposed a simple model including 5 indicators, taking into account the problems mentioned above:

– level of innovation activity of organizations, % (var1);

– proportion of organizations that implemented technological innovation in the total number of organizations under study, % (var2);

– proportion of innovative goods, works and services in the total volume of shipped goods, works and services, % (var3);

– proportion of innovation activities costs in the total volume of goods shipped, work performed and services rendered, % (var4);

– advanced manufacturing technologies used, units (var5).

Three of the proposed indicators reflect the process function, the other two reflect the resource function and the output function.

The proposed model differs fundamentally from the mentioned above because it does not involve a ranking of regions. But it is aimed at solving the problem of grouping regions with similar innovation parameters.

The use of predominantly relative indicators made it possible to include the data on Moscow and St. Petersburg, which absolute values of innovation indicators differ significantly from those of the other regions. To avoid double counting, the included larger regions (Nenets Autonomous District within the Arkhangelsk region, Khanty-Mansi and Yamal-Nenets Autonomous Districts within the Tyumen region) were not separately identified. As a result, 82 regions were included in the study.

In order to make the indicators with different units comparable, the standardized values of the parameters under study were calculated based on the maximum and minimum values of each indicator in the sample. We should note that all the indicators included in the model have the same vector – the higher the values of the indicator, the better the result.

The analyzed time period – eight years (from 2014 to 2021) – passes through different phases of the economic cycle. The years 2014 and 2015 are distinguished by a wide range of crisis phenomena (the global financial crisis, the introduction of anti-Russian sanctions, the depreciation of the rouble). The years 2016-2019 provided the relative stabilization and normalization of the economy. 2020 is the pandemic year of Covid-19 coronavirus infection. 2021 is the year of recovery from the pandemic and the last year for which the necessary statistics were available at the time of the study.

We used the average values of the indicators for the analyzed period for each region, as well as the values of the indicators by year and by phase of the period under study. The resulting dataset is a matrix of 5 x 82 (five indicators for each of the 82 regions).

We used clustering and k-means methods to cluster the regions. The k-means method (according to M.S. Oldenderfer) implies performing a certain sequence of actions that will allow us to divide the initial data array into a predetermined number of groups that are homogeneous according to the selected criteria.

The process is iterative. We separate the raw data into a number of clusters (5 in our case); for each cluster we define an 'economic power center'; place each point in the cluster with the nearest economic power center; calculate new 'economic power centers' of the clusters. In this way we look through all the array data without replacing clusters with new ones. The iterations take place until the composition of the clusters no longer changes. According to M.S. Oldenderfer, this procedure minimizes the variance within clusters.

We grouped the regions into clusters using MS Excel and Statistics 12.

**Results**

The analysis allowed for statistically significant identification of five virtual clusters, which were named «A», «B», «C», «D», «E». The clusters are distinguished by a decrease in the overall value of the results calculated using standardized indicators.

An F-criterion was used to assess the homogeneity of the clusters, and a p-criterion was used to assess the significance of the mean values (Table 1).

**Table 1** – Cluster analysis of variance (for the period 2014-2021)

| Indicators | Between | cc | Inside | cc | F-criterion | Relevance |
|---|---|---|---|---|---|---|
| Var1 | 2.187589 | 4 | 0.872277 | 77 | 48.27722 | 0.000000 |
| Var2 | 2.466732 | 4 | 0.671443 | 77 | 70.72017 | 0.000000 |
| Var3 | 1.818610 | 4 | 1.116050 | 77 | 31.36800 | 0.000000 |
| Var4 | 2.298859 | 4 | 1.068980 | 77 | 41.39743 | 0.000000 |

| Indicators | Between | cc | Inside | cc | F-criterion | Relevance |
|---|---|---|---|---|---|---|
| Var5 | 1.614624 | 4 | 1.586666 | 77 | 19.58919 | 0.000000 |

*Source: calculated by authors*

As can be seen, the statistical characteristics of the clusters satisfy the requirements of homogeneity and significance.

The values of the standardized cluster indicators are shown in Table 2 and their graphical interpretation is in Figure 1.

**Table 2** – Average standardized values of indicators of innovation activity of virtual clusters of regions (for the period 2014-2021)

| Indicators | Clusters | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Var 1 | 0.774990 | 0.527671 | 0.310176 | 0.389125 | 0.194303 |
| Var 2 | 0.823853 | 0.544738 | 0.321333 | 0.416223 | 0.199217 |
| Var 3 | 0.562187 | 0.347433 | 0.164270 | 0.144382 | 0.052773 |
| Var 4 | 0.589178 | 0.371734 | 0.347811 | 0.101433 | 0.073995 |
| Var 5 | 0.538206 | 0.263024 | 0.167730 | 0.076829 | 0.042457 |

*Source: calculated by authors according to Rosstat (2014-2021)*

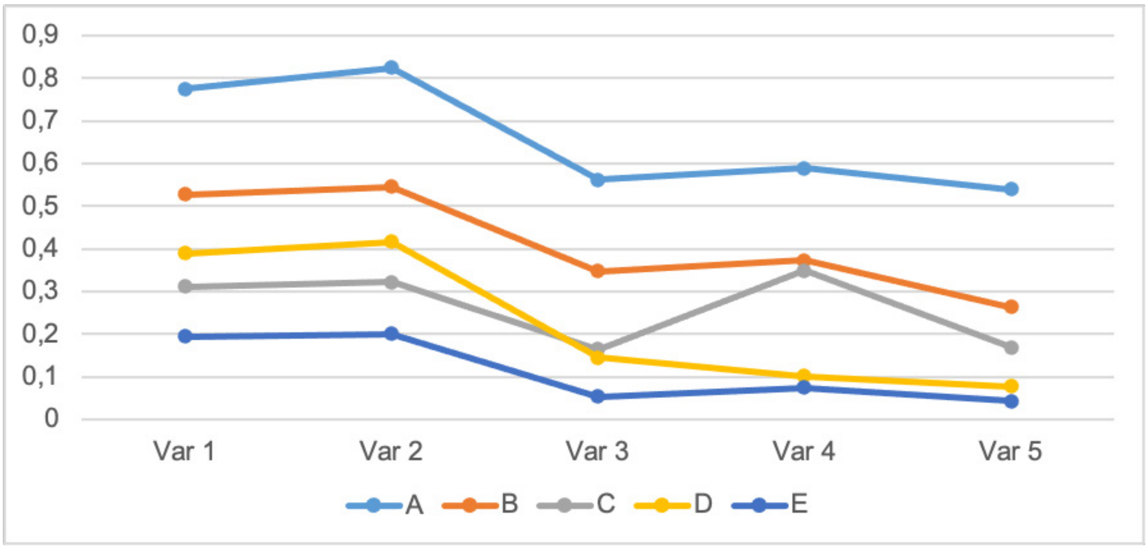



**Figure 1.** Main characteristics of cluster innovation development, (horizontally – Indicators; vertically – their average standardized values)

*Source: calculated by authors according to Rosstat (2014-2021)*

It should be noted that the clusters differ significantly by the parameters of innovative development studied.

Cluster «A» includes: Moscow and the Moscow Region, St. Petersburg, the Republic of Mordovia, the Republic of Tatarstan, the Chuvash Republic and the Nizhny Novgorod Region.

Cluster A is almost six times ahead of the weakest cluster E in terms of total standardized indicators. It is the undisputed leader for all indicators investigated. Nevertheless, the overall level of innovative development of the cluster is low. Even according to the normalized value of the parameter maximum for the cluster (0.83), it is still quite far from the maximum possible value of 1.0.

Cluster «A» is rather «amorphous». The distance of the representative region (St. Petersburg) to the cluster centre is 0.10.

Cluster B includes 20 regions, including eight regions in the Central Federal District (the Belgorod, Vladimir, Voronezh, Lipetsk, Ryazan, Tver, Tula and Yaroslavl regions), one region in the Southern Federal

District – the Rostov region, seven regions in the Volga Federal District (the Republic of Bashkortostan, Udmurt Republic, Perm Krai, Kirov, Penza, Samara and Ulyanovsk regions), two regions of the Ural Federal District (Sverdlovsk and Chelyabinsk regions), and one region each of the Siberian (Tomsk region) and Far Eastern (Khabarovsk Krai) autonomous districts.

It is more than 1.5 times behind the leader's cluster in terms of the total value of parameters. This lag is evenly distributed across all the studied parameters.

The representative region of the cluster is the Yaroslavl region.

Cluster C consists of 14 regions: Tambov (CFD) and Leningrad (NWFD) regions; Krasnodar Krai and Volgograd region (SFD); Stavropol Krai (NCFD); the Orenburg and Saratov regions (PFD); Tyumen region (UrFD); Altai Republic, Krasnoyarsk Krai, Irkutsk and Omsk regions (SFD) and the Republic of Buryatia and Sakhalin region (FDD).

The representative region of the cluster is the Volgograd region.

Cluster C is 2.5 times behind the leading cluster. The parameters of the cluster are developed unevenly. In terms of indicators var3 – var5, it ranks in the middle third position, and in the first two var1 and var2, it lags significantly behind even the generally weaker innovation cluster «D». At the same time, the cluster's strongest position is the specific ratio of expenditure on innovative activities to the total volume of goods shipped, work performed, and services rendered. The value of this cluster parameter is insignificantly lower than the corresponding parameter of cluster B.

Cluster «D» is the most numerous. It includes 23 regions, namely the Bryansk, Ivanovo, Kaluga, Kursk, Orel and Smolensk regions (CFD); the Vologda, Murmansk, Novgorod and Pskov regions (NWFD); the Republic of Adygea (Adygeya), Astrakhan region and Sevastopol city (SFD); the Republic of Ingushetia (North Caucasus); the Republic of Mari El (PFD); Kurgan region (UrFD); and the Altai Republic (Ural). Sevastopol city (SFD); Republic of Ingushetia (SFD), Republic of Mari El (PFD); Kurgan region (SFD); Altai Krai and Novosibirsk region (SFD), Republic of Sakha (Yakutia), Kamchatka and Primorsky Krai, Magadan region and Chukotka Autonomous District (FDD).

The representative region is Murmansk region.

Cluster «D» holds an average position by indicators var1 and var2, and by indicators var3 – var5 it loses to cluster «C», while by the specific ratio of innovative goods, works and services to the total volume of shipped goods, works and services the gap is quite insignificant.

The most powerful cluster position is the share of organizations that have implemented technological innovations in the total number of organizations under study.

Cluster E, consisting of 18 territories, is an innovative outsider. Kaliningrad region is its representative region.

Since cluster representative regions characterize the respective clusters in the best possible way, they can be used to predict the indicators under study. We will conduct trend analysis based on correlation and regression analysis using the example of the Yaroslavl region. We will use the capabilities of MS Excel to calculate the dynamics of indicators by five functions integrated into the program: linear, polynomial, power, logarithmic and exponential.

Table 3 and Figures 2-6 present the values and graphical representation of innovation development indicators for the Yaroslavl region.

**Table 3** – Indicators of innovation development in the Yaroslavl region in 2010-2021

| Indicators | Years | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| Var1, % | 10.0 | 12.0 | 12.3 | 11.0 | 10.3 | 8.7 | 7.1 | 8.3 | 14.2 | 10.6 | 10.7 | 12.8 |
| Var2, % | 8.7 | 10.7 | 11.2 | 9.8 | 9.6 | 7.5 | 6.4 | 7.1 | 25.6 | 24.6 | 23.6 | 24.1 |
| Var3, % | 12.1 | 11.4 | 15.1 | 9.3 | 10.5 | 7.0 | 14.9 | 12.2 | 12.8 | 6.0 | 5.4 | 5.0 |
| Var4, % | 6.3 | 6.7 | 6.6 | 5.4 | 6.3 | 4.5 | 1.8 | 1.5 | 1.2 | 1.3 | 1.6 | 2.1 |

| Indicators | Years | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| Var5, units. | 3267 | 2642 | 2675 | 2841 | 2889 | 2815 | 2962 | 2874 | 2851 | 3132 | 3235 | 3511 |

*Source: composed by authors according to Rosstat (2010-2021)*

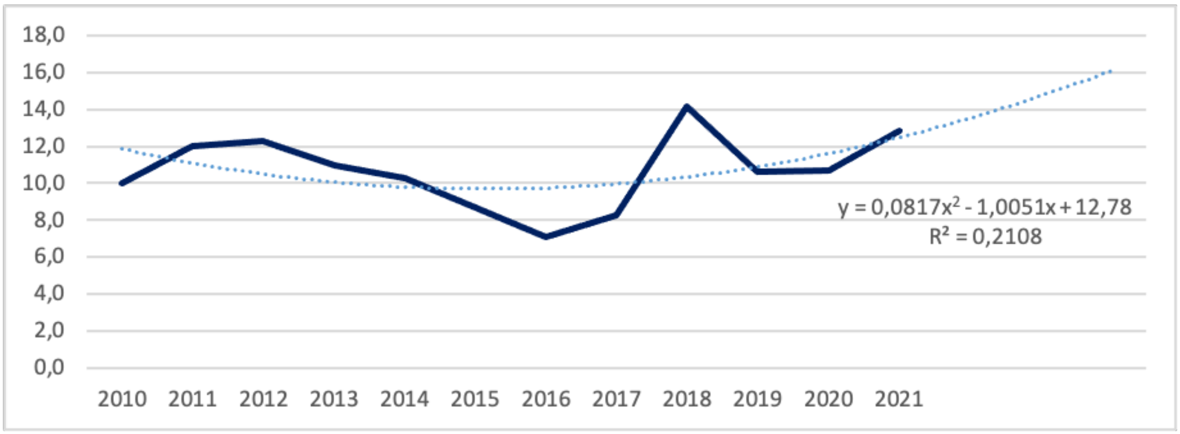
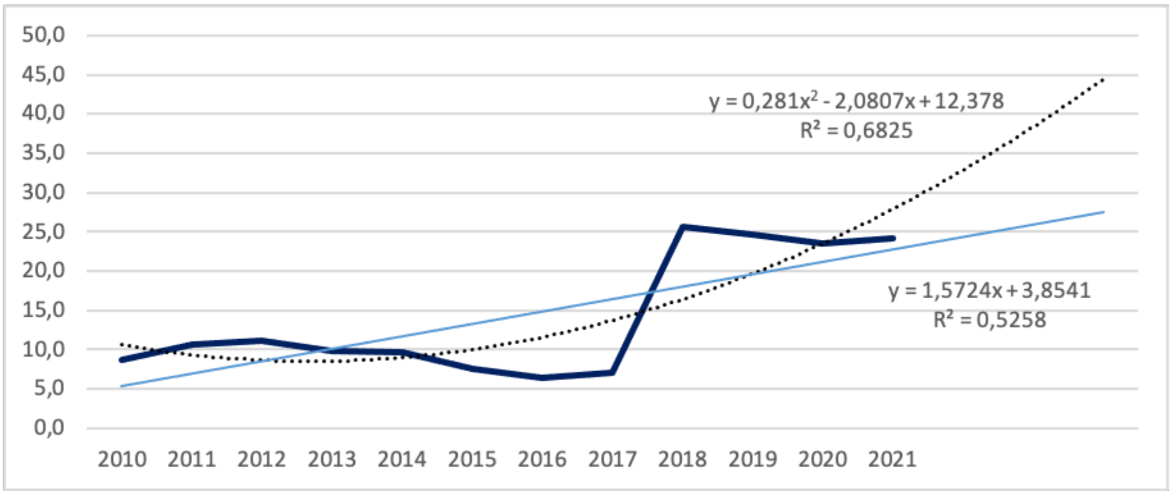



**Figure 2.** Level of organizations innovation activity in Yaroslavl region in 2010-2021, %
*Source: composed by authors according to Rosstat (2010-2021)*

The dynamics of the level of organizations innovation activity in the Yaroslavl region are highly variable. The polynomial (second-degree) function has the highest coefficient of determination. $R^2$ = 0.2108, which indicates that the function is unstable and does not allow predictions to be made with sufficient reliability.




—— linear, ······· polynomial
**Figure 3.** Specific ratio of organizations that implemented technological innovations to the total number of surveyed organizations in the Yaroslavl region in 2010-2021, %
*Source: composed by authors according to Rosstat (2010-2021)*

Throughout 2010-2017, the share of organizations engaged in technological innovation in the Yaroslavl region was relatively stable with a slight downward trend. However, in 2018 there was a dramatic jump (almost 5 times) followed by a gradual slight decrease of the indicator.

The dynamics of var2 can be reliably described by polynomial and linear functions. The other functions have a low coefficient of determination.

Figure 3 shows that the var2 forecast based on the polynomial function is more optimistic than the linear forecast. In this case, the forecast based on the polynomial function can be considered more reliable ($R^2$ = 0.6825).

The actual and forecasted dynamics of the specific ratio of innovative goods, works and services to the total volume of shipped goods, works and services (var3) are presented on Figure 4. According to the polynomial function equation, the indicator value will be 32.8% in 2022, 38.3% in 2023, and will reach 44.4% in 2024. The linear forecast is 24.3%; 25.9% and 27.4%, respectively.

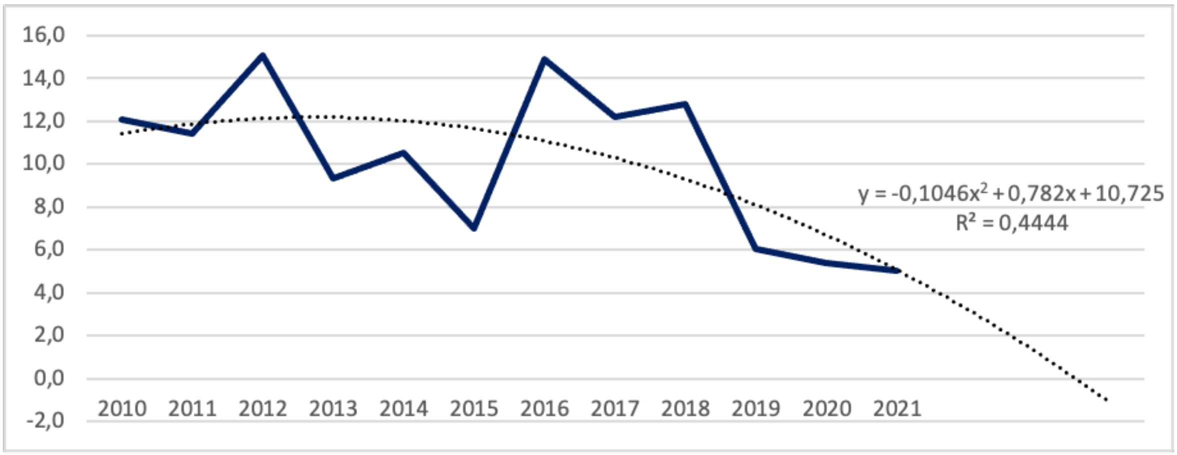


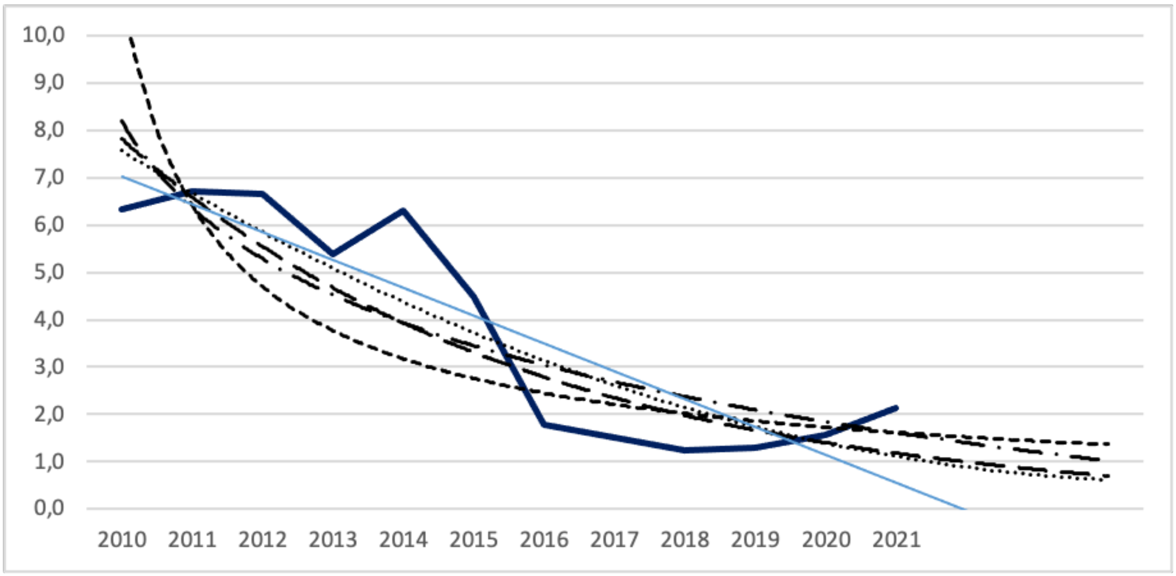

**Figure 4.** Specific ratio of innovative goods, works and services to total volume of shipped goods, works and services in Yaroslavl region in 2010-2021, %

*Source: composed by authors according to Rosstat (2010-2021)*

The Var3 indicator has shown a dramatic jump over the period under study. From 2012 to 2015, the indicator dropped by more than half, from 15.1% to 7.0%, and in 2016 it practically returned to the 2012 value. Thereafter, it decreased again. The overall decline was from 12.1% in 2010 to 5.0% in 2021.

The polynomial function has a maximum R2 value, but this is insufficient to make reliable forecasts even in the short term.

The dynamics of the specific ratio of expenditure on innovative activities in the total volume of goods shipped, work performed and services rendered in the Yaroslavl region (var 4) is shown on Figure 5.




— linear, – – – exponential, - - - -power, ······· polynomial,
– – Logarithmic function

**Figure 5.** Specific ratio of expenditure on innovation in the total volume of goods shipped, work performed and services rendered in the Yaroslavl region in 2010-2021, %

*Source: composed by authors according to Rosstat (2010-2021)*

The var4 indicator showed an unstable trend between 2010 and 2014, and has been declining since 2014, reaching a critical low of 1% by 2018-2019. In the last two years, the value of the indicator has increased marginally.

The dynamics of var4 can be described with a high degree of confidence by all five functions.

Linear: $y = -0.5872x + 7.5989$; $R^2 = 0.7927$;
Exponential: $y = 9.845e^{-0,172x}$; $R^2 = 0.7446$;
Logarithmic: $y = -2.649\ln(x) + 8.1943$; $R^2 = 0.709$;
Polynomial: $y = 0.0303x^2 - 0.9807x + 8.5173$; $R^2 = 0.8124$;
Power: $y = 10.928x^{-0,769}$; $R^2 = 0.6544$;

All functions give a forecast with the various degrees of pessimism. The least pessimistic are the power and logarithmic functions, the most pessimistic are the exponential and polynomial functions (Table 3). The polynomial function has the highest coefficient of determination, which allows us to consider polynomial development as the most probable.

Despite the high value of the coefficient of determination of the linear function in this case it cannot be used, as it gives negative values.

**Table 3** – Estimated forecast values of var4, %

| Function | Years | | |
|---|---|---|---|
| | 2022 | 2023 | 2024 |
| Power function | 1.520261 | 1.436046 | 1.361841 |
| Logarithmic function | 1.399749 | 1.203437 | 1.020675 |
| Exponential function | 0.992376 | 0.83556 | 0.703524 |
| Polynomial function | 0.8889 | 0.7263 | 0.6243 |

*Source: calculated by authors according to Rosstat (2010-2021)*

The actual and forecasted dynamics of advanced production technologies (var6) in use in the Yaroslavl region are shown in Figure 6.

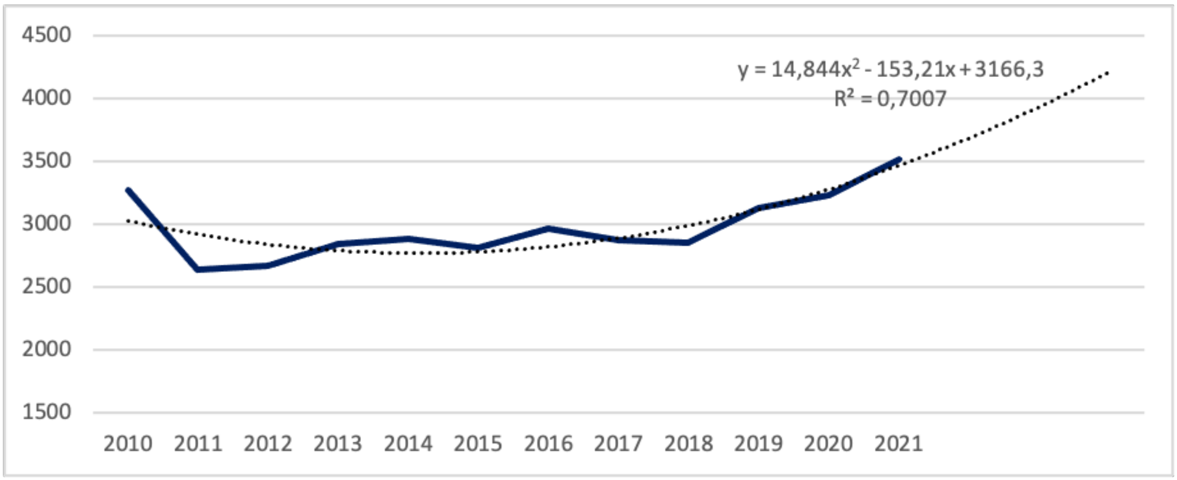



**Figure 6.** Advanced manufacturing technologies in use in Yaroslavl region in 2010-2021, units
*Source: composed by authors according to Rosstat (2010-2021)*

The var5 indicator shows an unstable increase throughout the study period. Only the polynomial function has a sufficient level of reliability (R2 = 0.7007).

The number of advanced manufacturing technologies in use is forecast to reach 3,683.2 units in 2022, 3,930.8 units in 2023 and 4,208.0 units in 2024.

As can be seen, of the five indicators examined, only two can give a positive prognosis with a sufficient degree of certainty.

**Conclusions**

The results of this analysis suggest that despite the elaboration and implementation of strategic documents aimed at ensuring innovative development, the level of innovative development of the country's regions is still rather low.

The virtual clustering method allowed us to identify five clusters with similar innovation development parameters over the period 2014-2021. The most innovation-active cluster «A» includes only eight regions. The other clusters lag many times behind the leader in the studied parameters. Thus, the gap between Cluster A and Cluster B (which includes 20 regions) is 1.6 times, Cluster C (14 regions) lags behind Cluster A 2.5 times, while Cluster D (23 regions) lags behind almost 3 times and Cluster E (18 regions) lags behind 6 times.

All clusters (except for «C») have the highest values of the indicator «specific ratio of organizations that implemented technological innovations in the total number of surveyed organizations». For cluster «C», the most developed indicator is «the specific ratio of expenditures on innovation activities to the total volume of shipped goods, performed works and services».

The following representative regions were selected for the clusters: St. Petersburg (cluster A), Yaroslavl region (cluster B), Volgograd region (cluster C), Murmansk region (cluster D), and Kaliningrad region (cluster E).

Analysis of the model region of cluster B – Yaroslavl region – allowed us to conclude that the region failed to achieve sustainable positive dynamics for the studied indicators over the period of 2010-2021. We revealed the positive trends in the share of organizations that implemented technological innovation in the total number of organizations surveyed and the number of advanced production technologies used. The forecast of changes corresponding to the specific ratio of expenditures on innovation activities in the total volume of shipped goods, performed works and services is pessimistic. For the other indicators, reliable forecasting of the dynamics is impossible due to the significant variability of their values during the period under study.

We should note that for the successful implementation of innovative development of the regions (especially those that are not innovatively active), it is necessary to develop a mechanism for supporting the innovative activities aimed at the production and implementation of innovations both at the federal and regional levels.

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