Assessment of Innovative Sustainability of Northern Resource-type Regions

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Abstract: The article is devoted to assessing the innovative sustainability of the regional innovation system. The research is reviewed and the concept of "sustainable development" is studied. It is noted that the country's sustainable economic development largely depends on the best possible development and effective functioning of the national innovation system, which is based on regional innovation systems. The methodological and procedural bases for assessing the innovative sustainability of Russian regions are studied. The system of main indicators in innovations is determined and the integral ranking of the northern resource-type regions' innovative development level for the period from 2010 to 2019 is performed. According to the ranking results, the regions are differentiated into three categories according to the innovative development level. Based on the method of calculating the variation coefficient for a random variable, which is widely used in probability and statistics, the authors propose a similar method for determining a region's innovative sustainability level by the coefficient of innovative sustainability, which is calculated using the composite index of the region's innovative development for the considered period. It is established that in northern resource-type regions, there is mainly a sustainable favourable innovative development, except for the Sakhalin Region, which has low innovative sustainability.

1 INTRODUCTION

Currently, the term "sustainable development" is widely used by economic researchers. Sustainability in a broad sense is understood as the ability of a system to return to an equilibrium position after it has been unbalanced under external or internal disturbing influences (Lukyanov et al., 2013).

The very concept of "sustainable development" was formulated in 1987 in the report of the UN World Commission on Environment and Development "Our Common Future", known as the report by G. Brundtland (Brundtland, 1987). According to this report, sustainable development is a development in which society meets its present needs and doesn't jeopardize future generations' ability to meet their needs. Sustainability of development is achieved by three interrelated core factors being developed: economic, social and environmental.

In Russia, the regulation "On the Concept of the Transition of the Russian Federation to Sustainable Development" (Decree of the President of the Russian Federation, 1996) determines the main tasks for a consistent transition to sustainable development, ensuring the solution of socio-economic tasks and problems of preserving a favourable environment and natural resource potential in order to meet current and future generations' needs.

In general, the concept of "sustainable development" includes the principles of viability and balance, while economic growth is associated with the country's dominant economic goals (including innovative factors), with its citizens' well-being: with the social development, with the state of the labour

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market and other factors (Kryukova et al., 2020). Various interpretations of the concept of "the region's sustainable development" are reviewed in the works (Kalinchikov, 2005; Gabidullina, 2020). According to the authors of the article (Bukreyev, Pshenichnykh, 2018), the region's sustainable socio-economic development is a development of the territory as a system of equal elements (man, nature, society), which, in response to the impact of environmental factors, contributes to the preservation of the system, restoring its balance, maintaining the state, type of functioning, its qualitative improvement at a new stage of development.

The analysis and assessment of the sustainability of innovative development of industrial enterprises in the region are considered in the work by Yashin S.N. and Korobov Yu.S. (Yashin, Korobov, 2017). According to the authors, the sustainability of innovative development of an enterprise is the ability of its economic system to set and maintain the necessary rates and parameters of innovative and general development in a dynamically changing macro- and micro-environment over a certain period. The higher the integral innovation index of the enterprise, the higher the sustainability of innovative development in the regional industrial sector.

It is well known that the country's sustainable economic development largely depends on how well and effectively the national innovation system is developed and functioning, the basis of which is regional innovation systems (RIS). RIS is designed to ensure the implementation of tasks of the national innovation policy in a particular region. To recognize regions as subjects of sustainable development requires activating the formation of RIS as a key component of sustainable development. The region's transition to sustainable development is impossible without the development of appropriate policies of regional authorities oriented to ensuring an effective innovation subsystem (Badmayev, 2015).

Innovative sustainability can be considered as one of the characteristic features of successful innovative development of the socio-economic system. The innovative sustainability of the regional socio-economic system should be understood as the ability of the system to generate intellectual property objects over a certain period, followed by their introduction in producing sector in order to significantly change the structure of the industry and develop new technological production. Innovative sustainability shows the strength and reliability of RIS, its dynamic balance, as well as its ability to withstand internal and external negative influences. Assessing regional innovative sustainability can be performed by the modified methodology of the Data Envelope Analysis. Herewith, the result of this approach is the calculated deviation of the actual value from the established standard (Charnes at all, 1994; Morgunov and Morgunova; 2003; Ruiga, 2015; 2017; Ruiga et al., 2019). This approach is rather labour-intensive due to the necessity to form a system of threshold values for indicating innovative development to determine correctly the quantitative parameters of the standard. For this reason, ranking based on forming a composite index of the region's innovative development can be considered the most simple and statistically reliable method of assessing the region's innovative sustainability.

2 METHODOLOGY OF RESEARCH

Assessment of the region's innovation potential based on constant monitoring of changes in its indicators is necessary for determining the level of regional innovative development of the economy and making various organizational and managerial decisions by local public authorities.

Currently, various methods and models for assessing the level of the region's innovative development are proposed in Russia (Barinova & Zemtsov, 2016; Bortnik et al., 2013; Il'ina et al., 2018; Lisina, 2012; Makaruk, 2017; Mityakov et al., 2017). Despite numerous studies in this area, there is no one-size-fits-all approach to assessing the innovation index (Mityakov et al., 2017).

There is also the author's method of rapid assessment of the region's innovative development based on the Triple Helix model, which allows performing a comparative econometric assessment of the region's innovative development level, as well as the contribution of academic organizations, business and the state to the overall innovative development of the economic entity according to their minimum statistical key figures in scientific and innovative activity (Egorov, 2017; Egorov at el., 2019).

Methodological issues of forming Russian regions' innovative development ranking are discussed in detail in the works (Mikheyeva, 2013; Yashin end Korobova, 2017). Currently, the Association of Innovative Russian Regions (AIRR) (Rating of Innovative Development of Russian Regions, 2018) and the Higher School of Economics (HSE) (Russian Regional Innovation Development Ranking, 2020) are mainly engaged in preparing the

assessment system for a region's innovative development.

The 2018 AIRR ranking includes 29 indicators. The developed analytical ranking system allows the regional authorities to clearly show their strengths and weaknesses, directions for further development and improvement of innovation systems, as well as the dynamics of changes in all areas reflected by the indicators.

The HSE ranking system is based on the original system of quantitative and qualitative indicators of the region's innovative development, which meets modern statistical standards applied both in Russian state statistics and in leading countries and international organizations. It also integrates indicators used in similar developments of the European Commission (Regional Innovation Scoreboard). The developed ranking is the result of ranking 85 Russian regional subjects in descending order by 53 innovation indicators grouped into five thematic blocks: socio-economic conditions, scientific and technical potential, innovation activity, export activity and the quality of regional innovation policy, each of which has its own sub-ranking.

When selecting indicators, their quantity required for the assessment is equally important. On the one hand, they should be enough for the assessment to be comprehensive and objective, on the other hand, their number should be limited by importance and significance for the sustainable development goals of a particular region (Alferova, 2020).

The main problem in determining the region's innovative development level is the lack of a scientifically based, necessary and sufficient number of indicators to assess the effectiveness of regional innovation processes. The analysis of management requirements shows that in order to improve the efficiency of managerial decisions in innovations, it is necessary to identify 15-20 indicators, on the basis of which the region's innovative development is assessed (Lisina, 2012).

We should also take into account the fact that by increasing the number of indicators, we are expanding the boundaries of the review, but at the same time, we are blurring the benchmarks in assessing the most significant aspects for achieving sustainable development (Tanguay and etc., 2010).

Given the above, the authors propose the following methodological approach (algorithm) for assessing the sustainability of the region's innovative development or a regional innovation system (RIS).

Ranking the region's innovative development level is based on three aggregative blocks of key indicators that characterize innovative activity. Each group of indicators includes several quantitative indicators, data on which are available on the official Internet resources of Rosstat, Rospatent and the Federal Treasury:

1. *The activity of organizations and citizens in innovations.*

– share of organizations, that implemented technological innovations, in the total number of organizations surveyed, %;

– number of employees engaged in research and development, people;

– internal costs for research and development, million rubles;

– innovation activity costs, million rubles.

2. *The effectiveness of innovative activities.*

–number of patents granted for inventions, utility models and industrial designs per 10,000 employees, units;

–advanced manufacturing technologies used by the subjects of the Russian Federation, units;

–volume of innovative goods, works, and services, million rubles;

–volume of innovative goods, works and services in the total volume of goods shipped, works performed, and services provided, %.

3. *The national policy of the region in the development of RIS.*

–share of public funds in internal research and development expenditures, %;

–expenses of the consolidated budget of the subject of the Russian Federation for scientific research, million rubles.

The subjects of the northern resource-type regions are ranked in descending order by an integral ranking score from 0 to 1 using the methodology of limitation of the annual indicators of the region's innovative development (Rating of the socio-economic situation of the subjects of the Russian Federation, 2019)

In this paper, the assessment of the region's innovative development was performed for the northern resource-type regions (NRTR) over 2010-2019. The general review shows that resource-type regions are regions characterized not only by high resourcing but also a certain degree of resource dependence. The authors assigned the subjects to northern resource-type regions by estimating the Far North regions' resource dependence by share of statistical indicators for Foreign Economic Activities of Mining and Quarrying (FEA MQ) in the Gross Regional Product (GRP) structure of the subject, they determine the following criteria for assigning a subject to the resource-type regions (Egorov, Kovrov, 2020):

Highly dependent – more than 50% of FEA MQ in the GRP structure of the subject.

Moderately dependent – from 21.4% to 50%;

Independent – under 21.4%.

After the obtained results of the regions' resource dependence analyzed and in accordance with the criteria proposed by the authors for classifying a subject as a resource-type region, the following 8 subjects of the Far North are proposed to be considered northern resource-type regions: the Republic of Komi; the Nenets Autonomous Okrug (NAO); the Khanty-Mansi Autonomous Okrug–Yugra (KhMAO); the Yamalo-Nenets Autonomous Okrug (YaNAO); the Republic of Sakha (Yakutia); the Magadan Region; the Sakhalin Region and the Chukotka Autonomous Okrug (CHAO).

At the second stage, to assess the region's innovative sustainability basing on the combined integral index values, the authors calculated the innovative sustainability coefficient of (Csust) RIS. For this purpose, the variation coefficient of a random variable widely used in statistical theory is taken. Variation coefficient V is a relative index of variability and is the ratio of the standard deviation (δ) to the arithmetic mean ($\bar{x}$), expressed as a percentage (Variation coefficient):

$$V = \delta/\bar{x} * 100 \quad (1)$$

It should be noted that the variation coefficient can be used to determine the sustainability of the forecasting model. V's gradual decreasing on the totality of forecast values from period to period indicates the sustainability of the forecasting model as a system. An increase in this indicator signals a loss of its sustainability. (Zaporozhets). In this regard, the authors propose to use the formula (1) to calculate the innovative sustainability coefficient (Csust) of RIS.

3 RESULTS OF RESEARCH

In accordance with the proposed methodology and with the selected indicators, the calculations of the innovative development indices by year and region and the composite index of innovative development were performed and resulted in an integral ranking of the northern resource-type regions by the level of innovative development, they are illustrated in a normalized form from 0 to 1 (Fig. 1).

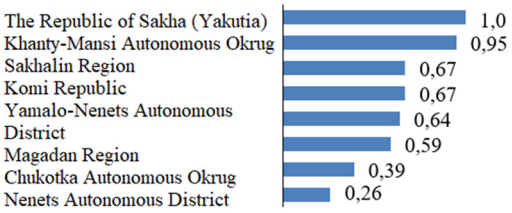

Figure 1: Ranking of the northern resource-type regions by the integral index of innovative development.

The analysis of the figure shows that the Republic of Sakha (Yakutia) and the Khanty-Mansi Autonomous Okrug have a high level of the region's innovative development (Fig. 2).

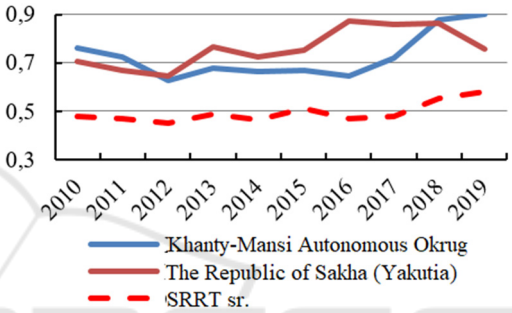

Figure 2: Regions with a high level of innovative development.

The average level of the region's innovative development is observed in the Sakhalin Region, the Komi Republic, the Yamalo-Nenets Autonomous Okrug and the Magadan Region (Fig. 3). This group of regions is characterized by large variations in the dynamics of the integral index development and comparable levels with the average value for the macroregion.

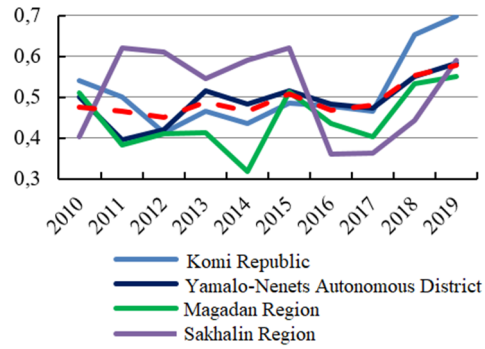

Figure 3: Regions with an average level of innovative development.

The Chukotka and Nenets Autonomous Okrugs are ranked last, with a low level of innovative development (Fig. 4).

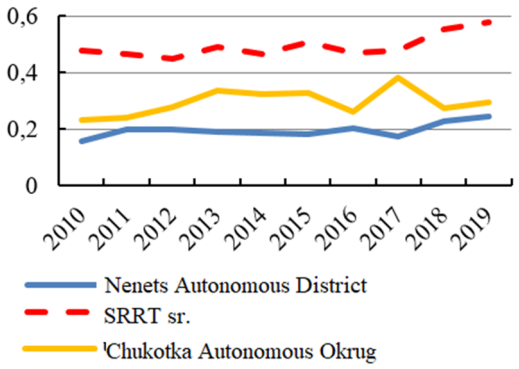

Figure 4: Regions with a low level of innovative development.

The innovative sustainability coefficient (C_{sust}) of the northern resource-type regions for the period of 2010-2019 is calculated by the formula (1) and presented in Table 1.

Table 1: Innovative sustainability coefficient (C_{sust}), %.

Northern resource-type regions	Csust, %
Republic of Komi	17.20
Nenets Autonomous Okrug	12.43
Khanty-Mansi Autonomous Okrug	12.41
Yamalo-Nenets Autonomous Okrug	10.69
Republic of Sakha (Yakutia)	10.12
Magadan Region	16.16
Sakhalin Region	20.26
Chukotka Autonomous Okrug	15.01

Source: compiled by the authors.

The obtained values of the C_{sust} indicator determine criteria for assessing the level of innovative sustainability of RIS in the northern resource-type regions (Table 2). The C_{sust} criteria correspond to the variation coefficient accepted in statistics, the value of which determines the corresponding sustainability criteria: high, average and low.

Table 2: Criteria for assessing the level of innovative sustainability of the northern resource-type regions.

Sustainability level	Criteria C_{sust}, %	Regions
high sustainability	<10	no
average sustainability	10–20	Yakutia, Yamalo-Nenets Autonomous Okrug, Nenets Autonomous Okrug, Khanty-Mansi Autonomous Okrug, Chukotka Autonomous Okrug, Republic of Komi, Magadan Region
low sustainability	>20	Sakhalin Region

Source: compiled by the authors.

The analysis of this table shows that no region has a high level of RIS sustainability (less than 10%). All the subjects of northern resource-type regions, except Sakhalin, belong to the group with an average level of innovative sustainability (C_{sust} = 10% - 20%).

4 DISCUSSION OF THE RESULTS

The research results obtained in this article are quite reliable since it uses statistical data from official sources intended for open publication. Quantitative assessment is carried out on a system of indicators in innovations, the system can be adjusted depending on the purposes and tasks of the research.

The methodological approach proposed by the authors is based on using the variation coefficient well-known in probability and statistics. The use of formula (1) for calculating the variation coefficient shows an adequate assessment for determining the sustainability of the regions' innovative development. Therefore, according to the authors, using the variation coefficient as a coefficient of the region's innovative sustainability is quite reasonable and can be used to assess the innovative sustainability not only of regions but also for other economic sectors and social spheres with corresponding changes in the system of indicators reflecting their production and economic activities.

The main advantages of this method include the simplicity of numerical calculations based on the standard Microsoft Excel platform, the use of official statistical data which exclude subjectivity that occurs when different weighing coefficients are used.

5 CONCLUSIONS

The innovative development of the northern resource-type regions for the period from 2010 to 2019 was ranked by using the selected key indicators. The authors propose a method for determining the level of the region's innovative sustainability by the value of the innovative sustainability coefficient, which is calculated according to the data of the composite index of the region's innovative development.

According to the research results, it can be concluded that the ranking system based on the formation of a composite index of innovative development can be used to assess the level of innovative sustainability of RIS. At the same time, the variation coefficient in the dynamics of the development of the consolidated level of the region's innovative development can be taken as the coefficient of innovative sustainability of RIS.

Besides the regional authorities, various economic and social entities can use the research results to monitor and forecast the innovative development of their sector, as well as to adjust the existing legal documents relating to innovation policy.

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