

Evaluating the Level of Innovation Activity of the Regional Economic System

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Abstract—The article describes the essence of the "innovative activity" category, the main characteristic of which is the intensity of activity on developing, implementing and diffusing various innovations. The article suggests methodology for estimating the level of innovation activity of the regional economic system, based on the method of integral rating analysis. Voronezh region was chosen as the object of analysis. It has been established that the regional economic system under analysis has the average level of innovative activity, with unsustainable dynamics. The major problem of the region is related to the insufficient use of the existing high innovation potential.

Keywords—*innovations; regional economic system; innovative development; innovative activity; integral rating analysis*

I. INTRODUCTION

In the process of evolution of the modern paradigm, which harmoniously connects the economic growth with preservation of the environment and formation of favorable social sphere, the innovations become a fundamental factor. It's their effective use in various fields of economy and social sphere that pertains to the adaptation of the domestic economy to the new technological revolution (Industry 4.0) and the establishment of "the markets of the future," which, in accordance with long-term forecasts, will determine the structure of the world economy. [1]

The Russian economy's movement along the innovation path directly depends on the extent of the progress of constituent entities of the Russian Federation in the field of innovation. It's obvious that the development of the regional economic system is determined by its ability to create favorable conditions for designing, diffusion and subsequent use of innovations, revitalizing of research and educational activities. Under these conditions, choosing the innovation scenario of socio-economic development as a priority by the majority of constituent entities of the Russian Federation makes sense. To ensure achieving the set goals and solving specific tasks concerning realization of the innovation vector of development of national and regional economy, the corresponding theoretical framework and methodological toolbox are required.

One of the most important aspects of assessing the level of innovativeness of the regional economic system is the analysis of its innovative activity. It is not by chance that one of the three main goals in the State Programme of the Russian Federation "Economic development and innovation economy," approved by RF Government Regulation No. 316 dated April 15, 2014, is the enhancement of innovative activity of businesses [2], and the May decrees of the RF President set forth the task to increase the number of organizations implementing technological innovations to 50% of their total number. [3] Moreover, the timely assessment of innovative activity of the regional economic systems allows for identification of growth points, negative trends, determination of optimal balance between traditional and innovative directions of development, as well as, their adjustment. [4] In this regard, the questions of development of methodology for assessing the innovative activity of the regional economic system are of relevance and considerable socio-economic significance at the level of both separate constituent entities of the Russian Federation, and the country as a whole.

II. METHODOLOGICAL APPROACH TO ASSESSING THE LEVEL OF INNOVATIVE ACTIVITY OF THE REGIONAL ECONOMIC SYSTEM

The performed research has shown that the understanding of the term "innovative activity," as concerns the national economic literature, is controversial. The identification of this concept as a basic category and its use in managerial practice make it possible to establish favorable conditions for speedy transition to the competitive innovation economy. The group of authors under the guidance of Russian academician, L.I. Abalkin, stated that the innovative activity is the dynamic, goal-oriented activity for designing, absorption in production and commercialization of product-related, process-related, organizational and managerial novelties so that an innovatively-active enterprise could gain commercial profit and competitive advantages. [5] By innovative activity A.A. Trifilova means the intensive manner in which the economic entities perform the activities for development and attraction of new technologies or improved products in the economic turnover. [6] In the works of O.N. Melnikov and V.N. Shuvalov the innovative activity is associated with productive work (creative energy)

of producers of goods or a service expressed in achieving the demand-driven increments in the novelty of technical-and-technological, economic, organizational, managerial, social, psychological and other indicators of the processes, goods or services offered to the market and produced by specialists in competitive times. [7] A.N. Bokach, A.A. Orlova and A.A. Khomyakova mention that, along with the innovatively-active enterprises, the innovative activity of the regions and the country as a whole is made up by the public sector by providing a regulatory framework and the educational system through scientific laboratories, innovation incubators, technology parks and innovation centers. [8] I.V. Matuzova, while defining the innovative activity as a complex characteristic trait of innovative work, made a focus on its main characteristics at the regional level:

- at the core of innovative activity is the innovative work involving scientific and technological activities for development, implementation and diffusion of innovations;
- the degree of intensity of innovative activity depends on the level of innovative capacity;
- the scope and effectiveness of innovative activity are determined by the state of innovation climate.

The result was that the author defined the innovative activity of the region as a dynamic characteristic trait of innovative work performed by the municipal authorities on planning, organization and implementation of innovative process for release of competitive products, the intensity of which depends on the level of innovative capacity of private capital and the population, and the effectiveness is defined by presence of favorable innovation climate. [9] While agreeing with the majority of researches on the fact that, as investment activity of the regional economic system, the complex characteristics of its innovative work should be understood, we accept the R.S. Petrov's viewpoint, according to which the innovative activity is also defined by the ability to mobilize scientific, human resource, investment, common resource, information potential and others and implies the degree of intensity of work on development, absorption and diffusion of product-, process-related, organizational and managerial innovations. [10], [11]

Using recommendations for assessing the innovative activity of an enterprise offered by V.B. Artemenko [12] and the innovative activity of a region offered by S.G. Alekseev [13], we suggest the techniques for assessing the innovative activity of the regional economic system based on applying the method of integral rating analysis of innovative activity, the most important objectives of which are:

- comprehensive assessment of innovative activity of each region against a set of indices-indicators (calculation of partial and summarizing indicators);
- carrying out interregional integral rating analysis for assessing the differences in levels of innovative activity by constituent entities of the Russian Federation;

- recognition of influence of the level of innovative activity on the performance indicators of business activities in the region;
- development of practices for identification of innovative activity reserves and setting priorities for using the identified reserves in the future. [11]

In accordance with the suggested technique, at first stage the partial indicators characterizing the region's positions in the field of innovative activity are to be calculated:

- share of organizations implementing technological, organizational and marketing innovations in the total number of the surveyed organizations (J1);
- share of volume of innovative products, works and services in the total volume of shipped products, performed works and services (J2);
- ratio of the number of personnel engaged in scientific researches and developments to the work-force size of the region (J3);
- ratio of the number of issued patent applications per 1,000 persons of work-force of the region (J4);
- ratio of volume of innovative products, works and services to the expenditure on technological innovations (J5).

At the second stage, to make the assessment of innovative activity more objective, the best values of indicators in this group of regions – innovation leaders – are taken as a basis of the calculations. The best value of an indicator among the regions is assigned maximum value of 1. In relation to this indicator the calculation is performed expressed as fractions of a unit of indicator values for the remaining regions in the federal district according to formula 1:

$$J_i = \frac{K_i}{\max\{K_i\}}, \quad (1)$$

where K_i is a value of a partial indicator characterizing the particular position of a region in the area with regard to innovative activity;

$\max\{K_i\}$ is the maximum value of the corresponding indicator

This approach allows for balancing the values of the analyzed indicators and converting them into a comparable form.

At the third stage is the level of innovative activity of the region (J_{ua}):

$$J_{ua} = \sqrt[n]{\prod_1^n J_i}, \quad (2)$$

where n is the number of partial indicators.

To assess the level of innovative activity, it is recommended to employ the method based on the use of desirability function (F) and Harrington's scale (see "Table I"):

$$F = 1/e \times \sqrt[x]{e}, (3)$$

where e is the base of the natural logarithm;

x is the value of the indicator characterizing the differences of the levels of innovative activity.

F function is defined in the range from 0 to 1 and is used as a dimensionless scale, for assessing the level of innovative activity of the region. A specific economic sense related with the activity level of innovation work of the object under study is attributed to each actual value of the function. Given that the function value equaling 0 corresponds to absence of innovative activity, and function value equaling 1 corresponds to the maximum possible level of activity. The intermediate value of the function and characteristics of levels of innovation activity are presented in "Table I".

TABLE I. CHARACTERISTICS OF VALUES OF INNOVATION ACTIVITY LEVEL

Values of innovative activity levels	Characteristics of values of innovative activity level
1	Maximum level of activity
0.8	Very high level of activity
0.63	High level of activity
0.51	Average level of activity
0.37	Low level of activity
0.2	Very low level of activity
0	Absence of activity

III. RESULTS OF THE ASSESSMENT OF THE INNOVATIVE ACTIVITY LEVEL OF THE REGIONAL ECONOMIC SYSTEM

The results of the performed assessment of innovative activity of the regional economic system illustrated by the example of Voronezh Region are presented in "Table II" and "Table III". "Table II" presents the values of the partial indicators characterizing the innovative activity in Voronezh Region, the indicator values of the regions, which are the innovation leaders of the Central Federal District, and the balanced values of the analyzed indicators for Voronezh Region converted into a comparable form.

TABLE II. PARTIAL INDICATORS CHARACTERIZING THE INNOVATIVE ACTIVITY OF VORONEZH REGION AND THE INNOVATION LEADER REGIONS OF THE CENTRAL FEDERAL DISTRICT

Indicators	Indicator values							
	2010	2011	2012	2013	2014	2015	2016	2017
<i>Indicator values for Voronezh Region data</i>								
J1	8.6	9.2	9.0	10.0	10.3	11.0	11.6	11.7
J2	7.1	6.3	5.6	4.6	7.2	12.4	5.9	6.1
J3	0.0110	0.0120	0.0093	0.0093	0.0094	0.0091	0.0088	0.0091
J4	0.43	0.42	0.57	0.64	0.58	0.596	0.559	0.50
J5	4.21	1.73	2.45	1.79	3.65	5.06	3.51	2.40
<i>Indicator values for innovation leader regions of the Central Federal District</i>								
J1	13.3	18.6	18.6	18.3	18.8	20.0	19.2	18.5
J2	12.1	11.6	15.1	15.3	13.6	17.1	18.8	14.7
J3	0.0370	0.0360	0.344	0.0345	0.0334	0.03339	0.0320	0.0310
J4	1.533	1.579	1.55	1.476	1.66	1.204	1.522	1.087
J5	10.17	8.77	13.31	14.19	6.7	17.42	11.04	13.07
<i>Balanced values</i>								
J1	0.65	0.49	0.48	0.55	0.55	0.55	0.60	0.63
J2	0.59	0.54	0.37	0.30	0.53	0.73	0.31	0.41
J3	0.30	0.33	0.27	0.27	0.28	0.27	0.28	0.30
J4	0.28	0.27	0.37	0.43	0.35	0.50	0.37	0.46
J5	0.41	0.20	0.18	0.13	0.55	0.29	0.32	0.18

The dynamics of the innovative activity level values for Voronezh Region is reflected in "Table III".

TABLE III. DYNAMICS OF THE INNOVATIVE ACTIVITY LEVEL VALUES FOR VORONEZH REGION

Year	Innovative activity level	Growth rates	
		Base index	Chain index
2010	0.42	1.00	1.00
2011	0.34	0.81	0.81
2012	0.32	0.76	0.94
2013	0.30	0.71	0.94
2014	0.44	1.05	1.47
2015	0.44	1.05	1.00
2016	0.36	0.86	0.82
2017	0.36	0.86	1.00

Thus, Voronezh Region had unsteady dynamics of innovative activity in the period under consideration. According to the Harrington's scale, the area under study may be included in the group of regions with an average level of innovative activity. There are a high proportion of organizations implementing technological, organizational and marketing innovations in the region. The dynamics of the volume of innovative products, works and services is positive, the volume of corresponding goods over the period under has increased by 2.42 times. [14] Voronezh Region is characterized by considerable innovation capacity, because it has a high concentration of scientific research and educational institutions providing for conduction of fundamental research and applied developments in the fields

of innovation technologies and modern technical systems. Despite the high innovative capacity and positive dynamics for the majority of indicators, characterizing the development level of science and innovation, Voronezh Region lags behind the leader regions in terms of using this capacity.

IV. CONCLUSION

The performed study shows that assessing the innovative activity of the regional economic system is important, because it allows us to reveal strong and weak sides in the region's innovative development, to adjust the directions of innovation policy in an objective manner, to create favorable conditions for investments and implementation of innovations.

The use of the suggested methodological techniques allows for making quantitative assessments of the level of innovative activity for the complete set of parameters under consideration and responding flexibly to the changes in any of them. The calculation of the innovative activity level leans on general indicators gathered in a centralized way and made publicly available in the press, which makes it possible to reduce the probability of data manipulation and distortion of the results when undertaking the interregional comparisons. It should be noted that, when building the indicators, it's almost always that one has to additionally simplify, systemize actual phenomena and that is why the set of them reflects the objective reality only to a certain degree of approximation. All these things highlight the importance of continuous work on refining methodology for assessment of innovative activity of the regional economic system in conformity with the development of the reflected objective reality and, as a result, gaining insight into the real economic systems.

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