

FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION OF
HIGHER EDUCATION THE «RUSSIAN ACADEMY OF NATIONAL
ECONOMY AND PUBLIC ADMINISTRATION»

As a manuscript

Serpukhovitin Dmitrii Alexandrovich

**Development of tools for evaluating the effectiveness of the national
innovation system of the Russian Federation**

5.2.3. Regional and sectoral economy

ANNOTATION

dissertation for the degree of Candidate of Economic Sciences

Dissertation Supervisor:
Doctor of Economics, Associate Professor
Polozkov Mikhail Gennadievich

Moscow
2025

Relevance of the research topic. The growing need for structural restructuring of the economy – the transition from a post-industrial to a "knowledge economy" - requires intensive production of high-tech goods, works and services based on innovation. The intensification of this process requires overcoming the existing barriers in the economic development of the Russian Federation, which currently inhibit the growth rate of the national economy. Many economic institutional entities are involved in the production of innovative products, which constitute the national innovation system of the Russian Federation. A large number of subjects involved in the process of production and sale of innovative products, as well as the links between them, entails a large variability in the results of various stages of this process and the entire system and requires careful selection of tools for evaluating the effectiveness of the national innovation system. The production of innovative products is a complex and multi-stage process, the effectiveness of which is simultaneously influenced by many economic, social and political factors, including national peculiarities of the NIS, and the international conjuncture. In an unstable international economic environment and a shortage of budgetary resources, the effectiveness of government support to entities of a foreign innovation system is of particular importance. Currently, there are various approaches and tools for evaluating the effectiveness of the national innovation system and government support measures, which have certain advantages and disadvantages. The development and expansion of tools for identifying the most promising areas of support, as well as government support measures developed on their basis, are of particular importance for improving the effectiveness of the national innovation system and the economy of the Russian Federation.

The degree of study of the problem. The basis of modern innovation is considered to be the theory of "big business cycles" by N.D. Kondratiev, developed at the end of the nineteenth century. The first theoretical studies of innovation activity and institutional management of national innovation systems appeared in the early twentieth century in the works of J. Schumpeter. Later, these ideas were comprehensively developed in the works of B. Santo, B.-A. Lundvall, R. R. Nelson,

V. G. Medinsky, T. Webler, W. K. Mitchell, D. North, A. S. Akhiezer, O. Williamson, V. Polterovich, K. Freeman, and others. Among modern researchers of the innovation production process and the functioning of national innovation systems, one can mention L. M. Gokhberg, T. E. Kuznetsova, I. G. Dezhina, Yu. V. Simachev, E. A. Sergeeva, M. V. Kudin, B. N. Kuzyk, Yu. V. Yakovets, A. A. Dagaev, A. Sasha, N. E. Bondarenko, I. P. Komarova, V. R. Atoyán, E. V. Eremina. The works of the above-mentioned researchers show that the national innovation system covers all areas of economic activity of the state and is a key aspect of the socio-economic development of the country, and an innovative enterprise as the basis of the national innovation system needs government support in a constantly changing external and internal environment.

Both foreign (G. Etzkowitz, L. Leydesdorff, E. Karayanisa, J. Faberg, S. G. Winter, T. Levitt, R. H. Hall, Ta Shiman, Ao Laili, Yu Fan, etc.) and domestic scientists (N. P. Maslennikova, V. L. Klyunya, S. V. Trubitskov, O. A. Boris, I.I. Shanin, S. N. Yashin, and others), who established the characteristic features, parameters, and approaches to evaluating the effectiveness of such systems, as well as the innovation production process.

The object of the research is the national innovation system of the Russian Federation.

The subject of the research is the tools for evaluating the effectiveness of the national innovation system of the Russian Federation.

The purpose of this study is to develop a scientific and methodological approach to assessing the effectiveness of the national innovation system of the Russian Federation using the graph-analytical method and machine learning tools.

The achievement of the set goals is ensured by **solving the following tasks:**

- to identify the institutional features of the national innovation system of the Russian Federation through consideration of its evolution and comparative analysis with the national innovation systems of the world;
- Identify the strengths and weaknesses of methodological approaches for evaluating the effectiveness of national innovation systems;

- to develop a grapho-analytical model for evaluating the effectiveness of the national innovation system of the Russian Federation using machine learning tools;
- to assess the impact of changes in the performance of the subjects of the national innovation system of the Russian Federation on its effectiveness;
- to formulate proposals on improving the effectiveness of state support tools for the national innovation system of the Russian Federation, taking into account international experience.

The theoretical and methodological basis of the research was the works of foreign and domestic scientists devoted to the development of elements of national innovation systems, including targeted measures of state support for participants in the production of innovative products. In our dissertation research, we used general scientific methods for studying economic systems, including analysis and synthesis; methods of mathematical modeling (including machine learning tools), methods of detailing and generalizing economic and statistical data; comparison of approaches to the analysis of innovation systems.

The information base of the study was open data from the Federal State Statistics Service, the Ministry of Science and Higher Education of the Russian Federation, the Ministry of Economic Development of the Russian Federation, statistical financial and economic Russian and international publications, the resources of the global Internet information network, analytical reviews published in periodicals and specialized scientific literature, monographic research materials of domestic and foreign scientists, regulatory- the legal framework governing the activities of economic entities in the Russian Federation, enterprise reporting data and materials developed directly by the author.

Compliance of the content of the dissertation research with the passport of the scientific specialty. The field of research in terms of content, object and subject meets the requirements of the passport of the nomenclature of specialties of the Higher Attestation Commission (Economics) 5.2.3. Regional and sectoral economics in scientific areas:

– Clause 7.6. "National innovation systems, their structural elements and participants";

– Clause 7.9: "Development of methodology and methods for the analysis, modeling and forecasting of innovation activities. Assessment of the innovation activity of business entities".

The scientific novelty of the results obtained lies in the development of theoretical provisions, a methodological approach to assessing the effectiveness of the national innovation system of the Russian Federation and practical recommendations for improving government support measures.

The most significant research results that possess scientific novelty and were obtained personally by the author:

1. It is proved that when developing tools for evaluating the effectiveness and proposals for improving state support measures for the NIS of the Russian Federation, it is necessary to take into account the key role of the state at all stages of the innovation production process. In this regard, it is theoretically justified that innovations have the properties of a public good and, therefore, their production needs government support at all stages of the production of an innovative product. An expanded list of stages of the production process of an innovative product is presented: determining strategic directions of development, obtaining new knowledge, transformation into a commercial product, sales and consumption.

2. A methodological approach to the study of the national innovation system of the Russian Federation as the results of the activities of interrelated institutional entities at all stages of the innovation product production process is proposed. The distinctive features of the approach are: taking into account the direct and feedback links of the institutional actors of the process (subjects of the national innovation system); taking into account the continuity of the production process of innovative products; assessing the variability of the results of the activities of subjects of the national innovation system. The presented features make it possible to identify the institutional parameters most sensitive to state support instruments (as the results of the activities of the subjects of the NIS of the Russian Federation) and assess the

potential effectiveness of targeted state support measures, taking into account variations in these parameters.

3. A set of parameters has been formed for a grapho-analytical model based on the representation of the production of innovative products as the results of the activities of interrelated institutional economic entities. A distinctive feature of the proposed set is the unambiguous attribution of the parameter to the stage of the innovation production process, which makes it possible to identify their impact on the effectiveness of the national innovation system of the Russian Federation. Additionally, each of the set parameters is attributed to clarify the classification and identification for both the construction and analysis of the NIS of the Russian Federation by a grapho-analytical model based on a cognitive approach.

4. For the first time, a graph-analytical model based on a cognitive approach using machine learning tools was developed and applied to evaluate the effectiveness of the national innovation system of the Russian Federation. In the proposed model, performance indicators of the subjects of the NIS of the Russian Federation are placed at the vertices of the graph, linked according to the principle of unambiguity of mutual influence. The effectiveness of the national innovation system of the Russian Federation was assessed using an original two-stage calculation algorithm with automatic selection of the best regression for the starting, resulting and intermediate vertices of the defining cycle. The original algorithm is implemented in the Python programming language and uses machine learning tools.

5. Based on the variational analysis of the grapho-analytical model of the performance of institutional entities, the most sensitive parameters of the system were identified and their classification was proposed in terms of the minimum required duration of government support measures. Proposals have been formulated to improve the efficiency tools of the NIS of the Russian Federation, taking into account the experience of developed and developing countries, which are leaders in international innovation ratings.

The scientific and practical significance lies in the fact that the obtained results of the dissertation research contribute to the development of state support for

the national innovation system of the Russian Federation in order to increase its effectiveness.

The reliability and validity of the results of the dissertation research are confirmed by the use of proven scientific methods, their compliance with theoretical and methodological provisions, as well as the practical experience of Russian and world science. Numerous theoretical sources on the research topic were used. Theoretical provisions, conclusions, and scientific and practical recommendations are provided with the necessary calculations, analytical tables, and graphical interpretations.

Approbation of the research results. The main theoretical and practical results of the dissertation work were presented at conferences:

1) Dmitry Serpuhovitin Prospective directions of state support of the national innovation system of Russia SHS Web of Conferences vol. 128, (2021), <https://doi.org/10.1051/shsconf/202112804009>;

2) Dmitry Serpuhovitin Growth zones of the national innovation system of Russia / Serpuhovitin D. A. Dela Press Conference Series: Economics, Business and Management 031, 01031/2022 <https://doi.org/10.56199/dpcsebm.tdao4707>;

3) Serpuhovitin D. A. Performance indicators of state institutions as parameters of the national innovation system. Collection of materials of the IX All-Russian Scientific and practical Conference. Penza, 2022. pp. 168-172;

4) Serpuhovitin D. A. The development of organizational innovations in a financial organization as a result of government support for the digital transformation of the industry, In the collection: Current aspects of the development of science and society in the era of digital transformation. Collection of materials of the II International Scientific and Practical Conference. Moscow, 2022. pp. 238-243;

5) Serpuhovitin D. A., Barkov S.S., Ovchinnikov S. A., Standardization of process modeling approaches as a promising measure of state support for innovative enterprises, In the collection: Innovative, information and communication Technologies. Collection of materials of the XX International Scientific and Practical Conference. Moscow, 2023. pp. 77-82.

Publications. 15 scientific papers with a total volume of 17.8 a. 1. (personal contribution - 16.5 a. 1.) have been published on the research topic in scientific publications recommended by the Higher Attestation Commission of the Ministry of Science and Higher Education of the Russian Federation and the Scientific Council of the RANEPA¹:

- 3 publications in K1 journals;
- 3 publications in K2 journals;
- 9 RSCI publications.

In the course of the research, two pieces of software for analyzing the national innovation system of the Russian Federation, written in the Python programming language, were developed and registered at the Federal Institute of Industrial Property². The software registration number 2023665495 was used in this work.

The structure and content of the dissertation are determined by the content and logic of the research, include: introduction, three chapters, conclusion, a list of references from 227 titles and 15 appendices on 31 pages. The main part of the dissertation contains 155 pages of text, 11 tables and 18 figures.



¹ Order No. 02-64 dated 30.01.2018 "On Approval of local Acts on the activities of Dissertation Councils and the Procedure for awarding academic degrees"

² Registration (certificate) numbers: No. 2023665495 and No. 2023664134