Country's innovative potential: indicators and measurement assessments

Tetiana Kiriienia * [1 A]; Yuri Lysetsky [2 A]

***Corresponding author:** [1] Dr of Technical Sciences, Research Fellow of the Research Department, e-mail: smokliak@ukr.net, ORCID: 0000-0002-6365-607X
[2] Dr of Technical Sciences, Senior Research Fellow of the Research Department, e-mail: smokliak@ukr.net, ORCID: 0000-0002-5080-1856

[A] Military-Diplomatic Academy named after Yevgeny Bereznyak, Kyiv, Ukrainia

Received: January 30, 2022 | Revised: March 26, 2022 | Accepted: March 31, 2022

UDC: 330.341+338.242.2

DOI: 10.5281/zenodo.6386794

Abstract

The innovative potential of a country reflects the ability of its economy to prospective development mainly due to its internal capabilities. Today, a substantiated choice of methods for its evaluation is a decisive factor of socio-economic systems competitiveness. An approach to the determination of an integrated assessment of the country's innovation potential, based on the integrated use of quasimetric methods and expert technologies, is proposed.

Keywords: innovation, potential, economy, modernization, processes, model, experts.

Introduction

Innovation processes are accompanied by changes in the world economic space. And these changes accelerate the transnationalization of production and capital, deepen integration and allow countries to modernize their own or adopt modern technologies by the latest scientific, technological, and information advances, to ensure the strategic competitiveness of national economies (Bilyk R.S., August 23th, 2019). The issue of opportunities for innovative modernization of the economy is particularly acute for countries that have relatively recently undergone an inversion transition from the planned distribution to the market model of management.

The chosen research is closely related to the research programs of the Yevhen Bereznyak Military Diplomatic Academy, the National Institute for Strategic Studies, and the implementation of Presidential Decree № 372/2021 dated August 20, 2021, on the decision of the National Security and Defense Council of Ukraine adopted on June 18, 2021 "On the Strategy for the Development of the Defense Industry of Ukraine".

Analysis of recent research and publications

In recent years, much attention has been paid to the development of innovative modernization of national economies and the assessment of their innovation potential, in particular in the works of L. Antonyuk, K. Buzhimska, I. Balabanov, V. Vergun, V. Geets, O. Dovgal, V. Zavalin, R. Zablotska, V. Kalyshenko, L. Kistersky, Y. Lopatynsky, N. Meshko, P. Nikiforov, T. Orekhova, Y. Prysyazhnyuk, V. Savchuk, I. Fesenko, L. Shamin and others.

The emergence of new types of intangible resources and, above all, information and knowledge radically change the relationship between the structural components of the global innovation process. It also requires fundamental approaches to assessing the ability of different countries to attract their potential for innovation modernization in integration processes (Bilyk R.S., August 23th, 2019). Innovative processes of economic modernization are in constant dynamic

motion. Their importance in ensuring competitiveness is constantly growing, and this causes new problems and requires in-depth study of the assessment of innovation potential of countries in modern conditions.

The purpose of the article is to research the indicators and real estimates of the country's innovation potential to determine its integrated assessment.

Results and discussion

One of the key differences of the modern world is the extremely dynamic development of innovation, which leads to significant changes and transformations in almost all sectors of the economy. Innovation is usually understood as the introduction of new methods, ideas, or products in the field of technology, labor organization, or management, based on the use of scientific advances and best practices, ensuring a qualitative increase in the efficiency of the production system or product quality.

Innovations are aimed at improving the quality of products, improving the manufacturing sector, the optimal and efficient use of economic, material, and social resources.

Strengthening international cooperation, increasing the scale of cross-border movements of new technologies, goods, services, labor, reformatting the interaction of national economies contribute to their transition from traditional to innovative economies, accelerate their modernization. Innovative transformations are characterized by a great differentiation of countries in terms of scientific and technical and industrial and technological development.

Due to the dynamic changes in the balance of power between different countries, conditions, and factors that determine the success of goods and services in world markets, global competition is intensifying, forcing governments to pay more attention to innovation and its ability to make structural and institutional changes.

Innovation potential is a system indicator that reflects the degree of readiness and ability of the system to transform existing resources into products or services that can meet existing or emerging market needs (Orlova-Kurilova O.V., 2018). Innovative potential reflects the ability of the state economy to prospectively progressive development mainly due to its internal capabilities. Most often in science and practice, innovation potential is seen as a set of different types of resources and flow processes (including efficiency reserves), which are necessary for the implementation of innovation activities. However, the most fully innovative potential can be analyzed as an objective need for efficient use of resources in terms of flexible development of the system in the market. Flexible development in this case is the basis for ensuring and increasing the innovation potential of any functioning system. The innovative potential is the active part of reproduction, involved in creating a national product and accumulation of national wealth through the development of human intellectual potential, accumulation of fixed capital and funds, rational exploitation and protection of the natural complex through the integration of science, innovation, finance, and industrial construction projects. The quality and volume of innovation potential are characterized not only by the development of education and science, scientific and technological structure of production, a financial and reproductive component of investment, but also the structure of gross domestic product by its share of science and national wealth or its elements of innovation. The economic content of innovation potential is characterized by the whole set of economic relations for the mobilization of factors of innovation in the reproduction of fixed capital and rational product at all structural levels of the economy.

Modern approaches to the assessment of innovation potential reflect mainly the micro-level. To assess the actual state of innovation potential is used, as a rule, a set of indicators that reflect its resource, technological and market components. After all, the reproduction of innovation potential involves the establishment of mutual links between the stage of use of existing capacity and the

creation of conditions for maintaining positive trends of its modernization, approaching the best standards in the global and regional dimension. After all, the reproduction of innovation potential involves the establishment of mutual links between the stage of use of existing capacity and the creation of conditions for maintaining positive trends of its modernization, approaching the best standards in the global and regional dimension.

The formation of innovation capacity is taking place against the background of the contradictory trend of increasing globalization in the context of deepening the international division of labor and the growing role of national capacity in the context of global competition. The development of the international division of labor is accompanied by the expansion of international economic relations, the growth of trade and financial flows, the exchange of information, technology, labor. This leaves an imprint on the innovative development of countries, which in the context of globalization can be based not only on the innovative potential of the country but also on attracting resources from external sources. This creates both opportunities and risks for the country's innovative development.

The contradiction between the need for dissemination and standardization of innovations in the global environment and the protection of the country's innovation potential and the competitive advantages generated by it determines the current trends in the development of productive forces. Objective patterns of development of commodity markets lead to an increase in international trade, standardization of commodity production, liberalization of economic relations, increasing financial transparency of borders, and financial globalization (Bilyk R.S., October 15-16, 2009).

To study the peculiarities of innovation development, and assess its potential, different indices of innovation are used. They are calculated based on the use of the most important indicators of the degree of innovative development of the economy, which assess the innovative potential of socio-economic systems at different levels, starting with the analysis of the resource component, indicators that measure knowledge, scientific and technological progress, human capital and finishing with the characteristics of the external institutional environment.

Thus, today the most common are the following indicators for assessing the innovation potential of the national economy:

1) the global index of competitiveness, which illustrates the innovative potential of economic growth in the medium and long term (Theories and Paradigms);

2) the index of the innovation capacity of the world (National Innovation Capacity), according to which M. Porter and S. Stern consider the national innovation capacity as the potential of the country to produce innovative products that are commercially successful (Porter M.E., January. 2008);

3) index of scientific and technical potential (World Economic Forum) as part of an integrated indicator for assessing the level of competitiveness of the state (Burmaka M., 2018);

4) the Innovation Scoreboard of the Commission of the European Communities (CES), which is used for a comparative study of the level of innovation activity in the EU, USA, and Japan (Boshota N.V., Shishola D.V., 2016);

5) European Innovation Scoreboard (SII). It consists of five groups of indicators – indicators of innovation drivers, knowledge, diffusion of innovations, implementation of innovations, intellectual property (Trubina M.A., 2013);

6) Knowledge Economy Index (KEI), which includes indicators of information technology development, its share in production and services, development of science and technology and the population, and the economy of access to information and communication technologies (Knowledge-based economy);

7) the Competitiveness Index of the Organization for Economic Co-operation and Development (OECD), which covers four key areas (human resources, level of commercialization of

technology, dissemination of information technology and funding structure) (Theories and Paradigms);

8) the International Innovation Index BCG is calculated using six sub-indices, divided into two groups of indicators that reflect the conditions and results of innovation development (Budkin V., 2010).

To solve the scientific problem of integrated assessment of the country's innovation potential, it is necessary to develop and apply approaches, as well as to determine the necessary indicators for this set of indicators. One of such approaches is proposed to use integrated methods of qualimetry and expert technologies (Lisetsky Yu. M.). In qualimetry, single, complex, and integrated quality indicators are used to assess the quality of systems.

A single indicator is an indicator of the quality of a system that relates to only one of its properties.

A complex indicator is an indicator of the quality of the system, which relates to several of its properties.

An integral indicator is an indicator of the quality of the system, which reflects the whole set of its properties in general.

By analogy, individual indicators include indicators 1, 2, 3, 4, and complex – 5, 6, 7, 8.

To calculate the integrated assessment of the innovation potential of the country (V) we use the model of multiple linear regression

$$\mathrm{V} = \sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{a_i x_i}, \quad (1)$$

where a_i – unknown regression coefficients, which are chosen so that their sum is equal to one $\sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{a_i} = 1$;

x_i – regressors (model factors);

n – the number of model factors.

To determine the regression coefficients, we use methods of expert evaluation, namely – ranking. The essence of ranking is that the expert has all n factors of the model (in our case – indicators) in a certain order, which seems to him the most rational, and assigns to each of them the numbers of a natural series – ranks. In this case, rank 1 receives the least important, in his opinion, the indicator, and rank N – the most important. Therefore, the ordinal scale obtained as a result of ranking must satisfy the condition of equality of the number of ranks N of the number of ranked indicators. An expert can assign the same rank to several indicators. As a result, the number of ranks N is not equal to the number of ranked indicators n. In such cases, the indicators are assigned standardized ranks. For this purpose, the total number of standardized ranks is assumed to be equal n, and indicators that have the same rankings are assigned a standardized rank, the value of which is the average sum of places of indicators with the same ranks. The average ranking of all experts for each indicator is calculated. To do this, the weighted rankings of each indicator are summed, and then the amount obtained is divided by the number of experts. The most important indicator will be the one with the highest average ranking (weight). Thus, the arithmetic mean is calculated for each indicator according to the following formula:

$$a_i = \frac{\sum_{j=1}^{m} a_{ij}}{\sum_{j=1}^{m} \sum_{i=1}^{n} a_{ij}} \quad (2)$$

where a_{ij} – the importance of the i-th indicator according to all experts;

$$a_{ij} = \frac{r_{ij}}{\sum_{i=1}^{n} r_{ij}} \quad (3)$$

where r_{ij} – the rank of the i-th indicator assigned by the j-th expert;
n – a number of indicators;
m – a number of experts.

In the case of different levels of expertise, this should be considered when calculating the integrated assessment of innovation potential. Modern scientific sources present many approaches to determining the competence of experts. In our case, it is most appropriate to determine the level of competence of experts based on the axiom of non-bias (Gnatienko G.M., Snityuk V.E.), according to which the conclusions of the majority are competent, and as a result, the most competent will be the expert whose discrepancy with the conclusions of other experts is minimal. This approach is described in detail in (Snityuk V.E., Rifat Mohammed Ali, 2000).

Conclusions

The results of the study show that countries whose economic development is based on innovation, are significantly ahead of others, changing the distribution of power in world markets. The innovative type of economic development is the foundation that determines the economic power of the country and its prospects in the world market, determines its competitiveness and place in the world economy. It is the ability to generate innovations, to provide their financial support, i.e. innovation capacity, which are the most influential factors in shaping the competitiveness of states in global competition. To determine the characteristics and state of development of key elements of the innovation environment, experts use global rankings, which are determined by international organizations, foundations, leading universities, and companies.

Thus, it can be argued that there is a need to prioritize policies that stimulate new sources of innovation growth, and this is impossible without an integrated assessment of the country's innovation potential, which allows developing practical recommendations for strengthening the impact of innovation modernization on competitiveness and acceleration.

Prospects for further research – organizational and economic support of the current stage of innovation in the military sector of the economy.

References

[1] Bilyk R.S. The role of innovation and investment potential in the modernization of national economies. III International Scientific Conference “From the Baltic to the Black Sea: The Formation of the Modern Economic Area”: Conference Proceedings, (August 23th, 2019. Riga, Latvia). Riga: Baltija Publishing, 2019. P. 7–9.

[2] Orlova-Kurilova O.V. (2018). Modern methods of assessing innovation potential. *Bulletin of Khmelnytsky National University*. №4. P. 143–146.

[3] Bilyk R.S. Directions for intensifying cross-border cooperation of regional economic structures. XIX International Scientific and Practical Conference “Institutional Nature of Market Transformations” (October 15-16, 2009, Chernivtsi). Chernivtsi, 2009. P. 268–272.

[4] Theories and Paradigms of International Business Activity: The Selected Essays of John H. Dunning. Volume 1. Cheltenham: Edward Elgar, 2002. P. 521.

[5] Porter M.E. The Five Competitive Forces that Shape Strategy. *Harvard Business Review*. January. 2008. P. 86.

[6] Burmaka M. (2018). Creativity of the global investment process. *International economic policy*. № 2 (29). P. 37–38.

[7] Boshota N.V., Shishola D.V. (2016). Foreign experience of state regulation of innovation. *Young*

scientist. № 9. P. 14–18.
[8] Trubina M.A. (2013). European Innovation Scoreboard as a generalized indicator of the country's innovative development. *Current issues of public administration*. № 1 (43). P. 370–377.
[9] Knowledge-based economy. OECD Statistics. Available from : https://stats.oecd.org/glossary /detail.asp?ID=6864/ (accessed 10.11.2021).
[10] Budkin V. (2010). Innovative model of national economies. *Ukraine economy*. № 6. P. 61–68.
[11] Lisetsky Yu. M. Models, methods and technologies for quantitative assessment of system quality: a monograph. Kyiv: LAT & K, 2018. 102 p.
[12] Gnatienko G.M., Snityuk V.E. Expert decision-making technologies: monograph. Kyiv: McLaut, 2008. 444 p.
[13] Snityuk V.E., Rifat Mohammed Ali (2000). Models and methods for determining the competence of experts based on the axiom of non-bias. *Bulletin of the Cherkasy Institute of Engineering and Technology*. № 4. P. 121–126.