THE IMPORTANCE OF KNOWLEDGE GENERATION AND DISSEMINATION IN THE NATIONAL INNOVATIVE SYSTEM OF UKRAINE

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Abstract. The article deals with the structure and conditions of national innovation system of Ukraine, trends and conditions of generation of knowledge.

In Ukraine, the potential of the subsystem for generating and disseminating knowledge is not used effectively enough, although there are significant prerequisites for its development. The sub-index of education of the Index of Knowledge Economy in Ukraine is quite high compared to the sub-index of information and communication technologies development.

Analysis of the sub-indexes of the Global Competitiveness Index shows that Ukraine consistently occupies a fairly high position in terms of human development, but the value of the sub-index of macroeconomic stability in the country is unsatisfactory. Ukraine faced obstacles to the formation of a third-generation national innovation system, some of which it inherited from the Soviet Union.

The national innovation system can become a field for the development of stable economic growth of the country. Therefore, by 2025 it is planned to implement the Concept of development of the national innovation system, which includes a subsystem of knowledge generation and dissemination. The article analyzes the purpose and objectives of the Concept, presents the possible consequences of implementation in three scenarios. Since the implementation of the Concept is only partial, the article considers the factors that hinder it.

The structure of the national innovation system, which consists of two subsystems, is considered. One of them is the subsystem of knowledge generation and dissemination. It is represented in Ukraine by the National Academy of Sciences of Ukraine, universities, and research centers.

The structure of the National Academy of Sciences is considered separately in the article. More attention is paid to the activities of higher education institutions, which today not only involves the dissemination of knowledge, but also the generation of new business ideas and innovative solutions. The article substantiates that at the regional level, local governments need to adopt international experience in solving socio-economic problems

with the assistance of academic entrepreneurship. It is noted that among the important areas of development of the regions of Ukraine is smart specialization and increasing the digitalization of education and other spheres of public activity.

Consolidation of efforts of local self-government bodies, state authorities, business structures, educational and scientific institutions should be the key to success.

Keywords: National innovation system, knowledge generation, knowledge dissemination, academic entrepreneurship, innovation, National Academy of Sciences of Ukraine, smart education, digitalization.

INTRODUCTION

Post-industrial society is formed using an innovative type of production, the development of national innovation systems (NIS). The knowledge generation and dissemination subsystem brings together interconnected institutions designed to create, store and transfer knowledge, skills and inventions that define new technologies. Therefore, this subsystem is an integral part of scientific and technological potential and is economically significant for socio-economic growth. In Ukraine, the potential of this subsystem is not used effectively enough, although there are significant prerequisites for its development.

MATERIALS AND METHODS

Dialectical method – for substantiate the importance of the subsystem of generation and dissemination of knowledge for the development of the national innovation system; methods of analysis and synthesis – for the study of academic entrepreneurship and the structure of the national innovation system; methods of theoretical generalization and formal logic – for study the obstacles to the effective formation of the national innovation system in Ukraine.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Historically, the concept of the national innovation system is quite new, dating back to the 80s of the twentieth century. Its appearance is associated with the names of B. Lundvall, K. Freeman and R. Nelson (Nelson, 1993), (Lundvall, 1992), (Freeman, 1987). The components of NIS are studied by Ukrainian economists L. Smolyar, O. Dudchenko, T. Lomakina (Smoliar et al., 2017), N. Kraus (Kraus, 2019), I. Yanenkova, V. Sumarskaya, A. Alferova (Yanenkova et al., 2016). Specialists of the Institute for Research of Scientific and Technical Potential and History of Science named after AHEM. Dobrova is working on an analysis of the importance of the development of knowledge-intensive production for the transition to an innovative direction of economic development.

THE PURPOSE OF THE STUDY

To consider the general characteristics of the subsystem of knowledge generation and dissemination as a component of NIS of Ukraine.

RESULTS AND DISCUSSION

The direction, sources and methods of state regulation of innovative development depend on the path of transition to scientific and innovative development:

1. the way of rapid spread of promising innovations: dissemination and clustering of innovations, creation of favorable scientific and technical environment for enterprises, encouragement through financial and credit mechanisms of risky projects, general high taxation and preferential treatment for innovative projects (Sweden, Switzerland, Germany);
2. the path of scientific and technical leadership: large-scale innovative projects, low levels of corporate taxation (USA, France, UK);
3. way of comprehensive innovative development: realization of modern achievements of world STP, absence of tax privileges, creation of conditions of active creative activity of citizens in the scientific and technical sphere, realization of state educational programs (South Korea, Japan) (Kraus, 2019).

Ukraine faced obstacles to the formation of a third-generation national innovation system, some of which it inherited from the Soviet Union:

- technical and technological lag behind the developed countries of the world;
- high material and energy consumption of production;
- relative isolation in scientific, technical and technological exchange;
- high level of production costs;
- low level of intensification of production, labor productivity;
- decline in production and economic crisis;
- weak coordination of NIS participants in the development, financial support and implementation of innovation;
- low level of protection of intellectual property rights;
- insufficient budget funding for innovation and inefficient definition of funding areas;
- negative trends in the increase and renewal of fixed capital;
- negative trends in the development of scientific and technical potential.

According to the Knowledge Economy Index, which determines the effectiveness of the external environment for the dissemination and use of knowledge to promote economic development, Ukraine occupied 52nd, 55th, 51st, 55th positions from 140 countries in 1995, 2000, 2009, 2012, respectively, the index itself was equal to 5.97, 5.63, 6.00 and 5.73. In 2019, the education sub-index was 7.97 (46th position among 189 countries). According to the sub-index of innovations, Ukraine ranked 47th among 129 countries. In terms of the development of information and communication technologies, Ukraine ranked 79th out of 175 countries.

According to the methodology of the World Economic Forum, the analysis of the national economy is conducted according to GCI – Global Competitiveness Index (Table 1).

Table 1. Global Competitiveness Index of Ukraine for 2007–2018

Years	Position	The value of the index
2007-2008	73	–
2008-2009	72	4,09
2009-2010	82	3,95
2010-2011	89	3,9
2011-2012	82	4,0
2012-2013	73	4,14
2013-2014	84	4,05
2014-2015	76	4,14
2015-2016	76	4,03
2016-2017	79	4,0
2017-2018	85	4,11

(Global Competitiveness Index, 2021)

Analysis of the sub-indices of the Global Competitiveness Index shows that Ukraine consistently occupies a fairly high position in terms of human development, but the value of the sub-index of macroeconomic stability in the country is unsatisfactory (The World Bank, 2021). We have a significant loss of Ukraine's position – by 12 points. This indicates inefficient use of its own innovation potential, the predominance of exports of raw materials with a small share of value added, and threats to economic security. Thus, the NIS of our country is at the initial stage of formation, as participants in the innovation process interact rather weakly, the use of information and communication technologies is insufficient, the institutional conditions for innovation are unfavorable. This state of affairs prevents significant scientific potential from being fully realized and qualitatively generating and disseminating knowledge.

The national innovation system can become a field for the development of stable economic growth of the country. This belief is confirmed by the fact that effective NIS affects all types of productive forces: increasing the competitiveness of labor resources by increasing the intellectualization of labor, careful treatment of land resources through the introduction of energy and resource-saving technologies, modernization of capital resources through restructuring of production on a technologically new basis. for the new requirements of the socio-economic environment, transformation of entrepreneurship for the new requirements of the socio-economic environment. In the process of such transformation, a favorable field is formed for the development of science-intensive industry of the country, which, of course, in the XXI century is a determining factor in macroeconomic dynamic.

By 2025, it is planned to implement the Concept of development of the national innovation system, which includes a subsystem for knowledge generation and dissemination, approved by the order of the Cabinet of Ministers of Ukraine of June 17, 2009 №680-r (Cabinet of Ministers, 2009).

The Concept assumes that the combination of state regulation, education, knowledge generation, innovation infrastructure and production form the basis of the national

innovation system. The purpose of the implementation of this Concept is to determine the basic principles of formation and implementation of a balanced state policy to ensure the development of the national innovation system aimed at increasing the competitiveness of the national economy.

Among the main tasks are the following:

- Ensuring the innovative orientation of the education system.
- Improving the effectiveness of the research and development sector.
- Ensuring expanded reproduction of knowledge based on the integration of universities, academic and industry research institutions.
- Ensuring the development of a system of financial and credit support for the implementation of competitive scientific, technical and innovative programs and projects.
- Ensuring the development of production and technological innovation infrastructure.
- Ensuring the development of effective information-analytical and expert-consulting infrastructure of innovation activity.
- Creating conditions for technology transfer and improving the protection of intellectual property rights.
- Introduction of an effective mechanism of public-private partnership aimed at achieving a high level of competitiveness of domestic products on the world market in certain sectors of science-intensive production, mainly based on the introduction of domestic technologies.
- Providing support and protection of the national producer.
- Formation of a positive attitude to innovation in society.
- Development of human resources in the field of innovation.

The expected results depend on the good faith implementation of the Concept and are divided into three scenarios (according to the conclusions of scientific institutions of the NAS of Ukraine) (Table 2):

Table 2. Options for implementing the Concept of development of the national innovation system and possible consequences

Options	Consequences until 2015	The value of forecast indicators
Full realization of the goal	inclusion of Ukraine in the global scientific and technological development, which will contribute to the large-scale involvement of financial and human resources in the technological development of the economy, increase foreign trade in high-tech products and technologies	<ul style="list-style-type: none"> • the share of innovative products in the volume of industrial production must be at least 50%; • the level of innovative activity of enterprises in industry will reach 60%; • the level of the high-tech manufacturing sector in the structure of the manufacturing industry will exceed 30%; • the volume of exports of high-tech products and technologies will increase 5-7 times
Partial realization of the goal	meeting only the needs of the domestic market in manufacturing products	<ul style="list-style-type: none"> • the share of high-tech sector products will grow to 25%; • increasing the level of knowledge intensity of manufacturing products to 2-2.5%; • reduction of the share of low-tech sector products in the structure of industrial production to 50%
Uncontrolled development	continuation of deformation of the structure of production, decline of scientific and technical potential and scientific and technical base of branch and factory sectors of science, gradual decrease of quality of education. The high level of resource and energy consumption of the final product will cause the loss of technological niches in world markets	<ul style="list-style-type: none"> • further reduction to 2-3% of the share of innovative products in industrial production; • the level of science-intensive products will be less than 1%; • the share of the knowledge-intensive products sector in the structure of the manufacturing industry will not exceed 10%; • in the structure of the total volume of investments in fixed capital, the share of innovative investments will decrease to 10%.

Systematized by the author

Unfortunately, as of 2021, we can observe only a partial implementation of the objectives of the Concept for the development of the national innovation system. At present, the effectiveness of the formation of the national innovation system in Ukraine is hampered by the following main factors:

- separation of science from economic practice;
- lack of a long-term development program at the state and regional levels;
- lack of mechanisms for evaluating the effectiveness of state and regional scientific and technical programs;
- imperfection of the legal framework in terms of stimulating innovation, material and moral stimulation of intelligence, especially higher education institutions;

- spontaneous initiation of innovations; lack of appropriate innovation infrastructure and mechanisms for commercialization of scientific and technical developments;
- inconsistency, inconsistency and to some extent chaotic implementation of public policy, etc. (Yanenkova et al., 2016)

Achieving the main goals of NIS requires the definition of its structural elements. There are several approaches to determining the structure of the national innovation system. Consider the structure proposed in the Concept of development of the national innovation system.

The analysis of the innovation system is based primarily on the analysis of scientific and technological potential, which combines the capabilities and resources of the national economy to ensure scientific and technological development. Ukraine's scientific and technical potential is high and is provided by world-famous scientific schools, unique achievements in many industrial and social spheres (new materials, radio electronics, biotechnology, low temperature physics, electric welding, nuclear physics, computer science).

The national innovation system is formed during the coordinated interaction of the state, business, science and education. Such cooperation of entities of the national economy provides the most benefits from innovation.

The external structure of NIS consists of two subsystems:

1. innovation infrastructure subsystem (required totality of public and private institutions and organizations that provide development and support of all stages of the innovation cycle). Thanks to the innovative infrastructure, coordination is carried out between the state, enterprises, research results and the market. The level of development of innovation infrastructure affects the implementation and effectiveness of innovative projects, the speed of innovative transformations of the economy;
2. subsystem of knowledge generation and dissemination (a set of institutions performing basic research and development, as well as applied research). It is the foundation of the national innovation system and is closely linked to the innovation infrastructure. It includes the National Academy of Sciences of Ukraine, universities, research centers, which perform the functions: basic and applied research, development, training of scientific personnel.

The *subsystem of knowledge generation and dissemination* in Ukraine is mostly represented by the National Academy of Sciences of Ukraine, universities, research centers. Their main functions are to conduct basic and applied research, development, training of scientific personnel.

In total, the National Academy of Sciences of Ukraine has 38 organizations and enterprises of research and production base and 160 scientific institutions, 43066 people work here (as of 01.01.2020): 14828 researchers (10 years ago – 19782) (2386 doctors and 6732 candidates of sciences), there are 170 full members (academicians), 364 corresponding members and 83 foreign members. 5 regional research centers of double subordination with the Ministry of Education and Science of Ukraine: Donetsk; Western; Southern; Northeastern; Prydniprovsky.

Sections and branches of the National Academy of Sciences of Ukraine:

1. Section of Physical, Technical and Mathematical Sciences: Department of Mathematics; computer science department; Department of Mechanics; Department of Physics and

Astronomy; Department of Earth Sciences; Department of Physical and Technical Problems of Materials Science; Department of Physical and Technical Problems of Energy; Department of Nuclear Physics and Energy.

2. Section of Chemical and Biological Sciences: Department of Chemistry; Department of Biochemistry, Physiology and Molecular Biology; Department of General Biology.

3. Section of Social Sciences and Humanities: Department of Economics; Department of History, Philosophy and Law; Department of Literature, Language and Art History (National Academy of Sciences of Ukraine, 2021) (Smoliar et al., 2017).

The activities of higher education institutions today not only involve the dissemination of knowledge, but also the generation of new business ideas and innovative solutions.

In September 2020, the Ministry of Digital Transformation of Ukraine together with the Ministry of Education and Science of Ukraine, the Ukrainian Startup Foundation and YEP with the support of the USAID „Competitive Economy of Ukraine” Program launched the „Entrepreneurship University” initiative. This initiative aims to create business universities in Ukraine with a strong business culture and startup infrastructure (Ministry of Digital Transformation of Ukraine, 2020).

At the regional level, local governments need to adopt international experience in solving socio-economic problems with the assistance of academic entrepreneurship:

- Academic entrepreneurship promotes the influx of staff. In the regions, young professionals with high potential are involved not only in startups, but also in all areas of real production.
- Bilateral transfer between science and the small and medium business sector is provided by startups based on the use of the results of scientific and technical developments.
- The development of high-tech clusters and innovation environment is facilitated by the dynamics of knowledge and specialists between business, higher education and public research institutes.
- Academic entrepreneurship helps to stop the migration of personnel from the regions.
- Therefore, in the field of higher education in Ukraine it is necessary to form an innovative infrastructure, in particular, to create small enterprises, business incubators, etc. at higher education institutions. Academic entrepreneurship will eventually allow:
- develop and implement methods, technologies, techniques of innovative development at all levels;
- generate and use new knowledge;
- wide dissemination (transfer) of new knowledge and advanced technologies;
- ensure the growth of the country's real GDP
- intensify the innovative activities of higher education institutions;
- help increase the competitiveness of the country's economy;
- disseminate knowledge in the field of entrepreneurship;
- increase the financial independence of higher education institutions (Zhukov, 2017).

Among the important areas of development of the regions of Ukraine is smart specialization. However, there are a number of obstacles: low financial literacy, innovation activity, awareness of smart specialization, low level of entrepreneurship among young people, ignorance of the population about the priority areas of regional development, the separation of theoretical

knowledge from their practical application, difficulties in commercializing business ideas. low level of smart education.

The subsystem of generation and dissemination of knowledge of the national innovation system can ensure the implementation of this task. It is important now to develop regional programs for the development of smart education for a period of 5 years. Their content should include the acquisition of knowledge about: rational consumption, financial literacy, business planning, smart technologies, priority areas of development of the regions of Ukraine. Consolidation of efforts of local self-government bodies, state authorities, business structures, educational and scientific institutions should be the key to success.

Innovative activity of developed countries is a priority for state support. But, as practice shows, the legislation of Ukraine on innovation does not yet provide full-scale regulation of social relations that arise in the process of development, creation and distribution of innovative products, its introduction as innovation and subsequent commercialization. Our legislation in the field of innovation is not systemic in nature, it is dominated by numerous separate bylaws. The organization of innovation activity in Ukraine today is regulated by more than 400 normative-legal acts of various branch affiliation. The legislation in force in Ukraine has not yet become a proper legal basis for the state's transition to an innovative model of economic development. In Ukraine, the systematization of the existing innovation legislation, its replenishment and further development should be carried out.

The order of the Cabinet of Ministers of Ukraine of September 10, 2012 №691-r approved the „Concept of reforming public policy in the field of innovation” (Cabinet of Ministers of Ukraine, 2012). Achieving the goals is ensured in the areas of: defining the tasks and functions of executive authorities and local governments in the innovation sphere, reforming the system of state procurement for research and development, creating favorable conditions for innovation, innovation infrastructure, market of innovations and technologies, introduction of results of scientific researches, inventions and technologies, maintenance of realization of the rights to objects of intellectual property, formation of innovative culture.

At the same time, the ways of realization of the specified directions are widely described and as a result it is planned to achieve by means of: to increase the efficiency of realization of the state innovation policy; reforming the system of state regulation in the innovation sphere; increasing the level of competitiveness of the national economy; creation of the market of innovations and technologies; ensuring the realization of scientific potential.

UNRESOLVED ASPECTS OF THE OVERALL PROBLEM

Support and development of research organizations and institutions of higher education as generators of knowledge; formation of regional partnership; raising the level of digital education of the population for public authorities should become a priority in public administration. Therefore, a promising area of further research is the analysis of the effectiveness of innovative development in higher education, as well as the study of opportunities, ways and principles of university (academic) entrepreneurship in Ukraine as a prerequisite for regional development.

CONCLUSIONS

The study showed that under today's conditions to increase the level of knowledge intensity of the national economy of Ukraine is possible primarily by increasing the amount of R&D funding from the state budget and increasing funding for innovation. This will create favorable conditions for the maximum realization of the human potential of Ukrainian science.

The subsystem of knowledge generation and dissemination is an integral part of the national innovation system. It has a significant potential in Ukraine, for the full use of which proper conditions have not been created. In general, the staff and all the scientific and technical potential of Ukraine is able to determine the quality generation and dissemination of knowledge. However, inefficient interaction of this subsystem with other components of the national innovation system, funding of academic science mainly in the amount that provides only the replenishment of the payroll, and a number of other problems are the reasons for inefficient use of all accumulated and preserved scientific and technical potential.

The level of education of the population, in particular, digital literacy, which increases the role of the educational component of NIS in Ukraine, also has a positive impact on innovative development. The development of smart education in the regions of Ukraine and the increase in the level of digitalization in all spheres of public life is especially timely.

Therefore, the formation of the national innovation system of Ukraine should be based on a cluster approach, which provides for close continuous interaction of all participants in innovation. It is necessary to create conditions for effective interaction of state power at the national and regional levels, scientific, educational spheres and the real sector of the economy.

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