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ІНТЕРАКТИВНА МОДЕЛЬ ДЕРЖАВНОГО РЕГУЛЮВАННЯ ТРАНСФЕРУ НАУКОВИХ ЗНАНЬ В НАЦІОНАЛЬНУ ЕКОНОМІКУ ЯК ЧИННИК ЇЇ ІННОВАЦІЙНОГО РОЗВИТКУ

Актуальність. У сучасних умовах наука та науково-технічна сфера відіграють визначальну роль у ефективному розвитку економік передових країн світу. Разом з тим, в Україні за роки незалежності наука втратила функції впливу на соціально-економічний розвиток, що обумовлено відсутністю ефективної системи перетворення результатів наукових досліджень у конкретні економічні здобутки, неспроможністю держави створити необхідні умови та стимули для трансферу знань із наукової сфери у виробництво.

Мета та завдання. Метою статті є обґрунтування інтерактивної моделі трансферу наукових знань у національну економіку як основи для вироблення практичних рекомендацій щодо державного регулювання у цій сфері, в умовах переходу до економіки знань.

Результати. Сформовано концептуальні засади інтерактивної моделі трансферу наукових знань в національну економіку. Зокрема, розглянуто характеристики економіки знань, що обумовлюють особливості державного регулювання трансферу наукових знань, а саме, акцент на розповсюдженні знань, не на їх створенні; ресурсний підхід до знань та їх орієнтація на дію. Надано класифікацію типів знання в економіці знань, та наголошено на особливій ролі неявного знання, що вимагає безпосереднього контакту для їх передачі або активної участі та присутності осіб, які ними володіють. Розглянуто моделі інноваційного процесу в економіці знань та показано переважання інтерактивної моделі інновацій, згідно з якою інновація виникає внаслідок взаємодії між виробниками знань та споживачами знань, які обмінюються як кодифікованими, так і неявними знаннями.

Розроблено інтерактивну модель трансферу наукового знання в національну економіку та показано її відмінність від лінійної моделі трансферу наукових знань. Сформовано підходи до державного регулювання трансферу наукових знань, згідно лінійної та інтерактивної моделей, що базуються на концепції «провалів ринку».

Висновки. Державне регулювання трансферу наукових знань в національну економіку України має відійти від вузького розуміння цієї діяльності як комерціалізації технологій, та зведення заходів регулювання в цій сфері до створення системи захисту прав інтелектуальної власності та «просування» вже створених розробок на ринок. Необхідне більш широке розуміння трансферу знань як інтерактивного процесу, що включає взаємодію між різними стейкхолдерами, а державна допомога в цій сфері має полягати у нівелюванні ризиків, пов'язаних з координаційною та мережевою неспроможністю суб'єктів трансферу знань; фінансуванні інфраструктури та заходів, спрямованих на стимулювання взаємодії між стейкхолдерами трансферу знань, заохочувати обмін та спільне створення знань.

Ключові слова: економіка знань, трансфер наукових знань, інноваційний розвиток національної економіки, державне регулювання трансферу наукових знань, інтерактивна модель трансферу наукових знань

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THE INTERACTIVE MODEL OF THE STATE REGULATION OF SCIENTIFIC KNOWLEDGE TRANSFER TO THE NATIONAL ECONOMY AS A FACTOR OF ITS INNOVATIVE DEVELOPMENT

Topicality. In modern conditions, science and technology play a decisive role in the effective development of the economies of advanced countries. At the same time, in Ukraine during the years of independence science has lost its influence on socio-economic development due to the lack of an effective system of converting research results into concrete economic achievements, and the state's inability to create the necessary conditions and incentives for knowledge transfer.

Aim and tasks. The purpose of the article is to substantiate the interactive model of scientific knowledge transfer to the national economy as a basis for developing practical recommendations for state regulation in this sphere, in the conditions of transition to the knowledge economy.

Research results. The conceptual base of the interactive model of scientific knowledge transfer to the national economy is substantiated. In particular, the characteristics of the knowledge economy that determine the features of state regulation of the scientific knowledge transfer, namely, the emphasis on the dissemination of knowledge, not on their creation; resource approach to knowledge, and their focus on action. The classification of types of knowledge in the knowledge economy is given, and the special role of implicit knowledge is emphasized, which requires direct contact for its transfer or active participation and presence of persons who possess it. The models of the innovation process in the knowledge economy are considered and the predominance of the interactive model of innovations is shown, according to which the innovation arises as a result of interaction between knowledge producers and consumers of knowledge, which exchange both with codified and implicit knowledge.

An interactive model of scientific knowledge transfer to the national economy has been developed and its distinction from the linear model of scientific knowledge transfer has been shown. Approaches to the state regulation of the scientific knowledge transfer have been formed, according to linear and interactive models based on the concept of "market failures".

Conclusion. State regulation of the scientific knowledge transfer to the national economy of Ukraine should move away from a narrow understanding of this activity as the commercialization of technology, and reduction of regulatory measures in this area to intellectual property rights protection and "technology push" measures. There is a need for a broader understanding of knowledge transfer as an interactive process involving interaction between different stakeholders, and state regulation in this area should be aimed at mitigation the risks associated with the coordination and network failure of knowledge transfer actors; funding infrastructure and activities aimed at stimulating interaction between knowledge transfer stakeholders, encouraging the exchange and joint creation of knowledge.

Keywords: knowledge economy, scientific knowledge transfer, innovative development of the national economy, state regulation of the scientific knowledge transfer, interactive model of scientific knowledge transfer.

Problem statement and its connection with important scientific and practical tasks. In modern conditions, scientific knowledge plays a decisive role in the advanced countries' economies' effective development. The knowledge intensity of GDP is growing rapidly, the number of people employed in the scientific and technical sphere is increasing, as well as funds for its financial and resource provision. The world market for science-intensive products is growing 2–2.5 times faster than the growth rate of the world economy. At the same time, in Ukraine during the years of independence, science has lost its influence on socio-economic development. According to the Global Competitiveness Index (GIC) in 2017–2018, Ukraine ranked only 81st (out of 137 countries surveyed). At the same time, according to some indicators of the development of the educational and scientific sphere, Ukraine is ahead of most countries in the world, in particular: availability of scientific and engineering personnel – 25th place; coverage of the population with higher education – 16th; the quality of teaching mathematics and natural sciences – 27th; development of higher education and vocational training – 35th; the quality of primary education – 42nd; the quality of research institutions – 60th; 52nd in the number of patents for inventions per million people [1]. This indicates the lack of an effective national system to transform the results of scientific research into concrete economic achievements, the inability of the state to create the necessary conditions and incentives for the transfer of scientific knowledge to the production sphere.

At the same time, such a strong innovation potential of Ukraine, especially in terms of its educational and scientific component, does not turn into a concrete economic result, which is due to the imperfection of the mechanism of knowledge transfer from the scientific sphere to production.

Analysis of recent publications on the problem. The issues of knowledge and technology transfer from the scientific sphere to production are becoming more and more popular among researchers, which is connected with the increasing attention of scientists to the problems of forming the knowledge economy. The basis of this study was done by the works of such foreign scientists as B. Godin, P. David, B. Johnson, B.-A. Lundvall, F. Mahlup, E. Rogers, D. Forey, and many others. Among domestic scientists should be noted the works of B. Grinyov, V. Denisyuk, S. Korsunsky, V. Omelyanenko, T. Kvasha, O. Pichkur, V. Solovyov, and others.

Allocation of previously unsolved parts of the general problem. The vast majority of research conducted by domestic scientists is mainly related to technology transfer (a narrower category that describes the processes of codified knowledge transfer, embodied in material media). At the same time, the processes of implicit knowledge transfer, which is embodied in the skills and experience of individuals, are left out of their attention. In addition, the model of state regulation of knowledge and technology transfer traditionally for domestic economics is based almost exclusively on the linear approaches to the innovation process, which contradicts the latest global trends in scientific thought and practice of state regulation of economically developed countries, associated with the transition to a knowledge economy.

Formulation of research objectives (problem statement). The purpose of the research is to substantiate the interactive model of scientific knowledge transfer to the national economy as a basis for developing practical recommendations for state regulation of this sphere, which are inherent to the transition to a knowledge economy.

An outline of the main results and their justification. Analysis of modern approaches to public policy-making has shown that recently more and more scholars view policy as a process of the argumentation and the formation of the conceptual frameworks that structure political action (unlike the previous approaches, which were based on rationalism in decision-making, studying stages of policy elaboration, choice of tools for their implementation, etc.). Policy development, from the first stage of awareness of the problem to the final - the implementation of measures, becomes a conceptual process [2, p.35]. Conceptual frameworks (or frames) are defined as "the way of selecting, organizing of information about the surrounding reality, its interpreting and understanding", in addition, they "form guidelines for cognition, analysis, consultation and action" [3].

This approach was taken by the author as a basis for justifying the interactive model of the state regulation of the transfer of scientific knowledge to the national economy.

In our opinion, the elaboration of the knowledge transfer state regulation model should be based on the following conceptual basis: the knowledge economy concept; the typology of knowledge in the knowledge-based economy with the emphasis on the special role of the implicit knowledge; the models of the innovation process in a knowledge economy which proceed from different types of knowledge transferred (Fig. 1)

Fig. 1. The conceptual framework for an interactive model of knowledge transfer
Developed by the author

The following features of the knowledge economy and its distinction from other types of economy determine the essence of the process of transfer of scientific knowledge to the production sphere.

The concept of a knowledge economy comes from Fritz Machlup [4, p.3], who in 1962 published an influential study that measured the production and distribution of all kinds of knowledge in the United States [5]. Machlup estimated that, in 1958, the knowledge economy accounted for \$136.4 million or 29% of GNP. He was the first to measure knowledge as a broad concept, while other measurements were concerned with the production of scientific knowledge, namely research and development (R&D), not its distribution. So according to the concept of "knowledge economy", its main difference from other types of economies is a new type of relationship, where the emphasis is made not on the creation of knowledge, but on the processes of knowledge dissemination as a key economic resource.

The other feature of the knowledge economy – is the resource approach to knowledge and the focus on the action which means that the main resource of the knowledge economy – the results of intellectual activity will not have any impact on economic development without their proper use. A limited resource in the knowledge economy is not knowledge by itself, but the possibility to use it [6, p.34; 7, p. 41, 44-45; 8, p. 72].

The next conceptual frame for building the knowledge transfer state regulation model is the distinction between explicit and implicit knowledge, which is necessary to make in the knowledge economy. Explicit knowledge includes knowledge related to knowledge of facts or "know-what", and knowledge related to

knowledge of the principles and laws of nature – "know-why". It can be expressed in words and numbers and transmitted in a formalized (codified) form on appropriate media to a large number of consumers [9; 10]. Explicit or codified knowledge includes such a concept as "technology" – "a set of methods, processes, and materials used in any field of activity, as well as a scientific description of these methods" [11]. Implicit knowledge ("know-how" – refers to the skills and ability to do something, and "know-who" – contains information about who knows what and knows how to do what) – is a personal knowledge that is inextricably linked to its carrier, consists of skills, abilities, capabilities of people and their mental models. Unlike explicit, implicit knowledge is more difficult to codify and measure, so it requires direct contact for its transmission or the active involvement and presence of the individuals who possess it [9; 10].

From the above, we can conclude that the category of "knowledge" is broader than the category of "technology", which is only one of the types of knowledge.

From the above we can make a conclusion that "knowledge transfer" is a much broader concept than "technology transfer" and includes both explicit knowledge transfer (codified knowledge, information, or technology) and implicit knowledge transfer (Fig. 2).

Fig. 2. Typology of knowledge transfer depending on the type of knowledge transferred

Developed by the author

These differences between the categories of "knowledge transfer" and "technology transfer" further determine the various instruments and measures of public policy to stimulate them.

Another conceptual frame, which is important while elaborating the knowledge transfer state regulation model is the interactive nature of innovation processes. In the context of the transition to the knowledge economy models of the innovation process evolved from linear one, according to which innovation is a process that begins with the discovery and occurs through a fixed and linear sequence of phases; from this point of view, innovation begins with new research, progresses successively through the stages of development, production, and marketing, and ends with the successful sale of new products, processes, and services – to an interactive model according to which innovation arises from the interaction between producers and consumers, that exchange of both codified and implicit knowledge [10].

Based on outlined conceptual frameworks (fig. 1) the interactive model of scientific knowledge transfer state regulation was elaborated, which consists of the following elements: "type of knowledge"; "characteristics of knowledge transferred"; "characteristics of the knowledge transfer process"; "mechanisms of knowledge transfer"; "knowledge transfer channels"; "approaches to state regulation of the knowledge transfer". Comparative characteristics of the linear and interactive models of knowledge transfer are presented in table 1.

Linear models of knowledge transfer are used for codified knowledge, which has the nature of the information. Knowledge transfer in this model is seen as a one-way and linear process when the creator of knowledge transmits a certain result to another party. Linear models of knowledge transfer are divided into the "transfer of public knowledge" model – open dissemination of research results, and the "knowledge transfer based on intellectual property" model – commercialization, transfer (purchase) of intellectual property rights created as a result of research conducted.

An interactive model of knowledge transfer is used for implicit knowledge, which considers knowledge transfer as a complex, systematic process that includes interaction between different participants in the innovation process and involves the exchange and joint creation of knowledge.

The next component of the interactive knowledge transfer model is the channels through which knowledge is transferred to the business sector. For linear models of knowledge transfer, the most appropriate channels are: publications of scientific research, reports at scientific conferences, etc. (model of “public knowledge transfer”), as well as licensing, transfer (sale) of intellectual property rights, etc. (model of “knowledge transfer based on intellectual property”). The interactive model of scientific knowledge transfer provides for the use of the following channels: scientific expertise, joint and contract research, creation of spin-off and spin-out companies, employment of scientists in enterprises, etc.

Table 1.

Models of scientific knowledge transfer to the national economy

	Linear knowledge transfer models	The interactive knowledge transfer model
Type of knowledge	Explicit (codified)	Tacit
Characteristics of knowledge	1) Knowledge as a public good 2) Knowledge as a commercial asset	Knowledge as an interactive process
Characteristics of the knowledge transfer process	Linear, chain process	A complex, systematic process that includes interaction between different owners of knowledge (knowledge exchange, joint knowledge creation)
Mechanisms of knowledge transfer	1) Open dissemination of knowledge 2) Commercialization of research results	3) Introduction of mechanisms to facilitate interaction between universities, industry, and other stakeholders in the process of knowledge transfer
Knowledge transfer channels	1) Publication of research results, reports at scientific conferences, etc. 2) Licensing, transfer (purchase) of intellectual property rights created as a result of scientific research	Scientific expertise; joint and contract research; creation of spin-off and spin-out companies, academic mobility; employment of scientists at enterprises, etc.
Approaches to the state regulation of knowledge transfer	1) Public funding of research to correct "market failures", in particular, disregard for positive externalities. 2) Creation of the intellectual property rights protection system, which generates incentives to invest resources in the production of knowledge and incentives to transfer (commercialize) knowledge.	State aid aimed at leveling the risks associated with the coordination and network failures of the knowledge transfer stakeholders; financing of infrastructure and other measures aimed at stimulating interaction between knowledge transfer stakeholders: joint knowledge creation, knowledge exchange, training, etc.

Developed by the author

The nature of the state regulation of knowledge transfer processes is determined depending on the type of market “failures” inherent in each of the models of knowledge transfer.

It is established that knowledge that is easily codified, has the nature of information, and is easily transferred from one person to another. This type of knowledge has certain properties of “public good” that cause “market failure” because competitive markets do not create sufficient incentives for private agents to produce the amount of knowledge optimal for society. In the model of “public knowledge transfer” overcoming such a “market failure” is carried out on the basis of state funding of research and open dissemination of their results in the form of publications, presentations, and more. This model is consistent with the aim of maximizing the external effects of knowledge and is based on the assumption that there is no need for any mechanisms to support knowledge transfer.

In the model of “knowledge transfer based on intellectual property” “market failures” in the knowledge production are overcome by creating a system of intellectual property rights, which generates

incentives to invest resources in knowledge production and incentives to transfer knowledge from one agent to another.

In the “interactive knowledge transfer model”, which involves direct interaction between the owner of knowledge and its recipient, when knowledge is jointly created rather than simply transferred, “market failures” are associated with coordination and network failure of knowledge transfer stakeholders and corrected by measures to support their interaction.

Conclusions and perspectives of further research. The challenge of the development of a modern knowledge-based economy in Ukraine has posed to the domestic theory and practice of state regulation the urgent task of revising the methodological tools for shaping state policy of scientific knowledge transfer to the national economy. The linear model of innovations, on which Ukrainian scientists and policymakers still rely, does not meet the requirements of time and cannot ensure the formation of adequate modern mechanisms for transforming Ukraine's significant educational and scientific potential into concrete socio-economic achievements. The technology transfer policy should be replaced by a modern knowledge transfer policy, which is based on the interactive model of innovation. State regulation in this sphere should move away from measures aimed at stimulating commercialization of research through the protection of intellectual property rights and “technology push” to broader measures, which consist in mitigation of the risks associated with the coordination and network failure of knowledge transfer actors; funding infrastructure and activities aimed at stimulating interaction between knowledge transfer stakeholders, encouraging the exchange and joint creation of knowledge, etc.

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