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SOCIO-ECONOMIC EFFICIENCY OF DISTRIBUTION THE INNOVATIVE DIFFUSION IN THE DIFFERENT DEVELOPED SYSTEMS/COUNTRIES

Summary

This chapter presents the results of research on the socio-economic efficiency of distribution the innovative diffusion in the different developed socio-economic systems. The essence of the socio-economic efficiency of the innovative diffusions determined and the classification of the socio-economic efficiency of distribution the innovative diffusion developed by highlighting such a feature as the level of resultiveness and socio-economic efficiency of the innovative diffusions. It proposes to distinguish the following levels of this feature: very low level; low level; average level; high level; very high level of resultiveness and socio-economic efficiency of innovative diffusion. Diffusion of innovation conceptualized as one that includes a number of broad economic indicators and indicators to assess the socio-economic efficiency of the innovative diffusion at the macro and micro levels. It states that the choice of appropriate indicators occurs contextually depending on the characteristics of each subject of a developed system in the formation of the main prerequisites for the successful implementation of innovations. Based on foreign cases, the authors prove the relationship between innovation and productivity, when the level of productivity is used as an indicator of assessing the socio-economic efficiency of the development of innovative diffusion in the developed socio-economic systems. It is established that the result of the introduction of innovations in production processes promotes economic growth, which

allowed to eradicate two differentiated models of groups of countries in terms of their productivity. The analysis of indicators for assessing the socio-economic efficiency for the development of innovative diffusion in the different developed systems proved their multivariance, however, the authors proposed to use a generalizing indicator of the socio-economic efficiency for the development of innovative diffusion. It established that the systemic effects of the innovative diffusion – multiplicative and synergistic – arise from the interaction of various innovation types in the process of their diffusion and enhance the perception and commercialization of innovations. To assess the effects of distribution the innovative diffusion, it proposes to use a set of relevant indicators based on the formalization of the synergistic effect of distribution the innovative diffusion in the developed socio-economic systems. Emphasis is placed on the study of specific effects and their role at different stages of the dynamic diffusion process for successful observation of systemic effects (multiplicative and synergistic) of innovative diffusion.

Introduction

This chapter is devoted to assessing the socio-economic efficiency of distribution the innovation diffusion in the different developed socio-economic systems, since the significance of innovation for the economy development is undoubtedly great. At the same time, the authors note that effective innovation can only be due to the diffusion of innovations, that is, the effective distribution of innovations themselves, and the prospects for their implementation depend on the development degree of socio-economic systems (countries, regions, and territories).

In addition, in the modern world, it is increasingly important not only to improve technology, but also to develop human capital. This means that economic growth at all levels of government is based on innovations not only of a technological, but also of a socio-economic nature. Now the economy is characterized by a transitional period, which is a specific stage in the development of society as a whole, which actualizes and accelerates the development of all socio-economic systems. For the implementation of this process, it is vital to maintain a balance between the interests of developed and developing socio-economic systems, where the innovations play the role of a driver. In this context, the distribution of innovative diffusions concept is growing that helps to mitigate the contradictions in the system and direct the process of society's perception of innovations in the right direction. Therefore, the distribution the innovation diffusion in the different developed socio-economic systems requires detailed research in the context of its socio-economic efficiency.

Socio-economic efficiency of distribution the innovative diffusion in the developed socio-economic systems is usually more active, so to determine the level of activity, one can use indicators to assess the socio-economic efficiency of distribution the innovative diffusion, which vary depending on the degree of

the socio-economic system development. Based on the assessing the results/socio-economic efficiency of the innovative diffusion, specialists have formed a classification of the diffusion types, however, the issue of its deepening remains relevant today. The timeliness of these issues and the expansion of the range of scientific research in the field of socio-economic efficiency of distribution the innovative diffusion in the different developed systems requires the definition of the synergistic effect and other effects, in particular multiplicative, in a formalized form. Aspects of assessing the socio-economic efficiency of distribution the innovative diffusion in the developed socio-economic systems arise in a modern scientific direction, which requires deep analytical research.

Part 1. Classification of socio-economic efficiency the distribution of the innovative diffusion in the developed systems

It knows that the Swedish scientist T. Hägerstrand is the author of the theory of innovative diffusion, who emphasized that innovations connected with the territory; they influenced, transformed and shaped. Of particular importance, there are the territory size and the people location in the country or region where innovations introduced, as well as the availability of transport communications, administrative and state borders. Depending on the socio-economic development of countries (as socio-economic systems), they are divided into developed, developing and undeveloped.

The International Monetary Fund (IMF) classifies countries into advanced countries and developing countries, the latter of which shown in the Table 1. The following indicators used as criteria: level of per capita income, level of export diversification, degree of state integration into the world financial system.

Countries that have developed socio-economic systems are countries with the greatest economic development, dominated by the third and fourth technological structures, which stipulate by the innovative aspect. Technological progress is a priority for all those countries that seek to support economic development, as innovation is widely seen as an important force for launch and growth. This approach to economic development usually characterizes by high per capita income and a maximum human development index. Such countries have huge financial resources and they account for 9/10 of foreign investment, that is, long-term capital investment directly in industrial enterprises, agriculture, trade and other branches of economic activity. They are economically developed countries – members of the Organization for Economic Co-operation and Development (OECD) and the so-called Paris Club, which controls the world financial market.

Table 1

Developing countries of the world

Regions	Countries
Europe	Albania, Bosnia, Herzegovina, Bulgaria, Georgia, Croatia, Kosovo, Moldova, Northern Macedonia, Montenegro, Romania, Serbia, Ukraine, Turkey
CIS	Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan
Asia	Bangladesh, Bhutan, Brunei, Cambodia, China, Fiji, India, Indonesia, Kiribati, Laos, Malaysia, Maldives, Marshall Islands, Micronesia, Mongolia, Myanmar, Nepal, Palau, Papua New Guinea, Philippines, Samoa, Samoa, Samoa Lanka, Thailand, East Timor, Tonga, Tuvalu, Vanuatu, Vietnam
Latin America and the Caribbean	Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela
Middle East, North Africa	Afghanistan, Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, UAE, Yemen
Tropical Africa	Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Republic of the Congo, Côte d'Ivoire, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe

Source: [1]

The main regularity of these countries is the presence of a highly developed economy, which combines the activities of the state and powerful groupings of national and transnational capital, created by attracting innovations. A particularly prominent place among them occupied by the countries of the so-called «Big Seven» (Group of Seven – G7). These are the USA, Japan, Germany, France, Great Britain, Italy and Canada. These countries are characterized by the following features: they are all post-industrial or industrial; their large corporations' control, directly or indirectly, the bulk of the productive forces of the world economy; the ruling circles and the capital of these countries hold real means of control over world political and economic processes in their hands [1].

In the developed and developing countries, the distribution efficiency of the innovative diffusion assessed, in particular, how they work for the effective development of the socio-economic system.

It known that the efficiency category can be attributed as one of the keys in science and economics, as well as one of the most important indicators of the development of socio-economic systems. As an economic category, efficiency provides a general quantitative and qualitative characteristic of the resultiveness for the development of socio-economic systems.

It generally accepted that the term «efficiency» first appeared in the economic literature in the works of V. Petit (1623–1687) – the English economist, the founder of classical political economy, the founder of the labor theory of value and the head of the school of physiocrats, the French economist F. Kenet (1694–1774). However, they did not develop «efficiency» as an independent economic concept. Most authors agree that the founder of the theory of economic efficiency is the outstanding Scottish economist A. Smith. Later his ideas developed in the works of D. Ricardo, K. Marx and others.

In the Ukrainian economic literature, the concept of «efficiency» is devoted to many scientific works and studies. In general, efficiency (transl. from Latin – effective, productive, which gives a result) characterizes developed systems, processes, phenomena; therefore, it acts as a development indicator of socio-economic systems. In addition, this category is also considered in the paradigm of foreign economic activity, in particular in the theory and practice of the state, region, industry and, secondly, the primary link of the national economy-enterprise. As a category, it has two sides – qualitative and quantitative: the qualitative side reflects its content, that is, the essence of the category, and the quantitative side reveals the operation of the law of saving time, resources, capital, and finance. It reflects their savings in achieving goals in the course of the reproduction process in its individual phases on the scale of the entire national economy, its individual regions, types of economic activity, economic entities, etc.

Table 2 presents the scientific approaches of various scientists to the essence interpretation of the concept of «efficiency» as well as the author's own definition of the socio-economic efficiency the distribution of the innovative diffusion as the ratio of the result obtained from the diffusion of innovations and the costs of their distribution. However, in order to form a classification of the socio-economic efficiency the distribution of the innovative diffusion, it is necessary to identify the types of diffusions.

The classification of the innovative diffusion types systematically and reasonably highlighted in the scientific works of R. Bivand [3], L. Vankovich [4], M. Dibra [5], Y. Zhai [6], V. Mahajan [7], P. Pererva, E. Rogers, J. Schumpeter and other scientists. Ukrainian scientists carried out a classification of innovative diffusions types, which proposed to clarify by highlighting the levels of performance and socio-economic efficiency of innovative diffusion (Figure 1). The presented classification can deep and expand to the definition of additional characteristics.

Table 2

Approaches of different authors to the interpretation of the concept essence of «efficiency»

Authors	Definition
V. Anfilatov	Efficiency is a complex property (quality) of the system functioning process, characterizes its adaptability to the achievement of the operation goal. The efficiency of a process is the degree to which it is adapted to achieve its goals. Efficiency criterion is a generalized indicator and a rule for choosing the best system.
Yu. Vertakova, O. Symonenko	Efficiency – the resultiveness of a process, operation, project, is defined as the ratio of the effect, the result to the costs that caused its receipt (relative indicator)
Economic Encyclopedia (ed. By S. Mocherny)	Efficiency is the ability to bring an effect, the resultiveness of a process or a project, etc.; it defined as the ratio of the effect, the result to the costs that provided this result.
N. Krasnokutska	Efficiency – comparing the results with the costs that provided this result.
V. Koyuda, L. Lysenko	Efficiency is a characteristic of an object (process, project, phenomenon), which reveals the degree of completeness and quality of achieving goals based on a system of indicators.
O. Skibitsky	Efficiency reflects the ratio of the effect to the costs that caused it or, conversely, the costs to the effect.
V. Solovyov	Efficiency in a broad sense is an economic category that disclosed because of a set of absolute and relative indicators. Efficiency in a narrow aspect understood as a relative indicator characterizing the ratio of the effect to the costs that caused it.
A. Chevvyachenko	Efficiency is a multidimensional concept that used only in relation to a purposeful action or process. Efficiency – the ratio of the activity result to its needs, goals and expenses.
V. Shvandar	Economic efficiency is an absolute indicator that determines by the ratio of the effect obtained with the costs or resources that used to achieve this effect. The criterion of efficiency is the maximization of the effect (profit) at the corresponding costs or minimization of the costs to achieve a given effect.
Own author's approach	The socio-economic efficiency the distribution of the innovative diffusion is the ratio of the obtained result and the costs for innovations distribution.

Source: [2]

According to the level of resultiveness and socio-economic efficiency of innovative diffusion (RCEE), it proposed to distinguish the following levels: very low, low, medium, high and very high level of innovative diffusion. This gradation is important in a specific environment (world, national market, region, enterprise, etc.).

In addition, modern scientists distinguish:

– cost-efficiency of research and development and their implementation, which provides for assessing the effectiveness of applied scientific and technical developments as potential innovations at all stages of their life cycle; comparison of the obtained results with domestic and foreign counterparts and establishing compliance with the best world counterparts;

Classification of types and results/socio-economic efficiency of innovative diffusion

By object:
diffusion of creative ideas brought to the level of know-how;
diffusion of innovations (innovative products, innovative technologies);
diffusion of property rights to use innovations and brands.

By geographical coverage:
national diffusion (diffusion at micro, meso and macro levels);
international diffusion (regional, continental, global).

By diffuser type:
diffuser-innovator;
diffuser-early recipient;
diffuser-early centrist;
diffuser-late centrist;
diffuser-conservator.

By mode type:
gravitational diffusion model;
epidemic diffusion model (expansive diffusion, relocation diffusion, hierarchical diffusion, two-phase diffusion, focused diffusion, explosive diffusion);
equilibrium diffusion model, consumer behaviour prediction, learning benefits, explosion.

Other signs of classification

By level of resultiveness and socio-economic efficiency of innovative diffusion:
very low level of socio-economic efficiency of innovative diffusion;
low level of socio-economic efficiency of innovative diffusion;
average level of socio-economic efficiency of innovative diffusion;
high level of socio-economic efficiency of innovative diffusion;
very high level of socio-economic efficiency of innovative diffusion

Figure1. Classification of diffusion types and results/socio-economic efficiency of innovative diffusion

Source: author's development

– implementation efficiency of innovative projects within the framework of technology parks, which provides for the assessment of the effectiveness directly for the technology park based on the efficiency criteria of innovation projects; comparison of innovation projects efficiency within technology parks in general;

– efficiency of investment projects and their selection for financing. It provides for an assessment of the economic feasibility of further project development (socio-economic and commercial efficiency), determination of the financing scheme and the participation effectiveness in the project of participating enterprises and higher-level structures (national, sectoral, regional efficiency); determination of the organizational and economic mechanism for the implementation of the project, the composition of the participants and financing [2].

In general, scientists distinguish the following types of efficiency from the distribution of the innovative diffusion: economic, social, environmental, political, scientific and technical, socio-political, ethnic-cultural, marketing, financial, regional, national, resource [2].

In the developed socio-economic systems for the positive result and high socio-economic efficiency of innovative diffusion, it is important to meet the following conditions: diffusion process should be incessant; diffusion process reaches its saturation when the need for innovation used by business entities is fully met; diffusion that provides a broad impact of innovation on the development of the socio-economic system; diffusion itself is essentially the replacement of outdated technologies or products with new ones.

The research found that the speed of socio-economic efficiency the distribution of the innovative diffusion in social and economic systems of developed countries depends on the following factors: nominal wages per 1 employee; gross regional product per capita; investment per capita; number of operating enterprises; population density; population; population structure: number of employed and unemployed.

Part 2. Indicators of evaluation the socio-economic efficiency of development the innovative diffusions of the developed systems

Undoubtedly, evaluation of the socio-economic efficiency of development the innovative diffusions of the developed socio-economic systems carry out using the data of official statistical reporting contains a limited number of indicators characterizing the effectiveness of the innovative diffusion development. However, it should note that for developing countries, data concerning the development of patenting activity, the level of business development, the ability to retain an educated workforce and the rate of creation as well as the growth of new innovatively active enterprises are important. For undeveloped countries, some of these data are losing their relevance. In particular, the lower the level of development of the country the less interesting and relevant are the data on research and development.

The creation and development of innovatively active enterprises is a problem for any country in the world. Therefore, the introduction of innovative surveys (questionnaires) conducted in developed countries can also be useful in other countries, if they will be adapted to specific challenges and needs.

Another modern tool for evaluation the socio-economic efficiency of development the innovative diffusions of the developed socio-economic systems is the audit of obstacles to innovation (when the key limiting factors for innovative diffusion and the introduction of innovations are determined). Such a tool should be thoughtful, well designed, executed by reliable actors, and presented as a dynamic result, not a constant. Few state authorities, even in developed countries, have introduced systematic mechanisms for evaluating the socio-economic efficiency of development the innovative diffusions. Often these assessments carry out on the creation of a national commission, which tasks with proposing a strategic plan for the development of a particular sphere of society's life or a broad reform.

Another tool for assessing the socio-economic efficiency of development the innovative diffusions is the activities carried out by international organizations. The OECD through its reviews of science, technology and innovation and Eastern Europe have extensively developed this practice in transition. These reviews, carried out with the help of international experts, did not always lead to major reforms, but were useful in informing debate among key innovation policy-makers. In recent years, other international organizations such as UNCTAD and UNESCO have begun to use and adapt the OECD methodology to carry out similar types of innovation policy surveys in a number of developing countries.

The key to success in the diffusion of innovations in any country is the development of state and local authorities, as well as communities interested in this process, justifies the importance of identifying indicators for evaluation the socio-economic efficiency of development the innovative diffusions. It is also important to assess the real results from the diffusion of innovations, which can carry out using an appropriate set of indicators.

According to the WBI knowledge assessment methodology, (120 countries are included in the database) indicators for evaluation the socio-economic efficiency of development the innovative diffusions of the developed systems are determined:

– gross foreign direct investment, percentage of GDP;
– number of researchers in the field of innovation;
– total expenditures on R&D, percentage of GDP;
– level of cooperation between universities, scientific institutions and business in the field of research;
– export of high technologies, percentage of production;
– payments of royalties and license fees (mln USD);
– number of royalties and licenses;

– coefficient of student enrolment in science (percentage of students of higher education level);
– patent applications granted by the USPTO;
– expenditures of the private sector on R&D [8].

Worldwide experience proves that there is a proven relationship between innovation and productivity. That is, the level of productivity uses as an indicator for evaluation the socio-economic efficiency of development the innovative diffusions of the developed socio-economic systems. At any given time, the productivity level of each economy is a positive function, depending on the economy readiness to innovate through R&D and transpose it into production activities. The introduction result of these innovations into production processes contribute to economic growth: the greater number of innovations adopted and widespread in the economy, the higher productivity level of this economy [8].

In addition, scientists note that there are two differentiated group models of countries according to their productivity level (Figure 2).

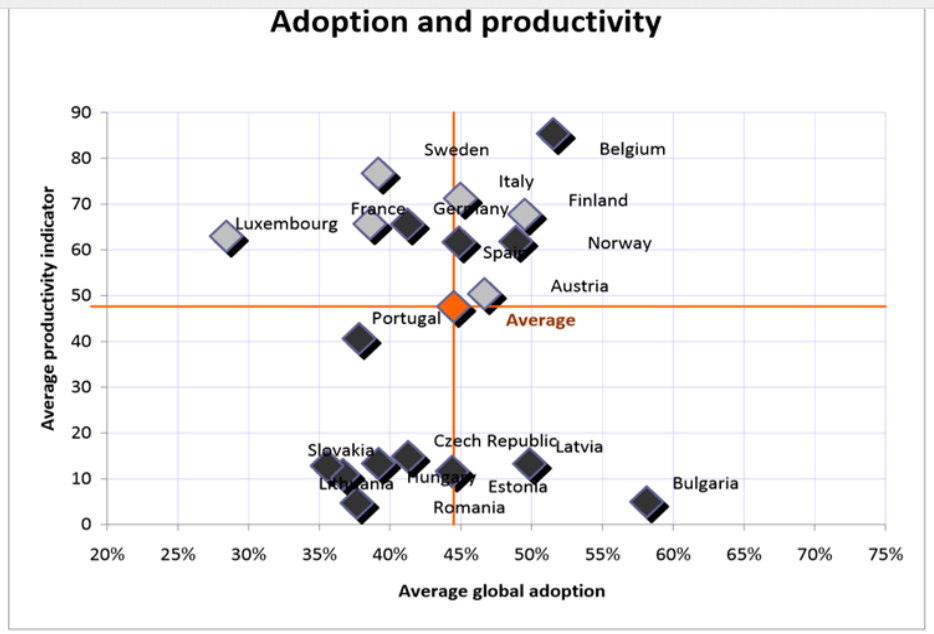

Figure 2. Diffuseness of innovation and productivity gains at the country level

Source: [9]

Countries with average level of productivity (Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, Norway and Spain) have a clear positive correlation with a significant value of 32.4% with the adoption of innovations. Conversely, countries with low level of productivity (Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Portugal, Romania, Slovenia and Slovakia) do not show significant correlation (value 16.4%, insignificant).

Therefore, the innovative diffusion of the socio-economic system has a direct impact on the level of its productivity, which increases, probably due to the presence of other intangible assets, such as human and social capital, entrepreneurship.

On the other hand, in sectors such as the production and distribution of electricity, gas and water in some countries (Belgium, Denmark, Spain, Italy, Portugal, Sweden and France), innovations introduced at different rates. At the same time, the distribution of the innovative diffusion theory solves the problems of not only the macroeconomic model of costs/benefits. Diffusion of innovation can conceptualizes as containing a number of broad economic indicators that measure, among other things, its social perception. In addition, the distribution of this theory overcomes the limitations of its application only at the micro level, since the theory is one of the most popular, that use in the developed and developing countries of the world [9].

As for Ukraine, to evaluate the results of innovative diffusion, scientists used the method of neural networks – Kohonen maps and conducting a cluster analysis of thirty innovatively active enterprises that made possible to build a model for assessing the enterprises readiness to implement innovations. It allows assessing the readiness by setting the following values: indicator X1 – «level of the crisis enterprise state» and indicator X2 – «activity of introducing innovations». The model built using the Surface Viewer module in an interactive environment for modelling nonlinear dynamic systems MATLAB (Figure 3). Evaluation the socio-economic efficiency of development the innovative diffusions is based on a large number of indicators, but their choice must be justified, on the one hand, their significance, and on the other hand, the laboriousness of collecting indicators. Table 3 demonstrates the system of indicators proposed by V. Miachyn [10], which can use to evaluate the socio-economic efficiency of innovative diffusions at the micro level. The assessment of socio-economic efficiency of development the innovative diffusions can also carry out at the national level.

Table 4 presents a fragment of the indicators system for the national level, formed on the results of scientific research by H. Anderson and J. Stejskal [11], M. Afzal [12], P. Koiuda and I. Sheiko [2], H. Moon [13], A. Rickne [14].

The analysis of indicators the socio-economic efficiency of development the innovative diffusions prove the insufficiently high level of innovative diffusions development in all industries of Ukraine: for instance, this process in 2018 observed only at 16.42% of enterprises. At the same time, we observe the maximum innovative activity at pharmaceutical enterprises (55.74%), among manufacturers of computers, electronic and optical devices (37.63%), motor vehicles, trailers and semi-trailers and other vehicles (31.14%) and in mechanical engineering as a whole – 29.8%.

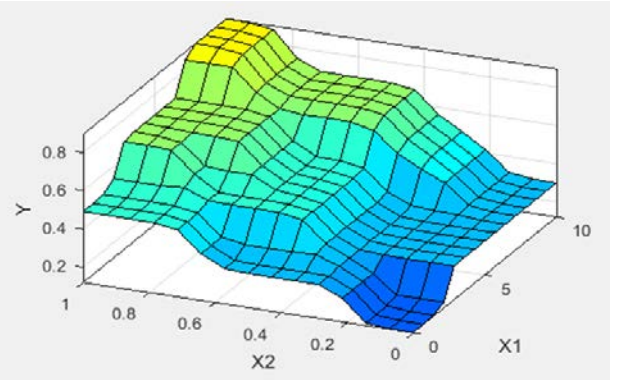

Figure 3. Visualization of the innovative diffusion results (Y) depending on the input variables X1 (level of the crisis enterprise state) and X2 (activity of introducing innovations)

Source: [9]

Table 3

Indicators` system of evaluation the socio-economic efficiency of development the innovative diffusions at the micro level

Components	Indicators	Weighti-ness
Production	fixed assets renewal coefficient	0,500
	share of active part of fixed assets	0,333
	presence of progressive technological processes	0,167
Financial	financial independence coefficient	0,500
	return on equity	0,333
	share of R&D expenses in total production costs	0,167
Personnel	staffing coefficient of highly qualified personnel	0,500
	staff development coefficient	0,333
	share of R&D workers in the total number	0,167
Scientific	ratio of the innovation to the volume of sold products	0,500
	share of internal R&D in total innovation spending	0,333
	security level of the enterprise with patents, licenses, know-how	0,167
Marketing	competitiveness of innovative products	0,500
	share of sold innovative products that are new in the market	0,333
	share of sold innovative products at the enterprise	0,167
Information	coverage coefficient of the collected information to the needs of enterprise	0,500
	promptness of collection, processing, transmission and use of information	0,333
	frequency of updating the information base	0,167
Organizational and managerial	assessment of the organizational and management structure in terms of promoting the innovative products at the enterprise	0,500
	assessment of the planning and control system in terms of promoting the innovative products at the enterprise	0,333
	the degree of innovations perception by the management of enterprise	0,167

Source: [10]

Table 4

Fragment of the indicators system for evaluation the socio-economic efficiency of development the innovative diffusions at the national level

Directions of evaluation	Share indicators
Innovative spending	Share of innovation costs in total production costs
	Share of research and development costs in GDP
	Share of costs for the acquisition of labor and equipment for the diffusion of innovations
	Share of marketing and advertising costs for the diffusion of innovations
Product nomenclature (assortment) updates	Share of fundamentally new products in the volume of sold innovative products
	Share of improved products in the volume of sold innovative products
	Share of innovative products sold outside Ukraine in the total volume
	Share of improved products sold outside Ukraine in the volume of improved products
Innovative activity	Coefficient of activity of patent and licensing operation
	Coefficient of own developments use
	Coefficient of new products introduction
	Coefficient of technology renewal
	Coefficient of seeking funds activity for financing innovations
Structure of financing sources for the development of innovative diffusions	Sustainability of relations with creditors and investors
	Funding volumes for the development of innovative diffusions in the country
	Share of borrowed funds for the development of innovative diffusions in total funding
	Share of costs for the development of innovative diffusions in the amount of fixed capital investment
Efficiency of development the innovative diffusions	Efficiency of using resources for the development of innovative diffusions
	Efficiency of using resources for the development of innovative diffusions by industry
	Net profitability of innovations
	Return on equity from the sale of innovative products
	Share of the innovative products volume created in the process of innovative diffusion in the total volume of manufactured innovative products

Source: author's development

All member states of the European Union grouped according to the level of innovation diffusion activity. The first group of innovation leaders includes member states that are 20% more efficient than the EU average, namely Denmark, Finland, Luxembourg, Netherlands, Sweden and United Kingdom. The second group of strong innovators are those who have reached a level higher than the EU average, but not higher than 20% of the average (Austria, Belgium, France, Germany, Ireland, and Slovenia). The third group of

moderate innovators, including member states, whose efficiency is between 50% and 90% of the EU average (Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia and Spain). Fourth, modest innovators, including member states, which demonstrate efficiency levels below 50% of the EU average (Bulgaria and Romania) [15].

Based on the results of the case study of enterprises according to Forbes (The World's Most Innovative Companies) and BCG (The Most Innovative Companies Ranking), the phenomenon of «innovator reputation» discovered. It is an indicator of a successful excellent innovative enterprise, closely correlates with such an indicator as efficiency of innovations.

R. Moreno, C. Autant-Bernard, S. Chalaye, F. Manca, J. Suriñach in the analytical materials «Design and construction of a set of indicators for innovation production and adoption in EU countries» [16] note that it is important to highlight specific indicators, which can be obtained using primary information (from the business entities themselves) in order to be able to compare these indicators not only at the micro level, but also in the international scale. The proposed indicators characterize the data using both for the innovation's adoption and for distribution, but this is not accidental. Such an integrated approach will allow measuring the innovation adoption index with similar «interstate» comparability for EU member states and, at the same time, based on micro- and meso-level data. Consequently, the degree of innovation distribution measures as the share of enterprises adopting innovations using the following ratio (indicator 1): level of innovation distribution by enterprises / total number of innovative enterprises.

The numerator measured as the number of economic entities declared they accepted and distributed an innovation that partially or fully developed by other entities. Instead, the denominator measured according to the official definition used by the EU to measure the share of innovation within a country. Thus, innovative enterprises are the business entities, introducing innovations into the product and/or process, including those with «current or discontinued innovation activities». This definition corresponds to the scientific understanding of the diffusion of innovations, which provides for their adoption as part of the innovation process. The nature of innovation adoption addresses two different issues related to the type and way of innovation adoption. It is important to obtain indicators that relate to these characteristics, since national and regional innovation profiles may depend on them:

– number of enterprises identified by the subjects of introducing innovations through an innovative product / total number of innovative enterprises (indicator 2);

– number of enterprises identified by the subjects of introducing innovations through the innovation process / total number of innovative enterprises (indicator 3).

These indicators will report on the nature of innovation (product or process), spreading across different sectors in the macroeconomic comparative series. However, through the subjective nature of diffusion and acceptance of innovations, the above indicators should investigate in dynamics. In addition, it is difficult to determine the level and extent of the intensity of innovative products and/or processes introduction by enterprises. Another type of characteristic of the innovative diffusion concerns the nature of its adoption, depending on the channels through which it distributes. This can be explored by distinguishing between two indicators that are used to assess the effectiveness of the innovation's adoption as business entities can independently indicate whether the innovations they disseminate are being developed (in collaboration with other or mainly other organizations):

– number of enterprises declare that an innovation process or product is developed «predominantly *together* with other enterprises or institutions» / number of innovative enterprises (indicator 4);

– number of enterprises that declare that the innovation process or product is developed «predominantly *by other* enterprises or institutions» / number of innovative enterprises (indicator 5).

Measuring the efficiency of innovation is individual for each enterprise in each country and for each type of innovation project, so the final selection of the appropriate indicators takes place contextually. At the same time, the main prerequisites for the successful implementation of innovations at the micro level identified, namely: minimum maturity level for business processes of innovative development, strategic compliance of innovative development with the goals of the enterprise, as well as commitment to innovation – the absence of organizational resistance [17]. The prerequisites for the successful implementation of innovations at the global level include the following: integrating possibility of created innovative products with the technological processes and products of the country; need for effective transfer of knowledge, experience exchange and replication of innovations in the framework of the innovative projects' implementation.

Based on the results of the primary data arrays formed on ranking the countries according to the methods of «Global Innovation Index INSEAD», «Social Progress Index», «Global Competitiveness Index», «Human Capital Index», «KOF Index of Globalization» within the general sample of countries the indicators of the development of a non-zonal innovation system identified:

a) GDP per capita and level of technological development, characterizing the conditions for the course of innovation processes in terms of their resource security, ability and willingness to perceive and distribute innovations;

b) state of generation, diffusion and applied use of knowledge of the genetic innovation resource;

c) state of information and communication technologies (ICT) development and level of network society readiness. On the one hand, it determines the ability and inclination of actors to «work» with new and latest forms of

knowledge and information presentation, technologies for their processing, and on the other hand, reflect the presence in the private and public sectors of the economy of the prerequisites for the ICT use and distribution;

d) level of human capital and social development; e) level of economic freedom, environment openness for entrepreneurial and innovative initiatives of economic entities.

Moreover, the calculations of the correlation coefficients (r), carried out within a sample of 132 countries, confirm the significant dependence of the socio-economic systems development on the innovation factor rHDI, GII = 0.8365; rEc_ef, GII = 0.8472; rGDP, GII = 0.8866; rGl_com, GII = 0.7071. Where HDI is the human development index, GII – INSEAD global innovation index; Ecef – ecological efficiency index; GDP – gross domestic product per capita, USD in purchasing power parity; Glcom – global competitiveness index) [18].

As a generalizing indicator of the socio-economic efficiency of development the innovative diffusions, it can be used such an indicator as the share of innovative products created in the process of innovative diffusions in the total volume of produced innovative products. The content of this indicator is to determine the result of the control action on the process of innovative diffusion, expressed in the acceleration of the cyclicity of innovation processes in the socio-economic system in connection with the use of the interaction effects of innovations during their diffusion [19].

Part 3. A synergetic effect of distribution the innovative diffusion in the developed socio-economic systems

The presence of effects of distribution the innovative diffusion in the developed socio-economic systems is due to the fact that they have internal reserves (invisible assets) associated with the consistency and interconnection of their structural elements, which makes it possible to accelerate the diffusion of innovations. In addition, the systemic effects of the diffusion of innovations – multiplicative and synergistic – arise from the interaction of various innovations types in the process of their diffusion and enhance the perception and commercialization of innovations.

Multiplier effects is the effects occur when the dependent variable rises above the initial impulse. The multiply mechanism provides for the impact appearance, that violates the existing equilibrium (initial impulse) and contributes to the activation of the propagation process of this impact (impulse) in the corresponding environment. The mechanism of multiplication includes two complementary components: initial impulse (which sets this mechanism in motion) and mechanism of diffusion (which implies the existence of a relationship between the elements of a given economic system).

A multiplier effect occurs when the primary effect increases due to the repeated use of appropriate measures in other areas of activity. It manifests itself in several specific forms:

– diffuse effect [20], which is realized when an innovation of a certain type distributions to other industries, due to which there is a multiplication;

– resonant effect that arises when an innovation implemented in a certain area is activated and stimulated, as well as developed of other phenomena in the production sphere;

– effect of the «starting explosion», which is a kind of «chain reaction» and gives rise to the next «avalanche» increase in the effect in a particular branch of production or activity;

– acceleration effect, which means accelerating the rate of diffusion and application of a particular positive outcome.

The synergistic effect determines the combined effect of the aggregate of innovations on the rate of their diffusion. The synergistic effect in the socio-economic system is «explosive» or «breakthrough» observed when the existing patterns in evolution violated, that is, it is a revolutionary effect, in which the emergence of a spatio-temporal order of a new quality occurs. The synergistic effect considers as the coordinated activity effect for the structural elements of the regional socio-economic system, which have the property of emergence, according to which the joint actions of several factors influencing the innovative diffusions differ from the sum of separate effects and provide a synergistic effect. The basis for obtaining a synergistic effect in the interaction of innovations is the formation a portfolio that optimally combines the types of interdependent innovations and uses the advantages of their interaction.

Thus, the result of the interaction of various innovations types is the emergence of systemic (multiplicative and synergistic) effects that enhance the degree of innovations perception in the socio-economic system [19].

The indicators that used to evaluate the multiplier effect of distribution the innovation diffusion include:

– indicators for evaluation the diffusion effect that characterize the innovations distribution of a certain type to other industries (number of commercialized innovations, number of acceptors that perceive innovations, number of common innovation projects created with innovation partner centres, number of innovative technologies used in new industries);

– indicators for evaluation the resonance effect, characterizing the activation and stimulation of innovations implemented in a particular area or production sphere. For instance, an increase in the share of small and medium-sized innovative companies in the country's economy, number of product innovations and process innovations produced in connection with the emergence of innovations in related industries, number of innovation copyright for scientific and technical development and transferred to legal entities and individuals;

– indicators for evaluation the effect of a «starting explosion», characterizing a further increase in the effect of a «chain reaction» of innovative diffusion in a particular area or production sphere. For example, number of research and development organizations for the innovations created over the past 5 years, number of innovations-products and innovations-processes, share of innovative

goods, works and services in general education and production volume, number of digital and IT technologies, number of technologies created on the basis of «disruptive» innovations;

– indicators of the acceleration effect, characterizing the acceleration of the diffusion rate and obtaining a specific positive result (growth rate of the volume of innovative products, number of exported advanced production technologies, dynamics of the innovation portfolio renewal, increase in the number of acceptors that perceive innovations).

Indicators that used to evaluate the synergistic effect of the distribution the innovative diffusion include those characterizing the effect of coordinated activity of structural elements [21] of the socio-economic system. These expressed in the following:

– growth of innovative production volumes and a decrease in transaction costs (increase in the production volume of innovative goods (works, services));

– increase in production volumes per employee as a result of the introduction of innovative technologies;

– volume of expenditures on scientific research;

– volume of attracting external investments in the innovative production;

– revenue of enterprises interacting in the field of innovative activity from the sale of innovative products;

– volume of profit growth from innovative activity;

– number of workers created places as a result of innovative activity;

– volume of the increase in the tax component in the budget revenues from the production of innovative products; number of realized innovative projects.

Noteworthy are the works of H. Xiong, P. Wang, G. Bobashev on the multiply peer effects in the diffusion of innovations on social networks [22]. This study identifies three main mechanisms through which the effects in the diffusion of innovation realized: information transfer, exchange of experience and externalities. Accordingly, the multiply effect in the diffusion of innovation includes informational effect, experience effect, and externality. In the case of innovative diffusion at the local level, it revealed that each of the three effects plays a dominant role at the early, middle and late stages, respectively. The diffusion effect of innovation can be better understood by examining the specific effects and their role at different stages of the dynamic diffusion process. Referring to the diffusion of innovation in the real world, scientists have developed a model that includes experience and external influences on a multiply innovation network [22]. The model makes it possible to evaluate the impact of each specific effect and to research the interaction of positive and negative effects: the parameters in the simulation model are set using survey data from 10 villages (local level). Carrying out experiments using the model, the scientists obtained the following conclusions: the diffuse process should consider from a dynamic point of view, and the influence of each specific effect should assess by its clear period in the process of innovative diffusion. In

addition, one should take into account the negative effect, if any, since it can significantly change the diffusion channel and the whole result [23].

Consequently, managing the diffusion of innovations using the multiply effect presupposes the diffuse penetration of innovations of a certain type into other industries with a subsequent increase in the «chain reaction» effect, as well as the search and creation of joint projects with innovation development centres – partners in the promotion and interaction of homogeneous innovations. The interaction of innovations expressed in an increase in the intensity of the diffusion of innovations, that is, in supporting demand and increasing the perception of innovations. Management of the diffusion of innovations using a synergistic effect involves determining the interaction directions of various innovation types and the selection of a qualitatively new set of innovations as well as have the property of emergence, according to which the joint actions of several factors influencing the diffusion of innovations differ from the sum of separate effects [19].

Thus, the synergistic effect of the distribution the innovation diffusion in the developed socio-economic systems in a formalized form can depict as follows:

$$S = (A, B, C) \quad \geq \text{Max } D \tag{1}$$

Where S – synergistic effect of the distribution the innovation diffusion in the developed socio-economic systems;

A – interaction function of the various innovation types;

B – managing function of the diffusion of innovations;

C – perception function of innovations by the socio-economic system;

Max D – maximum sum of separate effects.

On the other hand, there is also an approach called «double effect» [21], which involves the formation and comparison for the relative indicators of several competing goods or services in different areas, markets or levels, which requires further fundamental research.

Conclusions

Summarizing, is important to note that the conducted studies of the classification of socio-economic efficiency the distribution of the innovative diffusion in the developed systems made it possible to define the essence of the socio-economic efficiency of the innovative diffusion: ratio of the obtained result and costs of the diffusion of innovations. In the classification of diffusion types, such a feature as the level of resultiveness and socio-economic efficiency of innovative diffusion (RCEE) proposed to distinguish the following levels: very low, low, medium, high and very high level of innovative diffusion. In addition, the conditions for obtaining the call sign of the result and high socio-economic efficiency of the diffusion of innovations are determined. In addition,

we determined the conditions for obtaining a positive result and high socio-economic efficiency of innovative diffusion.

Diffusion of innovation conceptualized as one that includes a number of broad economic indicators to evaluate the socio-economic efficiency of development at the macro and micro levels. Measuring the efficiency of innovations is individual for each enterprise in each country and for each type of innovation project, so the final selection of the appropriate indicators takes place contextually. The innovative diffusion of the socio-economic system has a direct impact on the level of productivity, which increases due to the presence of other intangible assets, such as human and social capital, entrepreneurship. The analysis of indicators for assessing the socio-economic efficiency of the development of innovative diffusions in the developed systems proved their multivariance, however, as a generalizing indicator of the socio-economic efficiency of the development of innovative diffusions, such as the share of innovative products created in the process of innovative diffusion in the total volume of innovative products.

We established that the systemic effects of the innovative diffusion – multiplicative and synergistic – arise from the interaction of various innovation types in the process of their diffusion and enhance the innovation perception and commercialization. A set of indicators used to evaluate the effects for distribution the innovative diffusion, and examining specific effects using different models, approaches and mechanisms, can better understand the innovative diffusion effect. Thus, the synergetic effect of distribution the innovative diffusion in the developed socio-economic systems can formalize.

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