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ANALYSIS OF CREATIVE-INNOVATIVE ACTIVITY OF THE SCIENTIFIC SECTOR OF THE DOMESTIC ECONOMY

Abstract

Introduction. *Successful creative development of the domestic economic system is closely linked to the qualitative filling of factors that form the level of innovation activity of its subjects and provide competitive advantages in the world economy. This determines the relevance of the study for the parameters of the creative and innovative functioning of its scientific sector.*

Methods. *The research is based on a system of indicators proposed by the EBRD for analyzing the development of knowledge economy, taking into account the specifics of the national organization of official statistical observations.*

Results. *The purposeful study of the creative and innovative functioning of the scientific sector of the domestic economic system has made it possible to identify its strengths and outline the main problems. There is a phenomenon of self-financing of scientific organizations, a rapid increase in financing of the scientific sector at the expense of organizations of the state sector of the economy and educational organizations of high accreditation levels. At the same time, a general trend is found to reduce the allocation of research funding from budget sources. The high share of foreign financing, especially in the branches of high-tech sciences, carries the risks of a permanent dependence of domestic science. Most of the financial flows are not related to the quality of research work. Imperfection of institutional provision leads to the inability of full grants to support scientific projects. The low activity of domestic scientists' patent activity is a brake on the development of a creative economy.*

Discussion. *The direction of national science in the direction of globalization scientific and economic space opens up new prospects of integration with the European Research Area, the approximation of domestic institutional provision of science to EU policy in the relevant field.*

Keywords: *knowledge economy, creative development, scientific programs, scientific and research development, scientific and economic space, scientific sector of economy, patent activity.*

Introduction.

The success of the creative development of the domestic economic system in the post-

industrialized globalization civilization space is closely linked to the qualitative filling of a number of factors that form the level of innovation activity of its subjects and provide competitive advantages in the world economy. First of all, it is about the quality of training of creative workers, the investment orientation of venture capital towards innovative transformations, institutional support for the development of breakthrough technologies and the total modernization of technical and technological infrastructure. Therefore, in order to enable an adequate choice and scientific substantiation of strategic alternatives to the development of the national economy, the urgent need for an objective study of the parameters of the creative and innovative functioning of its scientific sector is urgent.

Analysis of recent research and publications.

Separate aspects of the development of the scientific potential of economic systems at the stage of post-industrialization transformations were considered by many modern researchers. In particular, the subject of our research is the work of F. Barron, D. Harrington, H. Anderson, O. Kuzmin, N. Savitskaya, O. Yaremenko, D. Lukyanenko, T. Halakhova, A. Zhemba, who studied the phenomenon the creativization of the global economy; O. Shnipko, N. Savitskaya, V. Semynozhenko, Y. Zhalila, devoted to the role of scientific and technical policy in raising the competitiveness of the national economy; The main direction of research N. Sineva and O. Yashkova were aspects of management of intellectual and creative activity of personnel of scientific organization and motivation of scientific activity; L. Bezsadnyny, G. Monastyrskaya, S. Kharabuga considered different aspects of the formation of creative competences. At the same time, the scientific achievements of the authors mostly cover only some of the narrowly specialized aspects of our chosen issues, and the question of the importance of the influence of certain factors on the level of creative renewal of the national economy remains open until now, which has led us to attempt a systematic analysis of the scientific potential of the domestic economy.

Purpose.

The purpose of the study is an objective analysis of the creative and innovative functioning of the scientific sector of the domestic economic system.

Research methodology.

To assess the level of creativization of the scientific sector of the domestic economy, we will use the system of indicators proposed by the EBRD for analyzing the development of the knowledge economy [1], taking into account the specifics of the national organization of official statistical observations according to the methodological provisions on statistics of scientific and scientific and technological activities [2], innovation activity [3] and the methodology for calculating the index of scientific production [4].

Results.

At the stage of post-industrialization transformations, the creative development of economic systems is no longer just a strategic choice; it picks up the features of an urgent need and perhaps the only prerequisite for ensuring the country's economic growth. In particular, in the light of the concept of sustainable development, the development of the scientific sector of the economy is a priority direction of harmonious economic growth based on knowledge, creative ideas and innovations, requiring additional institutional support for improving the quality of education, conducting research, innovating transformations and using information and communication technologies [5].

According to international experts published at the World Economic Forum in Davos [6], in 2017, a slow recession was observed in the Ukrainian economy. In addition to the purely economic (accumulated imbalance of development, mistakes of the previous economic policy) and political (consequences of hybrid aggression by the RF, military actions in the East of Ukraine and the annexation of the Crimea) reasons of economic instability, one should also highlight the problem of dispro-portionality and insufficient

funding of the domestic scientific field. Thus, the share of total expenditures on research and development in GDP in 2017 was only 0.45%, including at the expense of the state budget 0.16% [7], which in no way correlates with similar costs in the member states of the European Community (Fig. 1).

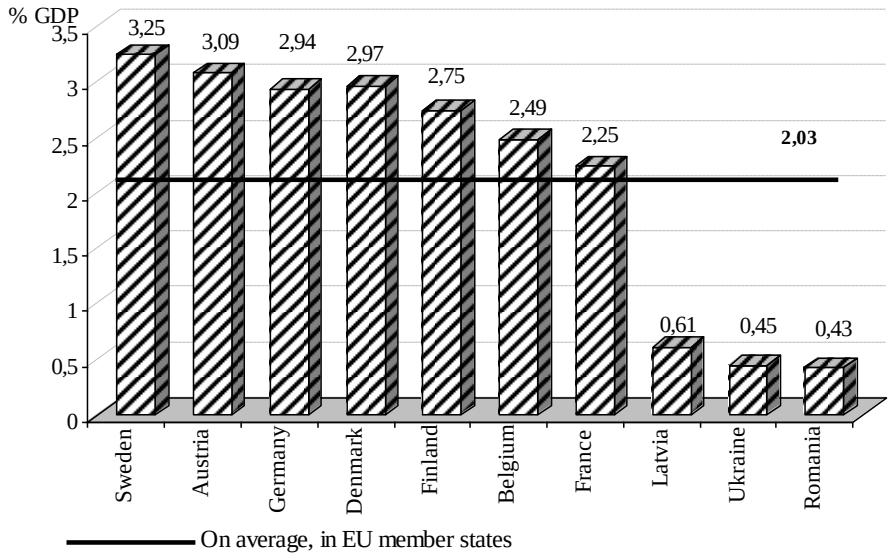

Fig. 1. **Comparison of the share of research and development expenditures in GDP of Ukraine and some other countries in 2017***

**Source: compiled by the author on the basis of [8].*

The dynamics of expenditures for R & D in 2013-2017 by sources of funding is presented in Table. 1. As we see, there is a general tendency to reduce the allocation of scientific research from the budget and foreign investment in 2013-2015, instead, from 2016, the negative trend was overcome and the corresponding indicators in 2017 show a significant increase compared to the previous year. A significant factor negatively affecting the efficiency of budget financing of domestic science is that significant financial flows were not related to the quality of research activities and were aimed at ensuring the activities of state scientific institutions.

Table 1

Dynamics of the distribution of total expenditures for R & D by sources of funding in 2013-2017, Mln. UAH*

Source of funding	2013	2014	2015	2016	2017	2017/ 2016, %	2017/ 2013, %
Budget funds	5347,8	4728,9	4689,9	4464,4	5236,3	117,3	97,9
Funds from foreign sources	2580,1	2185,8	1791,5	2728,7	3490,9	127,9	135,3
Own funds	1564,9	2057,0	2549,2	1222,8	1430,7	117,0	91,4
Funds from other sources	166,8	121,2	75,6	203,3	157,4	77,4	94,4
Funds from public sector organizations	344,0	319,1	294,1	381,5	758,3	198,8	220,4
Funds from organizations of the higher education sector	5,1	8,1	11,1	11,9	14,3	120,2	283,1
Funds from organizations of the entrepreneurial sector	2105,3	1962,8	1820,3	3590,2	3204,7	89,3	152,2
Funds from private non-profit organizations	7,7	14,6	21,4	14,1	14,3	101,4	185,6

**Source: compiled by the author on the basis of [7].*

At the same time, the imperfection of institutional provision leads to the impossibility of full-fledged grant support for scientific projects [9]. Lack of external sources of funding for domestic science has led to a visible increase in self-financing of scientific organizations in 2014-2015, but in the future such trends have ceased. In addition, the funding of the scientific sector at the expense of public sector organizations increased at an extraordinary rate, where the breakthrough in 2017 allowed the result of an increase in appropriation by 20.4%. Increasingly, funding for science is growing at the expense of educational institutions of high accreditation. This is a significant positive aspect of the dynamics of spending on research, since it indicates a reorientation of the national economic space towards a knowledge economy.

The high share of foreign investment in the total amount of research expenditures (22.1% in 2016, 24.4% in 2017), especially in the branches of high-tech sciences (respectively 64.8% and 72, 1%) seems rather threatening to us, because it leads to a permanent dependence of domestic science, leads to the loss of copyright for national intellectual property. At the same time, the vector orientation of national science toward a globalized scientific and economic space opens up new opportunities and prospects for cooperation with leading foreign scientific structures, integration with the European Research Area, approximation of domestic institutional provision of science to EU policy in the relevant field. In 2016, the National Academy of Sciences of Ukraine substantiated the priority areas of Ukraine's participation in the Strategy of Smart Specializations of the EU and proposed for the consideration of the European Commission the concept of the Program Initiative "Advanced Enduring Materials for Transport, Energy, Medicine and Environmental Protection". In 2016 Ukraine became an associate member of the European Organization for Nuclear Research. In April 2017, at the third meeting of the Joint EU-Ukraine Cooperation Committee in the field of science and technology, the issues of reforming the domestic scientific field and scientific international cooperation were discussed. In particular, the issue of Ukraine's inclusion in the EU Innovation Scoreboard was agreed, the priorities for further cooperation, the establishment of the Joint Research Council [8] were agreed.

In 2017, 21.9% of total expenditures were sent for fundamental research (19.3% in 2016), with 92.4% financed by the budget (2016 – by 91 , 7%). Regarding the sectoral distribution of funding for domestic fundamental science, it should be noted that in 2017, 48.3% of total spending was directed to the natural sciences, 25.5% – technical, 9.4% – agricultural (in 2016, respectively 48.7%, 25.0% and 9.9% respectively).

In pursuance of applied research in 2017, 23.6% of total expenditures were sent (in 2016 – 22.2%), 51.5% of which were financed from the budget, by 27.6% – due to funds of enterprises of the entrepreneurial sector (in 2016, respectively 49.5% and 31.2%). Among the total amount of applied research expenditures in 2017, 44.3% were directed in the technical sciences, 20.4% – natural sciences, 12.3% – agricultural (in 2016, respectively, 44.9%, 24 , 5% and 11.1%).

The largest share of total expenditures was allocated for the implementation of scientific and technical experimental research (in 2016, 58.5%, in 2017 54.5%,). Experimental development by 40.3% was financed by foreign partners (in 2016 – by 34.0%), by 28.7% by domestic organizations of the entrepreneurial sector (by 2016 – by 37.4%), by 14.3% % – at own expense (in 2016 – by 13.5%). 87.7% of the total expenditures for the implementation of experimental studies falls on the branch of technical sciences (in 2016 – 86.2%) [7].

Total expenditures on research activities carried out by the organizations themselves amounted to 13.8 billion hryvnias (in 2016 – 11.5 billion hryvnias). A detailed breakdown of these costs is presented in Table. ./

The distribution of expenditures for major budget programs in the scientific field at the expense of the general fund in 2017 is presented in Table. 3. Unfortunately, in recent years there has been a tendency to reduce the financing of scientific and technical developments at the expense of the general fund of the budget. In 2017, a total of 7,700 scientific developments were funded, which is 2,5% less than the same indicator in 2016. At the same time, in 2016-2017, funding for research on applied nature and scientific developments in the field of improving the defense capability increased and national security.

Table 2

Dynamics of allocation of expenditures for R & D activities by own organizations in 2013-2017*

Indexes	2013	2014	2015	2016	2017	2017/ 2016,%	2017/ 2013,%
Total expenditures, billion UAH, including:	11,2	10,3	9,4	11,5	13,8	120,0	123,2
Labor costs, mln. UAH	5413	5010,6	4608,2	5751	7152,9	124,4	132,1
% of the total	48,3	48,6	49,0	50,0	51,8	X	X
Other current expenses, mln	2400,6	2375,6	2350,6	5203,7	5444,6	104,6	226,8
% of the total	21,4	23,1	25,0	45,2	39,5	X	X
Capital expenditures, mln. UAH	270,1	236,7	203,3	576	781,8	135,7	289,4
% of the total	2,4	2,3	2,2	5,0	5,7	X	X
Of these, the cost of purchasing equipment	196,6	187,9	179,2	487,6	659,1	135,2	335,2
% of the total	1,8	1,8	1,9	4,2	4,8	X	X

**Source: compiled by the author on the basis of [7].*

The innovative and creative development of society, the integration of the national economic system into the global world scientific and economic space, the application of high-tech technologies in production require the rapid strengthening of the scientific component in higher education institutions.

Table 3

Breakdown of expenditures for budget research programs in 2017*

The name of the program	Amount of funding	
	Total, mln.UAH	share of total financing, %
Training of scientific personnel, financial support for the development of scientific infrastructure, the provision of activities of scientific libraries	1918,9	49,2
Training of scientific personnel, financial support of the press, development of scientific infrastructure, provision of activities of the State Fund for Fundamental Research	434,2	11,1
Training of scientific personnel in the field of agro-industrial complex, financial support for technical support of scientific institutions, development of scientific infrastructure	265,6	6,8
Fundamental research, applied scientific and scientific developments in the field of prevention and treatment of human diseases, training of scientific personnel, financial support for the development of scientific infrastructure	197,1	5,1
Execution of works for state target programs in the field of space industry, including the national target scientific-technical space program of Ukraine	176,9	4,5

**Source: compiled by the author on the basis of [10].*

In 2017, the amount of research and development funding spent by universities and other academic institutions subordinate to the Ministry of Education of Ukraine belonging to the Ministry of Education and Science of Ukraine's control area amounted to UAH 507.4 million (in 2016 – UAH 366.6 million) . The growth of expenditures by almost 40% was accompanied by a radical transformation of the system of selection of state support objects. The introduction of transparent competitive selection enables to objectively choose the best scientific projects and scientific organizations, which have sufficient potential for their realization.

Scientific activity provides higher education institutions with the improvement of the level of education and strengthens their rating positions. These processes are positively influenced by the cooperation between institutions of academic science and higher education institutions. In particular, 12 research institutions have a double subordination: the National Academy of Sciences and the Ministry of Education and Science of Ukraine. The educational process of the leading Ukrainian universities is ensured by cooperation with the basic departments in 20 institutions of the National Academy of Sciences, and almost 2,000 of its staff conduct teaching activities at university facilities.

Unfortunately, today only a few universities have sufficient scientific and creative potential to create world-class scientific and innovative developments. One of the main obstacles to the effective

development of university research facilities is the high pedagogical load of the teaching staff, the lack of technical equipment of scientific and research laboratories, and the complexity of access to scientific information. An analysis of the coverage of the results of research and developments in printed publications, especially those included in international science and technology databases, is an important part of the assessment of the scientific potential of the domestic economy (Table 4).

Table 4

Dynamics of the number of printed research papers in 2013-2017*

Indexes	2013	2014	2015	2016	2017	2017/ 2016, %	2017/ 2013, %
Number of printed works, total	143406	179653	175571	215482	246064	114,2	171,6
including:							
monographs	1833	3183	3999	5616	5799	103,3	316,4
of them issued abroad	209	381	981	939	1125	119,8	538,3
textbooks, tutorials	4828	7160	5226	9690	9889	102,1	204,8
articles in scientific professional journals	73275	106660	144484	175649	194253	110,6	265,1
of them that are part of international databases	20532	27000	32824	39614	41760	105,4	203,4
Others	63470	62650	21862	24527	36123	147,3	56,9

**Source: compiled by the author on the basis of [10].*

As we see, the dynamics of scientific publications is generally positive, but in modern economic realities, it not so much highlights the tendencies of scientific research of domestic scientists, but is a response to the introduction of requirements for publications to protect scientific works for obtaining a degree.

Full-scale integration of academic and university science requires the creation and development of joint research and educational associations. In 2016, in Ukraine, with the aim of accelerating the integration processes, drawing on the experience of leading foreign universities, the creation of a system of research universities was launched, which today brings together 14 such institutions. The main condition for obtaining a research status with a corresponding increase in public funding is the introduction of innovative technologies and the combination of educational programs with research [11].

Globalization tendencies of development of the national economic system, its integration into the European scientific and economic community increase the legal protection of intellectual property of its innovation-creative subjects. Technological surge and acceleration of the implementation of scientific knowledge in economic processes lead to the renewal of effective mechanisms for the management of national intellectual property and their harmonization with the EU policy in the field of protection rights. Thus, in October 2017, the 57th session of the General Assembly of the World Intellectual Property Organization took place in Geneva, where the cooperation program for 2018-2019 was signed and the functions and powers of the State Enterprise "Ukrainian Institute of Intellectual Property" as the International Searching Authority and the International Organization preliminary examination [12].

The analysis of the distribution of patent activity shows that 70.8% of the applications filed are signs for goods and services (20.2% of them are filed by the Madrid system), 17.1% are applications for utility models, 7.6% – for inventions , 4,5% - for industrial designs. The number of applications for utility models in 2017 decreased by 4.7% compared with 2016, which was caused by a decrease in the activity of domestic applicants. The share of foreign applicants in the total number of applications for utility models remains stable at a low level (0.9% in 2016, 1.5% in 2017), but in the reporting year they were 54% higher than in the previous one. The largest number of domestic and foreign applications related to medical equipment (11.2% and 11.4% respectively), analysis of biological materials (10.3% and 10.4%), measuring systems (6.7% and 6.8%), medicines (6.5% and 6.6%), food chemistry (6.2% and 6.3%).

In 2017, the activity of submitting applications for inventions slightly decreased in comparison with the previous year (Table 5). Of the national applicants, 52.5% were filed by legal entities, 47.5% – by

physical entities.

Table 5

Dynamics of filing applications for inventions in 2013-2017*

Indexes	2013	2014	2015	2016	2017	2017/ 2016, %	2017/ 2013, %
Total	5418	4814	4499	4094	4048	98,9	74,7
National procedure	3132	2675	2506	2422	2493	102,9	79,6
from national applicants	2855	2455	2271	2231	2279	102,2	79,8
incl. legal entities	1597	1335	1128	1207	1197	99,2	75,0
from foreign applicants	277	220	235	191	214	112,0	77,3
Under the PCT procedure	2286	2139	1993	1672	1555	93,0	68,0
incl. from national applicants	3	2	2	1	4	Not informative	

**Source: compiled by the author on the basis of [13].*

Among the Ukrainian scientific community, the majority of applications for inventions and utility models in 2017 are provided by educational institutions (4561, representing 63.8% of the total) and scientific organizations (1823 applications or 25.5%). Instead, only 255 such applications were submitted by industrial enterprises (in 2016 – 339 applications or 3.6%). The most active applicants were enterprises producing machinery and equipment, pharmaceuticals and food industries.

The share of applications from foreign applicants in the total patent activity amounted to 43.7%, there was a decrease in the number of applications submitted by their applications under the Madrid system; instead, according to the national procedure, they increased by 11.5%, while among the national applicants – only 2.2% (Fig. 2).

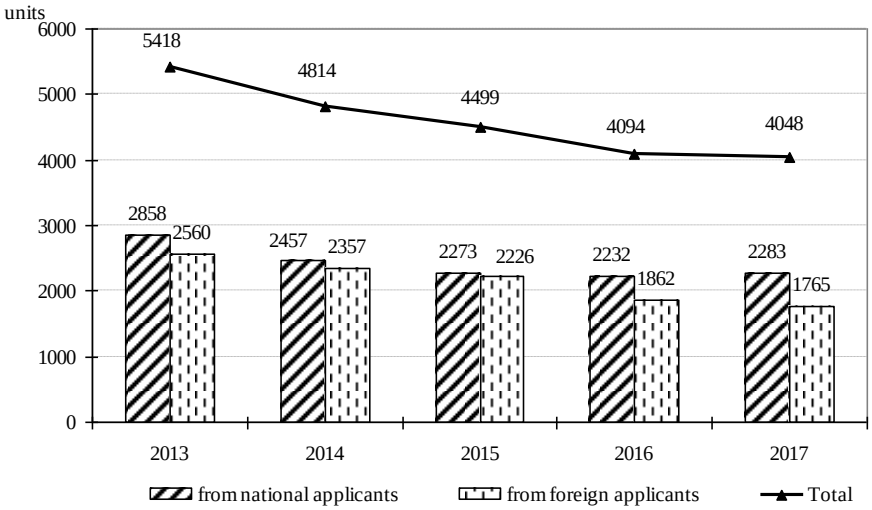

Fig. 2. **Dynamics of receipt of applications for inventions from national ones and foreign applicants in 2013-2017**

**Source: compiled by the author on the basis of [12].*

Among foreign applicants, 96% are filed by legal entities, 4% - by physical entities. The largest number of applications for inventions in 2017 was filed by US scientists (515 applications, which is by 7.5% more than in 2016), Germany (231 applications), Switzerland (202 applications, down 17.6% year-on-year), France (84 applications, a decrease of 15.2%), Great Britain (75 applications, a decrease of 14.8%), Belgium and Japan (59 applications). The number of applications from applicants from Denmark increased by 28.6% (36 applications), by 36.0% from Austria (34 applications), by 6.7% from China (32 applications), by 20.0% from Poland (24 applications). The priority directions of inventive activity were

medicinal products (more than 20% of applications), organic fine chemicals (10.5%), biotechnologies (10.4%), chemical raw materials (9.1%).

A significant disadvantage of the national intellectual property protection system is the practical dilution of the criteria for the protection of inventions and utility models, which leads to inconsistency in their classification. Hence, the results of intellectual creation and invention are protected as inventions or as utility models only depending on the method of filing an application. The invention is the result of inventive or creative activity, while a useful model is not necessarily the result of an invention. At the same time, the patent for a utility model brings to the patent holder more real advantages, a patent for the invention, because it requires less time and money to receive, simplified the patentability requirement compared with the invention, and the risks of non-recognition of the rights of the patent holder are also reduced. This institutional gap leads to a disproportionate relationship between these two objects of the law of defense, and the lack of qualification expertise for patents for utility models reduces the nationwide level of intellectual property protection.

The number of applications by national applicants for industrial property in 2017 exceeded the relevant figure in 2016 by 3.6%, for industrial designs – by 7.7%, remained at the level of the previous year the state of submission of applications for inventions, the number of applications declined slightly applications for trademarks for goods and services, applications for utility models were submitted by 4.8% less (Table 6).

Table 6

Dynamics of applications for industrial property objects in 2013-2017 *

Indexes	2013	2014	2015	2016	2017	2017/ 2016, %	2017/ 2013, %
Total industrial property objects, including:	53768	44146	47819	51559	53454	103,7	99,4
Inventions	5418	4814	4499	4094	4048	98,9	74,7
Useful models	10176	9384	8616	9558	9105	95,3	89,5
Industrial designs	3778	2664	2080	2302	2480	107,7	65,6
Marks for goods and services	34393	27280	32621	35605	37817	106,2	110,0
Including: - according to the national procedure	244781	18796	24652	29600	30183	102,0	12,3
- by the Madrid system	9922	8484	7969	6005	7634	127,1	76,9

**Source: compiled by the author on the basis of [13].*

The activation of national applicants led to an increase in the number of applications for industrial designs by 7.7% in 2017 compared to 2016. At the same time, the number of foreign applications decreased by 19.6%, which led to a decrease in their share in total from 12.4% to 9 , 3%. Interesting is the distribution of applicants: over 74% of domestic applicants are individuals, while almost 94% of foreign ones are legal entities. The leaders among countries whose representatives submitted applications for industrial designs in Ukraine in 2017 (49 applications vs. 5 in 2016), the USA (respectively, 20 and 9 applications), and the United Kingdom (9 and 4 applications). In 2017 no applications were received from the applicants of Sweden, Estonia and Singapore, although in 2016 these countries occupied leadership positions in this rating (65, 15 and 8 applications, respectively). The applications from the national applicants concerned, first of all, the branches of leisure and education (325 applications), packaging (320 applications), advertising (235 applications), construction (167 applications), transport (152 applications).

Conclusions and prospects.

Thus, the scientific sector of the economy provides a harmonious growth of the knowledge economy, but in modern economic realities, domestic science is negatively affected by a number of factors. There is a general tendency to reduce the allocation of scientific research at the expense of the budget and foreign investment, and most financial flows are not related to the quality of research work. Imperfection of institutional provision leads to the inability of full grants to support scientific projects.

Instead, there is a phenomenon of self-financing of scientific organizations, a rapid increase in financing of the scientific sector with the help of public sector organizations and educational institutions of high accreditation. In general, the low activity of domestic scientists in filing applications for the protection of intellectual property objects is a brake on the development of a creative economy. At the same time, the direction of national science in the direction of globalization scientific and economic space opens up new prospects of integration with the European Research Area, the approximation of domestic institutional provision of science to EU policy in the relevant field.

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