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THE LEVEL OF KNOWLEDGE INTENSITY OF THE COUNTRY'S ECONOMIC SYSTEM

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Abstract. The relevance of studying the issues of the knowledge intensity of economic systems has led to the conduct of these studies and determines their scientific and practical significance. *The purpose* of the study is a multidimensional analysis of the knowledge intensity of the domestic economic system, in particular, its creative potential, the activity of technological modernization of industry, and the creative initiative of economic actors. In the process of research, the EBRD *methodology* is used to evaluate the development of the knowledge economy, taking into account the specifics of the national organization of official statistical observations. In 2017, more than 1.8 thousand domestic enterprises (in the industrial sector – 1159 enterprises) created and used the latest technologies, innovation proposals, and other objects of intellectual property rights. The highest rates of creative activity were observed steadily among enterprises of information and communication sphere, financial and insurance directions, and also in the field of engineering. The leaders in the production and implementation of technological research and development (R&D) were processing industry, energy, engineering, professional scientific and advertising activities, non-technological – financial, insurance, information, telecommunication, processing enterprises. By types of economic activity, pharmaceutical companies, manufacturers of precise and extremely-precise equipment, chemical industry enterprises steadily occupied the leading positions in the field of creative activity. The analysis of regional dynamics shows the general tendency of reduction in the number of industrial enterprises that created, used or distributed creative developments. In general, during the period of research, the creative activity of enterprises decreased by almost a third, and downward processes are characteristic for almost all regions of Ukraine. In 2017, 2387 product innovations were introduced by the objects of industry, including innovative devices, equipment, machines, most of which were new for the relevant market. Today, there is a sufficient scientific and practical foundation for the development of creative clusters in high-tech sectors. However, these processes are hampered over the lack of budget allocations. There is a tendency of increasing R&D financing by leading industrial enterprises, establishing the practice of their acquisition of high-tech equipment and related technologies. In 2016–2017, there was a restructuring of investment flows, which manifested in reducing the costs of R&D intellectual components and reorientation of financial flows towards the acquisition of modern production equipment. In order to implement their own creative and innovative programs, in 2017, enterprises acquired 832 new technologies, most of which were completed with the corresponding equipment. By industrial enterprises, 59 creative technological developments were created and transferred to other entities. Total investments in updating domestic industrial enterprises amounted to more than 9.1 billion hryvnias in 2017. By types of economic activity, the leaders were the machinery and equipment industry and the food industry. *Conclusions.* Therefore, the significant creative potential of the domestic industry, further enhanced by active cooperation with scientific institutions, can become the basis for structural transformation and a source of scientific and technological "breakthrough" of our state.

Key words: high-tech sector of economy, creative activity, creative cluster, creative initiative, technological modernization, technological research and development.

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1. Introduction

Irreversible integration of Ukraine in the world economic system extremely actualizes the issue of improvement of knowledge intensity status of the domestic economy because today there is a rather high risk of occupying the place of an exporter of cheap human resources or becoming an agro-raw material supplier for developed countries. At the same time, the current trends in the development of the national economy confirm its steady direction towards the creation of high-tech competitive products with high added value. The degree of conformity of applied technologies and equipment to the requirements of the high-tech environment determines the cost, resource, and energy intensity of production processes. Consequently, the value of knowledge intensity of competitive production, which is based on scientific research, relations between scientific knowledge and production processes, continuous self-training of creative personnel, increases. The inadequacy of studying the issues of knowledge intensity of economic systems has led to these studies and determines their scientific and practical significance.

The purpose of this study is a multidimensional analysis of the knowledge intensity of the domestic economic system, which is based on the creative potential and technological modernization of industry.

In the process of research, the EBRD methodology for evaluating the development of the knowledge economy, taking into account the specifics of the national organization of official statistical observations, is used.

2. Development of creative potential in countries of Central and Eastern Europe

Modern challenges of the rapid development of a globalized society elevate the problems of intensified knowledge management development to higher levels of priority of the world economic community. These trends are conditioned, first of all, by the etiological factors of the formation and development of the knowledge economy, in particular, the rapid growth of knowledge intensity, intellectualization and high technology of production, which entails the need for a significant increase in labour productivity and actualizes the emergence of the newest post-industrial market segments.

The economic processes of the countries of Central and Eastern Europe in recent years are characterized by the intensification of knowledge management. One of the recognized leaders in building an information society among them is Poland, which recently is actively increasing the potential of the IT industry and invested more than 3.5 billion USD in the high-tech sector and attracted more than 500 thousand specialists. An interesting feature of Poland's creative economy is that its subjects are mostly small enterprises. Successful informatisation of the society is promoted by state support for the development of high-tech production. In the meantime, despite the significant strengthening of the creative potential of the countries of Central and Eastern Europe in recent years, the main development indicators still do not reach the corresponding indicators of the leading countries (Table 1).

In particular, the level of expenditures on R&D remains much lower, which negatively affects the dynamics of creative economic development. Processes of strengthening the personnel potential of science require intensification that would increase the share of employed in high-tech industries and qualitatively influence other indicators of creative activity, in particular, the processes of scientific and production cooperation and development of high technology industries.

In 2013-2017, there was a tendency for expanded involvement of private business representatives in knowledge-intensive and high-tech industrial production, in particular, in the fields of pharmaceuticals, electronics, and communications, which greatly

Table 1
The level of creative potential of the countries of Central and Eastern Europe in 2017

Country	The share of science expenditure in GDP, %	Number of researchers (per 1 million population)	The share of high-tech products in commodity exports, %,	Cooperation of science and business, %	The intensity of competition at the local level, %
Bulgaria	0,53	1586,7	7,9	0,16	0,29
Estonia	1,44	3210,3	9,1	0,77	0,80
Latvia	0,46	1601,2	7,6	0,60	0,42
Lithuania	0,84	2541,1	10,6	0,78	0,54
Poland	0,68	1597,6	6,7	0,54	0,73
Romania	0,48	894,8	10,9	0,17	0,30
Serbia	0,88	1060,1	0,59	0,02	
Slovakia	0,48	2437,7	7,1	0,46	0,74
Slovenia	0,85	3678,8	5,5	0,65	0,64
Hungary	1,15	2006	24,2	0,77	0,73
Croatia	0,83	1571,3	9,2	0,45	0,17
Czech Republic	1,52	2754,8	15,3	0,79	0,89

increased the competitiveness of the corresponding products. However, an indicator of competitive intensity at the local level (one of the indicators of the Global Innovation Index) in Central and Eastern European countries still does not reach the level of economically advanced countries.

The low creative activity of enterprises is conditioned, first of all, by the lack of financial resources for the qualitative disclosure of creative potential. The lack of foreign investment in high-tech sectors of the economy requires an increase in the enterprises' own resources and the search for opportunities for state support. However, in most countries of Central and Eastern Europe, at the initial stage of economic transformation, there was a separation of state institutions from investing in the scientific and technical sphere. At the next stage, this became one of the reasons for the technological lag behind the leading countries and led to the need to develop appropriate "catching-up development" strategies aimed at the rapid economic growth and technological breakthroughs. In order to implement such strategies, tools for attracting foreign capital, developing export-oriented models of the economy, and concentrating domestic financial resources on high-tech production lines are actively used.

The adaptation of the national economies of Central and Eastern European countries to the realities of the post-industrial structure requires a reorientation to the latest development model based on the dominant development of the existing intellectual, creative, and scientific and technical potential. Priority is given to the production of original knowledge and technologies, and the corresponding institutional means of stimulating activities in the field of high technologies such as electronics, nanostructured chemicals, energy, and biotechnology are created. Correspondingly, diversification of managerial tools for the creation and diffusion of new knowledge and facilitation of access to databases and intelligent systems are envisaged by the state strategic development programs.

3. Ukrainian industry's creative potential

In 2013-2017, the share of enterprises that carried out scientific and technological innovations in their activities amounted to 18.4%, of which 11.8% of enterprises declared technological updating, including 5.7% of enterprises created product innovations, 10.3% – introduced process innovations. Out of 13.4% of enterprises engaged in non-technological creative developments, 8.7% relate to organizational innovations and 10.2% to market developments (State Statistics Service of Ukraine, 2018).

In the service sector, creative and innovative entrepreneurship in Ukraine is most often represented by Internet entrepreneurs, web-specialists, and creative studios with creative authoring services. These areas are most highly characterized by high flexibility and adaptability, which allows levelling high risks of implementing creative projects and, if necessary, making managerial decisions for the rapid conversion of research programs and diversification of their areas of use.

In addition to enterprises of IT services, the largest creative and innovative activity in 2013-2017 was shown by large enterprises with a number of attracted personnel of 250 or more persons (an average, 39.6% of all enterprises of this type) while the shares of innovation-active enterprises in the medium and small business were 24.7% and 14.8%, respectively. It is clear that the refusal of the majority of small and medium-sized enterprises from high-tech creative developments indicates, first of all, their efforts to avoid additional risks that can substantially burden already imperfect financial and economic opportunities. At the same time, the low creative activity of powerful industrial enterprises directly indicates the steady orientation of the existing development model of the national economic system to low-tech production and in general significantly reduces competitive positions of the industrial sector (Sobkevych, Sukhorukov, Shevchenko, Krupeljnycjka, 2013). Alongside with that, the significant creative potential of the domestic industry, further enhanced by active cooperation with scientific institutions, can become the basis for structural transformation and a source of scientific and technological "breakthrough" of our state.

4. Technological modernization of Ukrainian industrial complex

The national industrial sector requires active use of creative management schemes capable of directing the vector of innovation development towards the development of scientific and technological potential. This will contribute to improving the competitiveness of products manufactured by using the latest technology and innovative production equipment. The additional effects of creative and technological modernization of the domestic industrial complex, capable of providing its sectoral restructuring, are the access to new markets (and hence – increase of sales volumes and improvement of financial results) and updating of the scientific and technological base of production (with the corresponding optimization of production processes).

In 2017, more than 1.8 thousand domestic enterprises created and used the latest technologies, innovation proposals, and other objects of intellectual property rights; in particular, in the industrial sector of the domestic economy, 1159 enterprises used R&D results (Table 2). During 2013-2017, the highest rates of creative activity were observed steadily among enterprises of information and communication sphere (22.1% of all enterprises of this sector), financial and insurance directions (21.7%), and also in the field of engineering (20.1%).

Table 2
Distribution of creative active enterprises by industry in 2017 (units)

	Total	Number of enterprises that			
		created advanced technology	used advanced technology	used intellectual property objects	used innovative suggestions
Total for Ukraine	1835	135	1669	368	203
Industry	1159	44	1127	222	75
Wholesale and retail trade; repair of motor vehicles	54	2	38	2	27
Transport, warehousing, postal and courier activities	218	1	203	24	14
Information and telecommunications	112	27	71	34	63
Professional, scientific and technical activities	217	36	172	59	14
incl. research and development	91	27	78	43	10
Public administration and defence, compulsory social insurance	7	5	1	–	2
Education	46	18	39	23	4
Health care and social assistance	21	1	18	4	4
Provision of other types of services	1	1	–	–	–

Regarding the introduction of technological R&D by the domestic industrial enterprises, the leaders are such branches as processing industry (15.6% of all enterprises of the industry), energy (12.6%), engineering, professional scientific and advertising activities (13.2% each). The leaders in the production and implementation of non-technological innovation in the studied period were financial and insurance enterprises (18.0% of all enterprises of the industry), information and telecommunication (17.3%), and also processing enterprises (15.3%).

By types of economic activity in 2013-2017, pharmaceutical companies (53.8% of all enterprises of the industry), vehicle manufacturers (37.1%), manufacturers of electronic and optical products (34.0%), precise and extremely-precise equipment (25.2%), and chemical industry enterprises (25.0%) steadily occupied the leading positions in the field of creative activity.

5. Technology transfer

Sustained trends in the growth of the role of creative potential for innovation in industrial development require adequate managerial regulation in the field of technology transfer from the academic science sector, the creation of effective mechanisms for the R&D commercialization and stakeholder cooperation. For the consolidation of information resources of state and public institutions, innovative enterprises, and scientific organizations in a single network, a pilot project "Ukrainian Technology Transfer Network UTTN" was created. Technology transfer for the purpose of integration into European transfer networks is defined as the institutional purpose of the formation, which involves increasing the efficiency of using the domestic intellectual potential, commercialization of R&D of academic universities and research institutions, reorientation of the industry to the production of high-tech products (Novikov, 2015). Creation of EEN-Ukraine Consortium has defined the business-technology cooperation of innovative enterprises and scientific organizations of Ukraine and the EU. One should also note transfer activity of the Ukrainian Institute of Scientific and Technical Expertise and Information, which regulates Ukraine's partner relations with the international community and promptly provides business structures and scientific organizations with scientific and technical information through an automated system for the formation of integrated interstate information resources.

The general megatrends of a globalized society, which include demographic changes, urbanization on the basis of the fullest possible automation, comprise elements of uncertainty and cause insecurity of the future development of the economic structure, which can be overcome only through persistent creative searches and corresponding infrastructure transformations. The creative planning of strategic directions for future business development allows creating potential technological update scenarios and timely predicting possible obstacles to radical change. In this sense, institutional support for the renewed imperatives and private-public partnership program is extremely important in order to financially support creative initiatives that stimulate the innovative transformation of the industrial sector of the national economic system, contributing to economic growth, environmental responsibility principles, and social progress.

The growth of creative activity of enterprises requires the use of new organizational levers to stimulate productivity growth, develop a creative product

with high added value, and develop high-tech and knowledge-intensive industries (Paschenko, 2017). Unfortunately, the general trends in the development of the national industrial sector still cannot be considered sufficiently creative. According to the findings of the World Economic Forum-2018 in Davos, the levels of technological effectiveness and energy efficiency of the domestic industry significantly lag behind similar indicators of the European Community countries, while the share of hi-tech product in exports remains negligible (World Economic Forum®, 2018).

More than half of the cases of the technological innovation of industrial enterprises took place through the purchase of new equipment and software. The analysis of the dynamics of the regional distribution of industrial enterprises, which used the R&D results in the economic activity in 2013-2017, is presented in Table 3 and shows a general tendency of reduction in the number of industrial enterprises that created, used or distributed creative developments. In general, during the study period, the creative activity of enterprises decreased by almost a third, and downward processes are characteristic for almost all regions of Ukraine.

The worst indicators of dynamics are observed in the Luhansk region (reduction by 85.2%), which can be explained by the complex socio-economic situation in the region over the hybrid aggression of the Russian Federation. Among the other outsiders, the worst dynamics are observed in Rivne (reduction by 79.5%), Chernivtsi (by 66.7%), and Donetsk (by 63.5%) regions. Three regions in 2017 slightly exceeded similar indicators in 2013, namely, Poltava (by 3.0%), Kharkiv (by 3.3%), Dnipropetrovsk (by 6.0%) regions, and sufficient growth rates of the use of R&D results in economic activity are observed only in Volyn (by 21.7%) and Vinnytsia (by 21.8%) regions.

At the same time, it should be noted that the downward trends of 2013-2017 are mainly determined by the general downturn in 2014-2015, after which positive trends began to recover in the national economy. Therefore, in comparison with the previous year, the majority of regions show an increase in the number of creative enterprises (somewhat significant). Leaders in this direction are Vinnytsia (increase by 45.7%) and Volyn (by 40.0%) regions. In 2017, activities above the average in Ukraine were demonstrated by enterprises in Kharkiv (28.1% of enterprises of the region), Ternopil (27.5%), Mykolaiv (26.9%) regions and the city of Kyiv (20.7%). At the same time, the lowest indicators are observed in Khmelnytskyi (5.7% of enterprises of the region), Rivne (5.9%), and Zakarpattia (9.0%) regions.

Table 3

The research activity of industrial enterprises of Ukraine in 2013-2017 by regions (according to data of the State Statistics Service of Ukraine, 2018)

Region	2013	2014	2015	2016	2017	2017/ 2016, %	2017/ 2013, %
Total for Ukraine	1715	1609	824	991	1159	117,0	67,6
Vinnytsia region	55	46	25	46	67	145,7	121,8
Volyn region	23	30	12	20	28	140,0	121,7
Dnipropetrovsk region	84	109	63	76	89	117,1	106,0
Donetsk region	85	45	28	30	31	105,1	36,5
Zhytomyr region	57	48	28	30	31	105,1	54,4
Transcarpathian region	15	16	14	13	12	92,3	80,0
Zaporizhzhia region	115	108	49	56	62	111,7	53,9
Ivano-Frankivsk region	87	99	27	32	36	114,3	41,4
Kyiv region	68	66	44	41	37	91,4	54,4
Kirovohrad region	46	49	25	31	37	119,4	80,4
Luhansk region	61	16	9	9	9	100,0	14,8
Lviv region	116	129	64	67	69	103,8	59,5
Mykolaiv region	81	67	29	31	32	104,9	39,5
Odesa region	69	67	36	36	36	100,0	52,2
Poltava region	33	33	30	32	34	106,3	103,0
Rivne region	39	45	13	11	8	76,2	20,5
Sumy region	32	46	23	24	24	102,1	75,0
Ternopil region	36	36	16	23	29	128,9	80,6
Kharkiv region	182	191	117	153	188	123,3	103,3
Kherson region	48	54	19	25	31	124,0	64,6
Khmelnytskyi region	58	38	18	24	29	123,4	50,0
Cherkasy region	47	37	25	29	32	112,3	68,1
Chernivtsi region	30	34	9	10	10	105,3	33,3
Chernihiv region	45	32	15	26	36	141,2	80,0
Kyiv	142	168	86	124	162	130,6	114,1

An analysis of the structural content of the activity of introducing the R&D results into practical activity characterizes its certain unevenness. In particular, the latest creative technologies were most actively implemented by enterprises in Rivne (19.1% out of all enterprises of the region), Kharkiv (18.7%), and Kirovohrad (14.7%) regions; the leaders of non-technological upgrade were innovation enterprises in the city of Kyiv (17.8% out of all enterprises), as well as Ivano-Frankivsk and Kyiv regions (15.1% each).

6. A creative initiative of economic entities

According to the sustainable development concept, the country's economic growth in the long run depends, first of all, on intensive factors of expanded reproduction, which necessarily requires the implementation of achievements of the domestic and world academic and applied science and technological re-equipment of production processes in the economic practice. A significant role in these processes belongs to the regulatory socio-economic policy, which mediates institutional functions of regulating the innovation development of industry and develops financial mechanisms for industrial reorganization. However, the main lever of the transformational breakthrough of the economic system in a knowledge economy is the management of the development of the creative initiative of economic entities. The main result of the creative activity of industrial enterprises is the creation, promotion, and transfer of a new product. In total in 2017, 672 industry facilities introduced 2387 product innovations (in 2016 their number was 3136), 751 of which – innovative devices, equipment, machinery. Herewith, 80% of the products introduced were new for the relevant market (Table 4).

1831 new or improved technological processes were implemented (in 2016 – 1217). Leaders of introduction in 2016-2017 are enterprises in Kharkiv (12.6% of the total number of technological innovations in 2017 and 17.4% in 2016), Sumy (12.3% and 15.2% respectively), and Zaporizhzhia (7.8% and 9.4% respectively) regions. Industry leaders in 2017 became machine-building enterprises (18.8%), gas-extraction companies (17.7%), and manufactures of finished metal products (13.4%). In 2017, 611 new low-waste and/or resource-saving technologies were introduced in industry, while in 2016 – 458. Regional leaders were enterprises in Kharkiv

Table 4
A number of enterprises that implemented the R&D results in 2017, by regionality and types of innovations (according to data of the State Statistics Service of Ukraine, 2018)

Region	Total enterprises	Innovative products			Innovative processes	
		of all	new to the market	new for the enterprise	of all	low-waste, resource-saving
Total for Ukraine	672	358	90	302	456	198
Vinnytsia region	15	11	5	10	8	5
Volyn region	16	4	1	3	8	5
Dnipropetrovsk region	46	18	5	16	40	11
Donetsk region	22	12	3	11	19	11
Zhytomyr region	23	9	1	8	10	3
Transcarpathian region	12	4	–	4	7	6
Zaporizhzhia region	37	26	6	22	21	7
Ivano-Frankivsk region	23	15	–	15	16	10
Kyiv region	37	16	4	14	28	4
Kirovohrad region	15	12	2	10	9	6
Luhansk region	5	3	–	3	4	3
Lviv region	47	24	8	20	40	12
Mykolaiv region	16	8	3	5	8	2
Odesa region	35	15	3	13	28	22
Poltava region	23	15	1	14	13	2
Rivne region	7	3	–	3	6	2
Sumy region	18	17	8	12	8	5
Ternopil region	25	7	2	5	23	4
Kharkiv region	105	55	17	44	68	38
Kherson region	15	11	3	11	11	2
Khmelnytskyi region	8	3	–	3	6	2
Cherkasy region	31	15	3	13	19	7
Chernivtsi region	8	7	–	7	6	4
Chernihiv region	10	7	2	5	9	6
Kyiv	73	41	13	31	41	19

(16.6% of all innovative products), Zaporizhzhia (13.4%), and Lviv (10.3%) regions.

7. The cluster-innovative scenario of Ukraine's economic development

The latest trend in the development of creative entrepreneurship is its adaptation to the cluster-innovative scenario of the development of a knowledge economy, in particular, the creation on the basis of large industrial enterprises of the kind of accompanying companies whose main task is the activation of the R&D and the introduction of creative developments. The concept of a creative cluster is considered to be an integral system covering a complete chain of creative development: from the development of a fundamental scientific idea to the production and distribution of a finished innovative product (Shovkaljuk, 2016). It should be noted that the majority of domestic clusters are oriented towards traditional industries, while in the EU countries priority is given to innovative clusters that combine high-tech productions into high-tech industries, playing the role of points of creative growth in the economy (Alslev Christensen, zu Kocker, Lammer-Gamp, Thomsen, Olesen, 2011). Today in Ukraine, there is created a sufficient scientific and practical basis for the development of creative clusters in high-tech sectors. In particular, on the basis of existing industrial parks and technopolises, clusters of biotechnology, electronics, automobile industry etc. can actively develop. However, these processes are hampered by the lack of budget allocations, while in Great Britain, France, Germany, the share of budget investments in technology parks is 65-80%, in Belgium – almost 100% (Mazur, Shovkaljuk, 2015). In addition, an important push for technological modernization of production, investing in high-tech modern equipment in modern conditions is the potential opportunity to engage the enterprise in infrastructure development of the region, which became possible after the introduction of the ProZorro Unified Electronic Procurement System.

8. Investment maintenance of technological renovation of the economy

Traditionally, innovation costs in Ukraine are mostly financed by enterprises on their own. In 2017, only 8 enterprises were financed from the state budget, and 17 other industrial enterprises were financed from local budgets. Only 5 industrial enterprises received funds of domestic investors and 3 – foreign ones, 21 enterprises turned to lending services. Despite the lack of significant progress in the innovation activity of the domestic industry, the cost of technological upgrades is steadily increasing. In addition, there is a tendency of increasing R&D financing by leading industrial enterprises, as well as establishing the practice of their acquisition of high-tech equipment and related technologies. Note that in 2016-2017, there was a restructuring of investment flows in domestic creative entrepreneurship, which manifested in reducing the costs of R&D intellectual components and reorientation of financial flows towards the acquisition of modern production equipment. The dynamics of the investment component of the creative activity of the domestic industrial sector in the regional section is shown in Table 5. As we see, the largest activity in the period of 2013-2017 was stably demonstrated by industrial enterprises in Zaporizhzhia, Dnipropetrovsk, Kharkiv regions. However, the dynamic analysis shows negative trends regarding the possibilities of investing in R&D, technological or product updates, which confirms our observations on the impact of general economic instability in the state on the willingness of enterprises to invest extra funds in the system technological upgrade of production. In order to implement their own creative and innovative programs in 2017, 170 enterprises acquired 832 new technologies (of which 129 – import), including 386 technologies (81 – import) were completed with the corresponding equipment. Moreover, 305 new technologies were the result of R&D, more than 100 received as an object of intellectual property rights, 10 – under national and international agreements for the acquisition of technology and know-how. In 2017, Ukraine's industrial enterprises also created and transferred 59 creative technological developments to other economic entities, of which two were exported.

The highest rates of decline in R&D financing by industrial enterprises are recorded in Luhansk (by 94.6% less than in 2013), Zhytomyr (by 85.8%), and Vinnytsia (by 85.6%) regions. At the same time, some regions show a certain investment "breakthrough", increasing investment in creative development more than 4 times. Undeniable leaders of growth are Zaporizhzhia (4.7 times more than in 2013), Ternopil (4.5 times), Kirovohrad and Cherkasy (more than 4.4 times each) regions. Compared to 2016, the regional dynamics seems somewhat more balanced, with no significant fluctuations, but the general tendency to reduce investment in R&D and high-tech equipment is noticeable. The worst indicators of rates of change are observed in Ternopil (by 76.5% less than in 2016), Dnipropetrovsk (by 74.1%), and Vinnytsia (by 70.3%) regions. The leaders of growth are Zaporizhzhia (by 62.6% more than in 2016), Kirovohrad (by 59.6%), and Sumy (by 57.3%) regions.

Total investments in production, technological, and organisational update of domestic industrial enterprises amounted to more than 9.1 billion UAH in 2017, where 2.2 billion UAH (24.2%) was spent on the development of own and acquisition of foreign R&D and technology, 5.9 billion UAH (64.8%) was directed to the purchase of equipment and software, 1.1 billion UAH (11.3%) – to other works related

Table 5
Dynamics of industrial enterprises' expenditures on R&D in 2013-2017, million UAH (according to data of the State Statistics Service of Ukraine, 2018)

Region	2013	2014	2015	2016	2017	2017/ 2016, %	2017/ 2013, %
Total for Ukraine	9562,6	7695,9	13813,7	11465,6	9117,5	79,5	95,3
Vinnytsia region	694,9	796,5	575,3	337,9	100,4	29,7	14,4
Volyn region	196,3	192,5	65,3	113,7	162,1	142,6	82,6
Dnipropetrovsk region	1057,8	825,2	7568,9	4348,1	1127,3	25,9	106,6
Donetsk region	930,7	516,1	827,6	776,5	725,3	93,4	77,9
Zhytomyr region	73,1	60,6	32,6	21,5	10,4	48,4	14,2
Transcarpathian region	25	16,6	22,5	24,4	26,2	107,6	104,8
Zaporizhzhia region	298,7	339,9	321	857,2	1393,4	162,6	466,5
Ivano-Frankivsk region	488,6	95,8	92,2	113,2	134,2	118,6	27,5
Kyiv region	104,4	122,1	144,8	217,3	289,7	133,3	277,5
Kirovohrad region	114,8	93	127,7	316,0	504,2	159,6	439,2
Luhansk region	372,5	35,1	24,3	22,3	20,2	90,8	5,4
Lviv region	257,1	219,7	277,8	294,0	310,1	105,5	120,6
Mykolaiv region	716,4	606,8	291,6	308,3	324,9	105,4	45,4
Odesa region	91	323,9	49,7	99,9	150,1	150,3	164,9
Poltava region	212,2	348,5	128,5	98,4	68,2	69,3	32,1
Rivne region	21,1	11,4	6,9	7,1	7,3	102,8	34,6
Sumy region	281,8	587,7	162,3	380,4	598,5	157,3	212,4
Ternopil region	24,2	57,4	14,6	62,2	109,7	176,5	453,3
Kharkiv region	642,3	711,1	667	779,0	890,9	114,4	138,7
Kherson region	161,4	90,5	70,1	63,1	56,1	88,9	34,8
Khmelnytskyi region	113,1	133,1	66,7	45,7	24,6	53,9	21,8
Cherkasy region	28,6	30,4	53,5	89,1	124,7	140,0	436,0
Chernivtsi region	51,3	68,8	18,8	22,5	26,1	116,3	50,9
Chernihiv region	134,1	106,4	35	53,4	71,7	134,4	53,5
Kyiv	1921,4	1306,8	2169	2015,1	1861,2	92,4	96,9

with the generation and transfer of knowledge (in particular, education, projecting, marketing). By types of economic activity, the leaders of investment in the scientific and technical upgrade of industrial enterprises in 2017 were the machinery and equipment industry (1.23 billion UAH or 13.5%) and the food industry (1.14 billion UAH or 12.6%).

9. Intellectual creative activities of Ukrainian economic entities

The largest volumes of intellectual creative activity and R&D in Ukraine traditionally belong to higher education and research establishments. Consequently, the implementation of a business creativitization policy requires enterprises to fully develop multifaceted links between science and industry and to take full advantage of opportunities of both scientific infrastructure and such modern tools as clusters and industrial-production zones. In general, over 34.4% of creative enterprises cooperated with scientific institutions, universities, research institutes in the period of 2013-2017. At the same time, in 2017, only 8.4% of such enterprises cooperated with scientific organizations, and their main partners were suppliers of equipment, materials, and information resources (including software).

In 2017, in the whole for Ukraine, 450 industrial enterprises were engaged in the sale of creative products, and the total sales amounted to 17.7 billion UAH. In 2016, these indicators were, respectively, 570 enterprises and 20.4 billion UAH, including 5.5 billion UAH were export deliveries (in 2016 – 10.8 billion UAH). About a third of domestic creative product belongs to software and high technology. The volume of the latest for the corresponding product market was 4.5 billion UAH, 41.5% of which was exported (in 2016, respectively, 7.3 billion UAH and 58.3%).

Creative developments of the domestic industry for 2013-2017 show the extraordinary potential of creative cooperation between business and science, which allows confidently asserting the possibility of the technological breakthrough of industrial high-tech and future leadership positions in the system of the sixth technological mode. Unfortunately, this indicator has been decreasing more than 2 times in Ukraine as a whole, while among the regions during this period only Cherkasy (with a slight increase by 2.9% compared to 2013), Chernihiv (growth of more than 2.3 times), and Zaporizhzhia (more than 2.4 times) regions have shown positive dynamics. The rest of Ukraine's regions in 2017 implemented their own creative product less than in 2013. Compared to 2016, the results are

somewhat better, however, in general in Ukraine and in most regions in 2017 there is still a decrease in sales by industrial enterprises of their own creative products. Industrial objects in Vinnytsia (by 40.5% more than in 2016), Chernihiv (by 156.5%), and Mykolaiv (by 170.8%) regions show the best results of growth.

10. Conclusions

Thus, the creative potential of the domestic economic system is determined by the ability to create high-tech competitive products based on the integrative cooperation of academic and applied science and economic complexes. In 2017, more than 1.8 thousand enterprises created and used the results of R&D, the latest technologies, and objects of intellectual property rights. By types of economic activity, the leaders were pharmaceutical companies, manufacturers of vehicles, electronic and optical products, precise and extremely-precise equipment, and chemical industry enterprises. At the same time, there is a tendency of reduction in the number of enterprises that created creative development and implemented them into specific product innovations. Costs for creative projects are mostly financed by own funds of enterprises. Structural reconstruction of investment flows manifested itself in reducing the cost of intellectual components of the R&D in favour of the acquisition of modern production equipment. Consequently, despite significant problems and complexities, the existing creative potential of the domestic economy allows asserting the possibility of implementing a technological breakthrough of industrial high-tech in Ukraine, which will contribute to a faster integration of the national economic system into the world creative community.

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