

**Oleksandr Levkivskyi**

**Volodymyr Levkivskyi**

*Chernihiv National University of Technology, Ukraine*

## **IMPLEMENTATION OF INNOVATIVE POTENTIAL OF UKRAINE IN THE CONTEXT OF ECONOMIC COOPERATION WITH PRC**

The article analyzes the positions of Ukraine and China in terms of the components of the “Innovation” sub-index in the global competitiveness rating and in terms of the components of the Global Innovation Index. The strongest and the weakest links of both countries in the system of resource and result indicators of innovative development of the Global Innovation Index 2017 are determined. The preconditions under which Ukraine and China can get a significant synergy effect from combining their innovative potentials within the framework of economic cooperation are summarized. The structure and dynamics of trade between Ukraine and the PRC in high-tech products is studied. The interests of countries in bilateral cooperation are highlighted. The ways of intensification of economic cooperation with the PRC for the implementation of innovative potential of Ukraine are proposed.

**Keywords:** innovative potential, “Innovation” sub-index of the Global Competitiveness Index, Global Innovation Index, bilateral trade, high-tech industry, exports, imports, direct investment, technopark.

**Problem statement.** Today the key factor of the socio-economic development of any country is innovations that can ensure the increase of competitiveness of the national economy and welfare of citizens.

International cooperation plays an important role in expansion of innovations. As one of the leaders in the world economy and innovation development is China, which has access to the latest technologies and foreign investments due to openness policy, Ukraine should use every opportunity to deepen its cooperation with the PRC in the innovation area. Moreover, today, our country needs financial and technological support for the policy of modernizing the national economy on innovative basis as never before. The potential of innovative cooperation between Ukraine and the PRC is getting more and more topical in the context of deepening strategic partnership relations between these countries.

**Analysis of recent scientific research.** Among the studies analyzing the Ukrainian-Chinese relations, one should note the works of both Ukrainian and Chinese scholars, including A.Goncharuk, S.Zaharin, Z.Makogin, I.Pogorelova, V.Rogovyi, Chen Hongji, Li Yining, Li Zhou, Van Ventsyan, Wang Peng, Zhang Yuan, etc. Scientists investigate various forms of economic cooperation between Ukraine and the PRC (trade, investment, scientific and technological), and emphasize the need to intensify cooperation and increase Chinese investment into Ukrainian economy. At the same time, a number of issues remain not fully covered, due to dynamic changes in the globalized world economy. Among such issues, research on the potential of innovative cooperation between Ukraine and the PRC is at the forefront. Such analysis will facilitate the development of recommendations for its implementation.

**The purpose of the article** is to analyze the implementation of innovative potential of Ukraine in the process of economic cooperation with the PRC.

**The statement of basic materials.** Innovative potential of the national economy is considered by us as a set of intellectual, technological, research and production resources, applicable for innovative activity, as the ability of the economic system to change. Scientific and technical, educational and investment segments can be distinguished in its structure.

Implementation of the innovative potential of the national economy ensures the diffusion of knowledge, generation of new ideas, improvement of technologies, manufacturing of new high-quality products. The scientific and technical component is associated with the emergence of pioneering move. The educational segment ensures its diffusion and effective use. And the investment segment helps pioneering move turn into innovation.

To measure the country’s innovative potential, different methods are used, one of which is the “Innovation” sub-index of the Global Competitiveness Index, which is calculated by the World Economic Forum. We have compared the ranks of Ukraine and China by this indicator (Table 1).

**Ranks of Ukraine and China in the Global Competitiveness Rating  
by the components of the “Innovation” sub-index**

	Ukraine				China			
	Report 2012-2013 <sup>1</sup>		Report 2017-2018 <sup>2</sup>		Report 2012-2013		Report 2017-2018	
	Rank (out of 144)	Score (1-7)	Rank (out of 137)	Score (1-7)	Rank (out of 144)	Score (1-7)	Rank (out of 137)	Score (1-7)
Global Competitiveness Index	73	4,1	83	4,1	29	4,8	27	5,0
12th pillar: Innovation	71	3,2	61	3,4	33	3,8	28	4,1
Capacity for innovation	58	3,3	51	4,3	23	4,1	44	4,5
Quality of scientific research institutions	64	3,7	60	3,9	44	4,2	36	4,6
Company spending on R&D	104	2,7	76	3,2	24	4,1	21	4,6
University-industry collaboration in R&D	69	3,6	73	3,4	35	4,4	28	4,4
Gov't procurement of advanced tech products	97	3,2	96	3,0	16	4,4	10	4,5
Availability of scientists and engineers	25	4,8	25	4,7	46	4,4	29	4,7
PCT patents, applications/million pop.	51	2,1	52	3,6	38	6,5	30	17,7

As Table 1 shows, despite some improvement in the “Innovation” sub-index and its individual indicators in the 2017-2018 report compared to the 2012-2013 report, Ukraine yields to the PRC by almost all components, except for the availability of scientists and engineers, where both countries have the same number of points. During the analyzed period, China improved its ranks by all indicators, except for the capacity for innovation, dropping from 23<sup>rd</sup> to 44<sup>th</sup> place. At the same time, this indicator looks better by the points scored. China holds the best ranks in the government procurement of advanced tech products (10<sup>th</sup> place) and company spending on R&D (21<sup>st</sup> place), in which Ukraine has the worst ranks (96<sup>th</sup> and 76<sup>th</sup> place, respectively). Ukraine holds the highest ranks in the availability of scientists and engineers (25<sup>th</sup> place) and the capacity for innovation (51<sup>st</sup> place).

The Global Innovation Index is an important indicator, an aggregate rate for measuring the level and results of the implementation of the country’s innovative potential, which captures the main components of the country’s innovative potential. The ranks of Ukraine and China by the components of the Global Innovation Index are reflected in Table 2.

The study of the ranks of Ukraine and China by the components of the Global Innovation Index in 2013 and 2017 shows a significant lagging of Ukraine from the PRC. However, the situation has improved for both countries. In comparison with the rating of 2013, Ukraine has gained 21 positions and is ranked 50<sup>th</sup> with the level of innovations of 37.6 points in the rating of 2017, and China has gained 13 positions, taking 22<sup>nd</sup> rank (52.5 points).

Indicators of the Global Innovation Index are grouped into two sub-indexes, one of which (Innovation Input Sub-Index) assesses the resources of innovations, i.e. the conditions and factors required for the creation of innovations, and the second (Innovation Output Sub-Index) aggregates the results of innovative activity.

<sup>1</sup> Compiled by the authors on the basis of: The Global Competitiveness Report. 2012–2013.

<[http://www3.weforum.org/docs/WEF\\_GlobalCompetitivenessReport\\_2012-13.pdf](http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf)> (2017, November, 17).

<sup>2</sup> Compiled by the authors on the basis of: The Global Competitiveness Report. 2017–2018.

<<https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018>> (2017, November, 17).

**Assessment of the ranks of Ukraine and China by the components of the Global Innovation Index**

Components of the Global Innovation Index	Ukraine				China			
	2013 <sup>1</sup>		2017 <sup>2</sup>		2013		2017	
	Rank (out of 142)	Score 0–100 or value (hard data)	Rank (out of 127)	Score 0–100 or value (hard data)	Rank (out of 142)	Score 0–100 or value (hard data)	Rank (out of 127)	Score 0–100 or value (hard data)
Global Innovation Index	71	35,8	50	37,6	35	44,7	22	52,5
Innovation Input Sub-Index	83	37,9	77	41,0	46	45,2	31	54,2
1 Institutions	105	51,4	101	47,9	113	48,3	78	54,8
2 Human capital & research	44	37,9	41	39,6	36	40,6	25	49,2
3 Infrastructure	91	26,0	90	39,3	44	39,8	27	57,9
4 Market sophistication	82	44,0	81	43,2	35	54,2	28	54,7
5 Business sophistication	79	30,2	51	35,3	33	42,9	9	54,5
Innovation Output Sub-Index	58	33,7	40	34,2	25	44,1	11	50,9
6 Knowledge & technology outputs	45	32,0	32	32,8	2	56,4	4	56,4
7 Creative outputs	81	35,3	49	35,6	96	31,9	26	45,3
Innovation Efficiency Ratio	31	0,9	11	0,8	14	1,0	3	0,9

Both in Ukraine and in China, resources are ranked lower (in 2017, 77<sup>th</sup> and 31<sup>st</sup> place respectively) than the results (40<sup>th</sup> and 11<sup>th</sup> place), that reflects the Innovation Efficiency Ratio (11<sup>th</sup> rank of Ukraine and 3<sup>rd</sup> rank of China), which characterizes the creation of favorable conditions for innovative performance.

The strongest link in the system of resource indicators of the innovative development of the Global Innovation Index 2017 for Ukraine are the indicators relating to the educational potential and characterizing human capital and research (41<sup>st</sup> place); and in the system of results indicators – indicators relating to the information and communication technologies and characterizing the application of knowledge and technology (32<sup>nd</sup> place). China has the best ranks by the level of Business sophistication (9<sup>th</sup> place) and the Knowledge & technology outputs (4<sup>th</sup> place, but two ranks lower than in 2013).

The weakest link in the system of resource indicators of the innovative development of the Global Innovation Index 2017 for both Ukraine and China is the group of indicators characterizing the institutional environment (101<sup>st</sup> and 78<sup>th</sup> place, respectively), and in the system of results indicators – indicators characterizing creative outputs (49<sup>th</sup> place and 26<sup>th</sup> place).

Despite different positions in international rankings, both countries can get a significant synergy effect from combining their innovative potential within the framework of economic cooperation. After all, there are certain preconditions for this. In particular, Ukraine is rich in natural resources, has a developed education system, scientific potential for joining the Chinese innovation space, an appropriate base for experimental work, low labor costs and scientific and technical development costs, and is attractive for complex research work. This means that this country can create the potential necessary for integration of two innovative systems, which will promote not only transfer of technologies, but also their development.

However, innovative activity in Ukraine tends to slow down. One of the drawbacks of the national innovation system is the relative backwardness of companies in transforming the results of scientific and

<sup>1</sup> Compiled by the authors on the basis of: The Global Innovation Index. 2013.

<[http://www.wipo.int/edocs/pubdocs/en/economics/gii/gii\\_2013.pdf](http://www.wipo.int/edocs/pubdocs/en/economics/gii/gii_2013.pdf)> (2017, November, 17).

<sup>2</sup> Compiled by the authors on the basis of: The Global Innovation Index. 2017.

<[http://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_gii\\_2017.pdf](http://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2017.pdf)> (2017, November, 17).

technological developments into competitive advantages. The main factors inhibiting inventors from introducing new technologies are the inability of the national industry to innovate in production and the lack of information among inventors about the possibility of selling their technologies<sup>1</sup>. The solution to this problem could be seen in the Chinese market, which has a high demand for new technologies and is interested in importing ready-made high-tech products.

At present, innovation in China is being carried out with broad state support: preferential taxation, preferential loans for introduction of new technologies in production, public-private partnership in investing into innovative activity, etc. Industrialization and commercialization of technologies are well developed in China. This can contribute to bilateral cooperation, namely: expansion of markets for innovative products, concentration of investment resources in innovative areas, minimization of research costs, joint development of innovative projects, sharing of experience gained in implementation of innovations.

Currently, in addition to traditional clothing and footwear, China supplies to the world market, including Ukraine as well, products of the automotive industry, mechanical and electrical machines, polymeric materials, etc. Thus, in 2016, the share of electric cars in the total imports of Chinese goods to Ukraine was 24.7%; nuclear reactors, boilers, machines – 17.4%; plastics, polymeric materials – 5.7%; means of land transport, except for railways – 2.6%; optical and photographic devices – 1.9%<sup>2</sup>. At the same time, the share of high-tech products in Ukraine's exports to China is negligible.

To consider the structure and dynamics of trade of Ukraine and the PRC with high-tech products, we use the classification of industries by technology intensity, proposed by the OECD specialists. According to this classification, the area of information technologies (computer, office equipment manufacturing and software development), aerospace, pharmaceutical industry, electronics and telecommunication equipment, medical, high precision and optical machinery manufacturing are classified into high-tech industries. However, the affiliation of goods to these industries does not mean their automatic inclusion into the group of high-tech goods.

Taking into account the OECD classification, as well as the work of domestic researchers (I.Yu.Matyushenko<sup>3</sup>, T.M.Melnik<sup>4</sup>, O.B.Salikhova<sup>5</sup>), based on the data of Trade statistics for international business development, we will analyze the trade in products of high-tech industries between Ukraine and China (Table 3).

According to the data in Table 3, during 2012-2016, the share of exports of high-tech goods to China in the total exports of Ukraine did not exceed 6.7% (2013) and tended to decrease, falling to 1.2% in 2016. Unfortunately, raw materials and low-cost technologies remain the basis of Ukrainian exports to the PRC. At the same time, the share of imports of high-tech Chinese goods to Ukraine initially declined during the analyzed period; in 2015 it reached the highest level – 25.2%, and in the following year decreased to 17.7%. It should be noted that trade in high-tech goods, as well as overall trade with the PRC, has a negative balance.

Among the products of high-tech industries, the largest share in exports during 2012-2015 related to the "Aerospace machinery" commodity group, but then dropped sharply in 2016. Only this group has a positive trade balance with China. At the same time, the individual shares of other commodity groups do not reach even 1%. "Electronics and Telecommunications" commodity group represents the largest share in Ukrainian imports from the PRC among the products of high-tech industries (17.3% in 2012 and 11.3% in 2016). Almost all commodity groups of high-tech industries experienced fluctuations in volumes of exports and imports during the analyzed period, but the declining trend prevails.

<sup>1</sup> Медведкина, Е.А., Обухова, М.И. (2010). Научно-техническое сотрудничество Украины и КНР: Инновационный аспект. *Теоретичні і практичні аспекти економіки та інтелектуальної власності: збірник наукових праць / ПДТУ, Маріуполь*, Т. 2, 101-106.

<sup>2</sup> Державна служба статистики України. <<http://www.ukrstat.gov.ua/>> (2017, November, 20).

<sup>3</sup> Матюшенко, І.Ю., Костенко, Д.М. (2012). Перспективи розвитку торгівлі високотехнологічними товарами у світі та Україні. *Бізнес Інформ*, 8, 103-114.

<sup>4</sup> Мельник, Т.М., Зубко, О.В. (2011). Оцінка рівнів технологічної місткості зовнішньої торгівлі України. *Формування ринкових відносин в Україні*, 4, 133-139; Мельник, Т.М., Зубко, О.В. (2011). Інноваційний регрес у товарній структурі зовнішньої торгівлі України. *Маркетинг і менеджмент інновацій*, 4, Т. II, 192-199.

<sup>5</sup> Саліхова, О.Б. (2012). Імпорт високотехнологічних товарів в Україну та його визначальні детермінанти. *Наука та наукознавство*, 4, 40-55.

Table 3

Trade of Ukraine with China with high-tech products<sup>1</sup>

Commodity group	Year	Exports			Imports			Balance
		Value, USD thousand	Relative share, %	Compound growth rate, %	Value, USD thousand	Relative share, %	Compound growth rate, %	
All products	2012	1777169	100	-	7899576	100	-	-6122407
	2013	2726653	100	53,4	7903219	100	0,05	-5176566
	2014	2674118	100	-1,9	5408879	100	-31,6	-2734761
	2015	2399079	100	-10,3	3770968	100	-30,3	-1371889
	2016	2490795	100	3,8	4216953	100	11,8	-1726158
High-tech products	2012	78354	4,4	-	1918557	24,3	-	-1840203
	2013	181515	6,7	53,4	1836612	23,2	0,05	-1655097
	2014	111804	4,2	-1,9	1177257	21,8	-31,6	-1065453
	2015	73203	3,1	-10,3	950645	25,2	-30,3	-877442
	2016	29899	1,2	3,8	744359	17,7	11,8	-714460
Aerospace machinery	2012	51344	2,9	-	4231	0,05	-	47113
	2013	159761	5,9	211,2	6245	0,08	47,6	153516
	2014	95830	3,6	-40,0	4045	0,07	-35,2	91785
	2015	54363	2,3	-43,3	3685	0,1	-8,9	50678
	2016	6035	0,24	-88,9	2226	0,05	-39,6	3809
Computer and office equipment	2012	671	0,04	-	179409	2,3	-	-178738
	2013	9	0,0	-98,7	191081	2,4	6,5	-191072
	2014	63	0,0	7,0	275248	5,1	44,0	-275185
	2015	10	0,0	-84,1	241651	6,4	-12,2	-241641
	2016	1	0,0	-0,9	79380	1,9	-67,2	-79379
Electronics and Telecommunications	2012	6735	0,4	-	1366595	17,3	-	-1359860
	2013	6590	0,2	-2,2	1222168	15,5	-10,6	-1215578
	2014	4736	0,2	-28,1	598881	11,1	-51,0	-594145
	2015	10408	0,43	119,8	510512	13,5	-14,8	-500104
	2016	7731	0,3	-25,7	484905	11,5	-5,0	-477174
Non-electric technique	2012	2627	0,15	-	29502	0,4	-	-26875
	2013	2672	0,1	1,7	31912	0,4	8,2	-29240
	2014	2649	0,1	-0,9	23575	0,4	-26,1	-20926
	2015	862	0,04	-67,5	12734	0,3	-46,0	-11872
	2016	8780	0,4	918,6	31184	0,7	144,9	-22404
Electric machines and equipment and parts thereof	2012	762	0,04	-	19122	0,24	-	-18360
	2013	870	0,03	14,2	32791	0,4	71,5	-31921
	2014	187	0,0	-78,5	29523	0,5	-10,0	-29336
	2015	4231	0,2	2162,6	28814	0,8	-2,4	-24583
	2016	1052	0,04	-75,1	13650	0,3	-52,6	-12598
Scientific instruments	2012	4849	0,3	-	86982	1,1	-	-82133
	2013	8722	0,3	79,8	91463	1,2	5,2	-82741
	2014	4391	0,2	-49,7	54423	1,0	-40,5	-50032
	2015	2554	0,1	-41,8	49222	1,3	-9,6	-46668
	2016	5955	0,2	133,2	45940	1,1	-6,7	-39985
Pharmaceutical products	2012	270	0,02	-	49407	0,6	-	-49137
	2013	80	0,0	-70,4	40097	0,5	18,8	-40017
	2014	79	0,0	-1,3	40461	0,7	0,9	-40382
	2015	6	0,0	-92,4	35755	0,9	-11,6	-35749
	2016	1	0,0	-83,3	13374	0,3	-62,6	-13373
Chemical products	2012	11096	0,6	-	183309	2,3	-	-172213
	2013	2811	0,1	-74,7	220855	2,8	20,5	-218044
	2014	3869	0,14	37,6	151101	2,8	-31,6	-147232
	2015	769	0,03	-80,1	68272	1,8	-54,8	-67503
	2016	344	0,01	-55,3	73700	1,7	8,0	-73356

<sup>1</sup> Compiled and calculated by the authors on the basis of: Trade statistics for international business development. <<http://www.trademap.org/Index.aspx>> (2017, November, 21).

Thus, Ukrainian export of high-tech products demonstrates low-level implementation of the country's innovative potential within the Chinese vector, and import of technologies has not become yet an effective tool for the innovative development of its economy. Although the strategic partnership relations between Ukraine and the PRC were established in 2011, during his visit to Ukraine, Chinese leader Hu Jintao emphasized the need to intensify cooperation between the two countries in the areas of high technologies, aviation, bioengineering, development of new materials, implementation and application of scientific and technical developments into industrial production.

The priority directions of cooperation in the areas of innovation and R&D are determined as follows: energy efficiency, aircraft building, shipbuilding, rational use of natural resources, development of aerospace, information and communication technologies, as well as preparation and training of postgraduate students and young scientists.

Both countries have their own interest in bilateral co-operation. Chinese partners are concerned in increasing the volume of procurement of high-tech products, development of high technologies; joint implementation of projects in the area of development and introduction of nanotechnologies; accelerating the execution of high-tech contract with the state-owned enterprise "Ukrspetsexport", concluded in 2008; development of the roadmap for implementation of the Chinese initiative to create the "Silk Road Economic Belt".

At the same time, Ukraine is interested in massive attraction of Chinese direct investment for implementation of investment and innovative projects on its territory; creation of joint ventures and production clusters for manufacturing of high-tech products in the aerospace, power engineering, automotive industries, and further implementation of projects in the space industry; establishment of Ukrainian-Chinese innovation center or technopark on the territory of the PRC; conducting presentations of economic, investment and innovative potential of Ukrainian regions in the PRC; obtaining free assistance from the Government of the PRC for implementation of social projects through purchase and delivery of innovative medical and emergency equipment to Ukraine<sup>1</sup>.

However, a significant number of agreements and contracts concluded between Ukraine and China are not being executed, promising infrastructure and innovative projects are "frozen".

Ukraine has real opportunities to improve the implementation of its innovative potential through mutually beneficial cooperation with the People's Republic of China through the development of such forms of cooperation as foreign trade, foreign investment, implementation of joint projects and production cooperation. In this regard, it is necessary to clearly determine the strategy for developing relations with the People's Republic of China and the specific objectives of bilateral cooperation. These are intensification of cooperation in all economic areas and improvement of foreign trade indexes in tactical terms; and attraction of investment potential, latest Chinese production technologies to modernize the national economy, as well as obtaining access for Ukrainian goods, services and technologies to the Chinese market in strategic terms. At the same time, our state can use the experience of the PRC to implement state measures aimed at stimulating the development of science and technology, increasing the sales of high-quality, high-tech, science-intensive products in foreign markets.

An important factor in promoting innovative cooperation between Ukraine and China is the development of technoparks, which include integration of science and production, creation of joint ventures for sale of knowledge-intensive and high-tech products. The differences of China's technoparks from those in other countries relate to attractiveness for foreign investors: low taxes, cheap labor, preferences in income taxation, and incentives to sell products in foreign markets. In addition, the structure of technoparks comprises advisory centers that provide administrative, information and communication support to companies.

Today, technoparks in China are important centers for the development of new and high technologies. In this regard, Ukraine's participation in such a form of scientific and technical cooperation as technoparks is an important step in implementing national innovation policy. There are currently four Ukrainian-Chinese technoparks in the cities of Jinan, Shanghai, Harbin and Zhenjiang. They represent a platform for scientific cooperation in specific areas, including biomedicine, new materials, aerospace, new energy sources, etc.

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<sup>1</sup> Захарін, С.В., Інін Лі, Веньцянь Ван. (2016). Активізація українсько-китайського економічного співробітництва. *Науковий вісник Мукачівського державного університету. Сер.: Економіка, Вип. 2*, 28-32.

**Conclusions.** The realities of Ukraine and China make it possible to argue that there are currently potential opportunities for deepening innovative cooperation between the two countries. The main tasks in the implementation of innovative potential are development of various forms of scientific and technical cooperation, in particular creation of joint ventures for manufacturing of high-tech products, R&D clusters, research centers, technoparks. This will enable to bring together the innovative potentials of the two countries and use them in the interests of mutually beneficial development.

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