

The processes of globalization and integration pose new challenges to the economy of any country, in particular, the issues of assessing and stimulating the innovative activity of enterprises in the context of constant transformation arise. Therefore, the purpose of this study was to substantiate the methodology for assessing the safety of the country's innovative environment, based on stimulating the innovative activity of enterprises in the context of European integration.

The result of the study is the formation of methods for calculating the relative indicator of the country's innovativeness and the general indicator of the safety of the innovative environment, which can be used in the future to assess the potential of other countries, they can serve as the basis for making decisions by foreign investors regarding investments in innovative projects. The advantages of using this methodology are taking into account the main factors of influence and conditions on the innovative activity of a particular country, and the simplicity of calculations.

As a research result, an assessment of the innovative activity of enterprises in the studied country in the context of European integration was obtained. To do this, first, the calculation of the relative innovation index was justified and performed. The advantage of this index is the visibility and greater accuracy in determining the place of the country, the level of innovativeness of the activities of its enterprises.

Justification and recommendations for cooperation with the EU are facilitated by an analysis of the peculiarities of commodity trade with the EU, a detailed analysis of the country's environmental conditions for innovative activities of enterprises using statistical indicators that are easy to find in the public domain.

The compilation of a methodology for assessing the state of security of the innovation environment was facilitated by a detailed analysis of the dynamics of GDP and the factors contributing to innovative development, which adds validity to the research results and demonstrates the ease of calculations. The proposed methodology has been tested and can be used to assess the potential of other countries seeking to integrate into the European space

Keywords: innovation, innovative activity, innovative action, trade and economic cooperation, clustering, process of European integration, security of the innovative environment

EVALUATION OF INNOVATIVE ACTIVITY OF ENTERPRISES IN THE CONDITIONS OF EUROPEAN INTEGRATION

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Received date: 15.04.2021

How to Cite: Zubko, T., Kovshova, I., Ilchenko, N., Laptieva, V., Vavdiichyk, I. (2021). Evaluation of innovative activity of enterprises in the conditions of European integration. *Eastern-European Journal of Enterprise Technologies*, 3 (13 (111)), 63–73.

Accepted date: 09.06.2021

Published date: 30.06.2021

doi: <https://doi.org/10.15587/1729-4061.2021.235950>

1. Introduction

The innovative activity of enterprises in the context of European integration is the basis for the social and economic development of the state, the main lever for ensuring the country's economic security and an indicator of positive changes in the national economy in the global competitive environment. The focus of business entities on the intensive introduction of innovations helps to create competitive advantages, increase sales of products in the domestic and European markets, increase the profitability and profitability of enterprises and contribute to economic progress in general.

However, in practice, positive trends are hampered by the lack of sufficient financial resources for enterprises to replace obsolete fixed assets with a high degree of physical and moral deterioration. Additional factors in reducing the level

of introduction of new technologies are often the overflow of national funds abroad, lack of institutional experience in the protection of intellectual property rights and limited access to the European or world capital market. These factors cause a certain economic regression for entrepreneurs in Eastern Europe striving for integration (Ukraine, Moldova, the Republic of Belarus, Georgia, Armenia, etc.) and show insufficient activity in introducing new technologies into the production process for the production of innovative products. Such enterprises are under-investing in R&D due to resource constraints and poor collaboration between the R&D and manufacturing sectors. And the lack of institutional experience in the protection of intellectual property rights and the poorly developed clustering of enterprises do not allow reducing research costs due to the scale. The logical consequences are the low level of labor productivity, the general inefficiency of the activities

of most of the economic and political institutions and the inhibition of innovation. According to the effective innovation activity of enterprises starts the cycle of economic progress, and destructive one can cause regression.

The processes of globalization and integration pose new challenges to the economy of any country, this determines the relevance of this scientific problem. In particular, questions arise about the assessment and stimulation of innovative activities of enterprises in the context of constant transformation. One of the methods of stimulating innovation is attracting foreign direct investment, and therefore the question arises of assessing the level of security of the country's innovation environment. The results of this study can be used to assess the potential of other countries seeking to integrate into the European space. They can serve as a basis for making decisions by foreign investors about the possibilities and feasibility of investing in innovative projects.

2. Literature review and problem statement

Various aspects of innovative activity are highlighted in the works of foreign and domestic scientists. The work [1] presents the results of studies on the impact of enterprise size and market concentration on the use of innovations as a result of government support. An interesting study is about the impact of government support on the decision of companies to cooperate. But the issues of international integration and its impact on the innovative activity of enterprises remained unconsidered. An attempt to determine the advantages of international integration in innovative projects was made in a thorough revision [2], where the general research activities of enterprises were analyzed according to the monitoring of community innovations in France, Germany, Spain and the United Kingdom. Also, the best practices for determining innovative performance indicators of enterprises, taking into account gender dynamics [3], obtained on the basis of small business innovation research (SBIR). This study is somewhat limited, since only one factor of influence on the indicators of innovative activity is highlighted and the influence of factors of the international level is not considered at all. In article [4] there is a connection between the concepts of "entrepreneurship" and "innovation", where the second is a way of expressing the first. In addition, evidence is provided that this concept is the basis for the formation of social roles and views of subjects who are active in development. The substantiation of a dynamic model of the general equilibrium of education, innovation and technology transfer to explain the development of industries and economic growth of the country's economy as a whole was carried out in [5]. But there remains the problem of determining the safety of the innovative environment to justify decisions on financing innovative projects by foreign investors. An attempt to overcome it is given in [6], where the authors investigate the impact of the introduction of innovations on the development of enterprises, consider the role of the EU in the implementation of innovations in small and medium-sized enterprises. Interesting research [7] on innovations in family business, where the main consequences of intra-family succession are considered and practical recommendations for attracting innovations for family business owners, managers and consultants are given. The issue of stimulating the development of innovative potential is considered in [8], where the need to focus on supply chains is justified and emphasizes the importance of focusing on the sustainable consequences of the core business and a clear

balance of value that is created in costs. This article argues that supply chains tend to have great innovation potential for sustainable development. But the disadvantage of this work is that the integration processes of the international level have not been sufficiently analyzed. A more extensive analysis of the innovative potential of the country's economy may be a solution. This is what is considered in the article [9], where it is analyzed how the innovation potential of the economy affects long-term economic growth. The advantage of this analysis is that it was performed using multiple regression models estimated for Poland, Czech Republic and Hungary. The following variables were used to quantify innovation, such as the number of patents, the number of trademarks, and R&D expenditures. But the problem remains in determining the impact of European integration processes on the innovative activity of enterprises.

Disclosure of the main principles for assessing the innovation process from the standpoint of international integration is presented in [10]. In this monograph, a retrospective analysis of views on the implementation of innovative projects is presented, it has made it possible to identify key factors that have significantly influenced the innovative development of national economies. The article [11] examines exclusively the financial aspects of the country's innovative development in the context of European integration, but there are no practical recommendations and any calculations as to whether foreign investors should invest in the development of innovations. The article [12] demonstrates the results of the analysis of the world experience of innovative development in the leading countries of the world in order to study the possibility of its introduction into the process of functioning of the national system in the conditions of the knowledge economy. But questions remained unresolved regarding practical recommendations for stimulating the innovation process and methods for assessing the country's innovative potential. The asset [13] describes the experience of functioning of clusters of EU countries, article [14] reveals global structural transformations. The monograph [15] is devoted to the consideration of issues of European integration, the structures of partnership processes, the prospects for the development of the economy of a particular country in the context of strengthening foreign economic relations. But in the revisions [10–15], the issue of determining the safety of the innovative state of a separate country, stimulating the innovative activity of enterprises and adjusting the association agreements with the EU remained unresolved.

All this gives grounds to assert that the problem lies in the absence of a unified methodology for assessing the innovative potential of countries in the context of international integration. Such a methodology should be based on an assessment of the innovative activity of enterprises and take into account the influence of the global innovation environment.

3. The aim and objectives of research

The aim of research is to develop a generalized indicator for assessing the security of the country's innovative environment, based on stimulating the innovative activity of enterprises in the context of European integration.

To achieve the aim, the following objectives were set:

- to investigate the state of innovative development of countries and substantiate the proposed methodology for calculating the relative innovation index;
- to determine the level of economic development of the country in terms of purchasing power parity (PPP);

- to highlight the features of trade in goods with the countries of the European Union;
- to analyze the most active innovative industries in the context of European integration;
- to develop a methodology for assessing the state of security of the country’s innovation environment in the context of European integration.

4. Materials and methods of research

The theoretical and methodological basis of the study is the foundations of socio-economic theory and management. The study used the works of famous scientists [1–15], statistical data on the sources of financing the innovative activities of enterprises.

General scientific and special research methods were also used:

- economic and statistical – for assess the current state of innovation, the country’s position in terms of financial and statistical indicators, to assess the financing of innovative activities, to assess the structure of scientific workers, to assess trade with EU countries, formulate a methodology for calculating the relative innovation index, assess the level of security of the innovative environment of the country;
- tabular and graphical – for visual display of indicators;
- system-analytical – for the theoretical generalization of scientific approaches to determining the level of security of the country’s innovation environment and proposals for its improvement;
- analysis and synthesis – to detail the factors of influence on the state of innovation activity of enterprises; abstract-logical – for the reasonable formulation of the conclusions of economic research.

5. Results of the study of innovative activity of enterprises in the context of European integration

5.1. Determination of the state of innovative development of countries and substantiation of the methodology for calculating the relative innovation index.

The high innovative potential of the EU is one of the most powerful and motivating factors for the European integration choice of the countries of Eastern Europe. This

confirms the success of the Baltic States. In terms of the level of innovative development, Estonia has reached the average indicators of the Netherlands and Austria, surpassing the indicators of Denmark and France [14].

The main indicators for determining the state of innovative development of countries are the Global Competitiveness Index, the Global Innovation Index (GII), and the European Innovation Scoreboard (EIS).

The Global Competitiveness Index (GCI) is published in the annual reports of the World Economic Forum and demonstrates the use of the available resources of the country to ensure a high level of well-being of its citizens (Global Competitiveness Report). This index reflects the macro- and microeconomic aspects of business activity in the country and includes more than 110 factors, combined in twelve blocks. In particular, experts assess the quality of institutions, infrastructure, macroeconomic stability, health status, level of education, efficiency of the goods and labor market, the level of development of the financial market and technologies, the volume of domestic and international markets, the release of new goods, innovation potential [15].

The competitiveness index is calculated as a weighted sum of the values of the factors, where a certain weight is assigned to each of the blocks. Accordingly, this indicator depends on the stage of the country’s economic development and per capita income. For the period from 2016 to 2020 The TOP-10 ratings of the Global Competitiveness Index included Switzerland, Singapore, USA, Germany, the Netherlands, Finland, Hong Kong, Sweden, Japan, and Great Britain (Table 1).

The Global Innovation Index (GII) has been published annually by the World Intellectual Property Organization since 2007. The level of development of innovative industries in different countries of the world is also assessed by an expert method that takes into account various factors. The latter include the scientific component, the quality of innovation legislation, the absence of obstacles to doing business, the level of corruption and other factors that affect the state of science and technology.

The Global Innovation Index (GII) provides indicators on innovation indicators for 131 countries and economies around the world. It is annually selected by the leading French business school, the European Institute of Business Administration, Cornell University of the United States and the World Intellectual Property Organization. Its 80 indicators explore a broad vision of innovation, including the political environment, education, infrastructure, and other aspects of business.

Table 1

Determination of the state of innovative development of countries by the global competitiveness index

№	2016 (140 countries)	№	2017 (138 countries)	№	2018 (137 countries)	№	2019 (140 countries)	№	2020 (141 countries)
1	Switzerland	1	Switzerland	1	Switzerland	1	USA	1	Singapore
2	Singapore	2	Singapore	2	USA	2	Singapore	2	USA
3	USA	3	USA	3	Singapore	3	Germany	3	Hong Kong
4	Germany	4	Germany	4	Netherlands	4	Switzerland	4	Netherlands
5	Netherlands	5	Netherlands	5	Germany	5	Japan	5	Switzerland
6	Japan	6	Japan	6	Hong Kong	6	Netherlands	6	Japan
7	Hong Kong	7	Hong Kong	7	Sweden	7	Hong Kong	7	Germany
8	Finland	8	Finland	8	Great Britain	8	Great Britain	8	Sweden
9	Sweden	9	Sweden	9	Japan	9	Sweden	9	Great Britain
10	Great Britain	10	Great Britain	10	Finland	10	Denmark	10	Denmark
...
79	Ukraine	85	Ukraine	81	Ukraine	83+	Ukraine	84	Ukraine

Note: * – compiled according to [14–16]

The Global Innovation Index is calculated as the weighted average of the scores for two groups of indicators and demonstrates the ratio of the costs of developing innovations in the country and the effectiveness of efforts. Switzerland, Sweden, Great Britain, USA, Netherlands, Finland, Singapore, Denmark, Ireland, Luxembourg, Hong Kong, Germany, South Korea occupy the top places in the ratings for the period from 2013 to 2020. Over the years, the number of countries studied changes. So, for example, Ukraine in 2016 took 56th place (out of 128 countries), in 2017 – 50 (127 countries), in 2018 – 43 (out of 126), in 2019 – 47 (129), in 2020 – 45 (out of 131 countries). The GII rating highlights the weaknesses of Ukraine: institutions (93), political environment (105), business environment (104), political stability (123), rule of law (109), infrastructure (94), market (99), investments (121), microcredit (78), venture capital (64).

For greater clarity of the presented data for certain countries, let's propose to study the dynamics of changes in the relative innovation index, which is calculated as the ratio of the difference in the total number of places and occupied places to the total number of places in the ranking. So, the diagram of changes in the relative innovation index of Ukraine is shown in Fig. 1.

The level of innovation activity in Ukraine has slightly increased over the past seven years, which indicates a slight improvement in the conditions for innovative activities of enterprises. In 2020, Ukraine took 45th place. In total, 131 countries are represented in the Global Innovation Index. Five countries that use innovation most effectively are Singapore, USA, Hong Kong, Netherlands, Switzerland. The neighboring countries of Ukraine took the following positions: Poland – 38th, Moldova – 59th, Belarus – 64th, RF – 47th [16].

The European Innovation Scoreboard (EIS) provides an annual comparative assessment of research and innovation results across the EU, other European countries and regional neighbors. This allows policymakers to assess the relative strengths and weaknesses of national research and innovation systems, track progress, and prioritize areas for improving innovation performance. EIS covers EU member states as well as Iceland, Israel, Montenegro, North Macedonia, Norway, Serbia, Switzerland, Turkey, Ukraine and the UK.

For a more limited number of publicly available indicators, the EIS compares the EU with Australia, Brazil, Canada, China, India, Japan, the Russian Federation, South Africa, South Korea and the United States [12]. However, not all countries are included on the list on a regular basis.

27 indicators of the European innovation board are systematized into eight groups, for each of which the corresponding generalized value is calculated [12]. The composite innovation index is calculated as the arithmetic mean of these eight indicators. Based on the results obtained, the status of the country is determined. There are four options: innovative leader, active innovator, moderate innovator, slow innovator. The grouping of countries according to the analysis of the “European Innovation Scoreboard” for 2017–2020 is given in Table 2.

Table 2

Groups of European countries by the level of innovation activity

Efficiency group	Countries
Innovation leaders	Switzerland, Sweden, Denmark, Finland, Netherlands, Great Britain, Luxembourg, Germany, Belgium, Ireland
Active innovators	Austria, Iceland, Norway, France, Israel, Slovenia
Moderate innovators	Czech Republic, Portugal, Malta, Spain, Estonia, Cyprus, Italy, Lithuania, Serbia, Hungary, Greece, Slovakia, Turkey, Latvia, Poland, Croatia
Slow innovators	Bulgaria, Macedonia, Romania, Ukraine

Note: * – compiled according to [17]

Bulgaria, Macedonia, Romania and Ukraine are classified as Slow Innovators. In particular, our country lags behind in all indicators, except for indicators of enrollment in higher education. Experts attributed innovators, communications and entrepreneurship, the attractiveness of research systems to the weaknesses of the country's innovation system. And in terms of strengths – human resources, company investment and the impact of employment [15, 17].

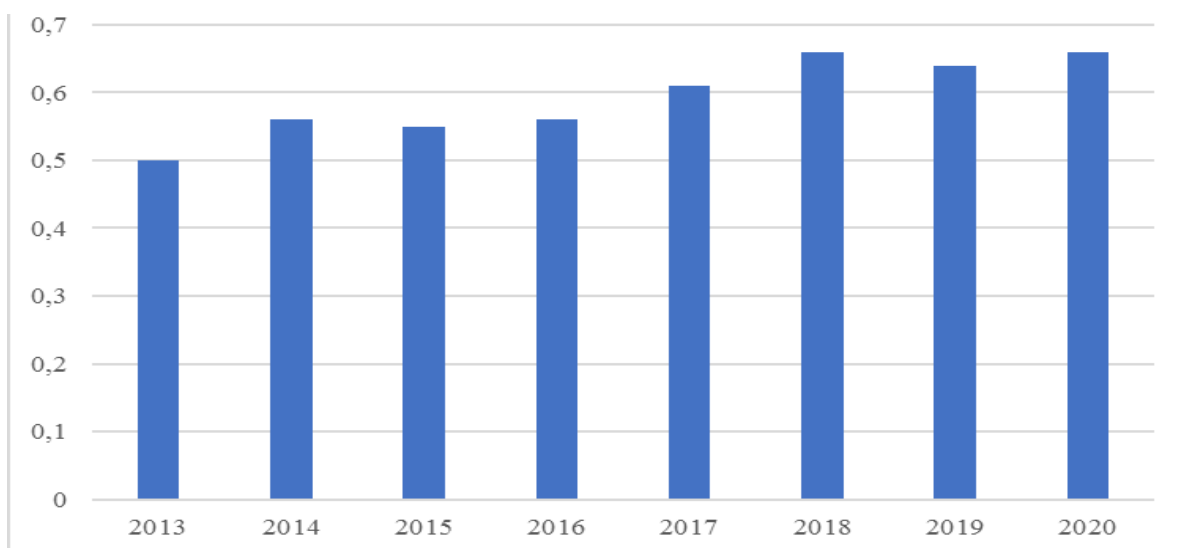


Fig. 1. Diagram of changes in the relative innovation index of Ukraine (Compiled according to [4–16])

5. 2. Study of the level of economic development of the country in purchasing power parity (PPP)

The current size of the national economy, expressed in terms of gross domestic product (GDP), critically limits the significance and international competitiveness of countries. Therefore, for consideration and comparability of data, it is better to use the GDP indicator calculated in purchasing power parity (PPP). Note that GDP is understood as a macroeconomic indicator that reflects the market value of all final goods and services (taking into account PPP) produced in the country per year, on average by one person. That is, GDP (PPP) per capita is a characteristic that determines the level of economic development of a country. For ease of comparison, the figures are calculated in USD. Conversion from national currencies is carried out not at market exchange rates, but at purchasing power parity [18].

Investment resources are formed from two sources: own funds (self-financing) and borrowed funds. Part of the net result from the sale of products, depreciation deductions, part of the circulating assets have been mobilized to their own. In the current conditions of political, financial and economic crises, big enterprises with dynamics of profitability resort to this source of financing.

At the end of 2019, Ukraine created a GDP in the amount of 41 billion USD, accounting for 0.05 % of world GDP. A slight positive dynamics of this indicator can be clearly seen in Table 3. In the last row of the table, the GDP level is calculated taking into account the influence of inflation.

Table 3

Dynamics of Ukraine's GDP for 2016–2020

indicators	2016	2017	2018	2019	2020
GDP in actual prices, billion USD	93.36	112.18	130.90	137.29	93.36
Physical volume index, %	102.4	102.5	103.4	104.1	105.1
Deflator index, %	117.1	122.1	115.4	108.1	109.8
Consumer price index, %	113.9	114.4	110.9	107.9	106.8
Industrial producer price index, %	120.5	126.4	117.4	104.1	103.6
Real GDP, billion USD	79.73	91.87	113.44	127.00	79.73

Note: * – compiled according to [18]

Along with the relative growth of GDP (in 2017 it grew by 20 %, in 2018 – by 26 %, in 2019 – by 19 %, in 2020 – by 5.52 %), inflation grew significantly: in 2017. This figure was 22.1 %, in 2018 – 15.4 %, in 2019 – 8.1 %, 2020 – 9.8 %. Accordingly, consumer prices and industrial producer prices grew. Evaluating the dynamics of the indices of these indicators, it is possible to see that the insignificant growth in the physical volume of GDP is actually leveled out by the rise in prices and the increase in inflation.

The dynamics of changes in sources of financing for innovative activities of industrial enterprises are shown in Table 4. In 2019, the total expenditures for the implementation of research and development on their own by organizations amounted to 579.40 million USD. At the same time, labor costs – 295.44 million USD, other operating costs – 257.56 mil-

lion USD, capital costs – 26.41 million USD, of which the cost of purchasing equipment – 20.31 million USD [18].

Table 4

Sources of financing for innovative activities of Ukrainian industrial enterprises, million USD

Costs	Years			
	2016	2017	2018	2019
Innovation costs, including:	909.18	342.76	447.80	491.22
Own funds of enterprises	862.47	289.63	394.93	430.91
State budget funds	7.01	8.55	23.50	19.22
Funds of non-resident investors	0.92	4.05	3.93	1.47
Funds from other sources	38.79	40.54	25.44	39.62

Note: * – compiled according to [18]

The largest share of funding for innovations falls on the own funds of enterprises, the smallest – on the funds of non-resident investors. The borrowed and attracted sources of investment support of the enterprise include: investment loans from banks, targeted financing, targeted government loans, grants, credit lines of international financial institutions. Investment resources on credit have a longer term for providing funds and a high degree of risk. Public investment is very insignificant, since it comes from the state budget, ministries, departments and is not applied due to the long-term crisis in the financial and industrial spheres.

The introduction of innovative projects depends significantly on the conduct of scientific research in the country. Information on the number of employees involved in the implementation of research, by categories of personnel is systematized in Table 5.

According to the data presented, the number of employees in these categories is constantly decreasing. The proportion of doctors of sciences and doctors of philosophy (candidates of sciences) among the performers of research work was 29.6 %, among researchers – 44.7 %. More than half of the total number of doctors of sciences and doctors of philosophy (candidates of sciences) who carried out research and development, worked in organizations of the public sector of the economy, 35 % – higher education, 5 % – the business sector [18, 19]. The dynamics of the volume of completed scientific and scientific and technical work for the period 2016–2019 is shown in Table 6.

Table 5

The number of employees involved in the implementation of Ukrainian research and development, by category of personnel

personnel categories	Number of persons				Percentage, %			
	2016	2017	2018	2019	2016	2017	2018	2019
Total	97912	94274	88128	79262	100	100	100	100
researchers	63694	59392	57630	51121	65,05	63	65,39	64,5
technicians	10000	9144	8553	7470	10,21	9,699	9,705	9,4
support staff	24218	25738	21945	20691	24,73	27,3	24,9	26,1
Of the total, they have a scientific degree:								
Doctor of Science	7091	6942	7043	6526	7,242	7,364	7,992	8,2
Doctor of Philosophy (Candidate of Science)	20208	19219	18806	16929	20,64	20,39	21,34	21,4

Note: * – compiled according to [18–20]

Table 6

Internal costs of research and development by type of work in 2016–2019 in Ukraine (million USD) *

Research categories	2016	2017	2018	2019	Change, % 2019/2016
Total	451.30	502.98	616.68	596.01	+32.07
Basic scientific research	87.11	109.94	138.11	129.21	+48.33
Applied research	100.24	118.92	131.19	125.59	+25.29
Scientific and technical developments	263.95	274.12	347.39	341.23	+29.28

Note: * – compiled according to [13]

There has been an increase in research spending during the study period. However, given the inflation rate, there is no actual increase in financing costs.

5.3. Highlighting the features of trade in goods with the countries of the European Union

With the entry into force of the Association Agreement between Ukraine and the European Union, the process of creating a free trade zone with the EU countries has begun within ten years from the date of entry into force of the agreement. During the transition period, the country should become a full-fledged participant in the competitive market of the European community, opening access to goods and services of European origin to the domestic market and at the same time gaining access to Ukrainian goods and services.

The commodity structure of trade with the EU is an established structure and requires an increase in the share of goods with higher added value (Tables 7, 8).

According to the given data, raw materials with low added value are mainly exported from the country. According to imported products with a higher added value and a level of innovation.

Table 8

Imports of goods from EU countries in 2018–2020 (thousand USD by groups of goods, more than 5 % of the share of imports)

Years	2018		2019		2020	
Code and name of goods according to UKTVED	volume	%	volume	%	volume	%
Total	23216495.4	100.0	25012187.7	100.0	23456914.9	100.0
including:						
Prepared food products	1444842.1	6.2	1683983.3	6.7	1941889.1	8.3
Mineral products	3272873.9	14.1	2798002.6	11.2	1681089.8	7.2
Products of the chemical and related industries	4017674.4	17.3	4384653.0	17.5	4499869.1	19.2
Polymer materials, plastics and products from them	1701634.5	7.3	1682716.7	6.7	1687290.3	7.2
Base metals and articles thereof	1228511.6	5.3	1325499.1	5.3	1211814.8	5.2
Machines, equipment and mechanisms; electrical equipment	5134791.8	22.1	5435556.7	21.7	5090940.5	21.7
Land vehicles, aircraft, floating equipment	2320035.7	10.0	2320035.7	10.0	2848591.6	12.1

Note: * – compiled according to [19, 20]

Table 7

Exports of Ukrainian goods to the EU countries in 2018–2020 (thousand USD by groups of goods, more than 5 % of the share of exports)

Years	2018		2019		2020	
Code and name of goods according to UCGFEA	volume	%	volume	%	volume	%
Total	20157012.7	100.0	20750741.6	100.0	18612100.5	100.0
II. Vegetable products (except oil)	3694908.5	18.3	4480008.9	21.6	3375536.2	18.1
III. Animal or vegetable fats and oils	1143823.4	5.7	1544502.7	7.4	1845674.4	9.9
V. Mineral products	2704062.3	13.4	2697072.7	13.0	2069580.4	11.1
IX. Wood and wood products	1043749.4	5.2	1004866.6	4.8	992741.1	5.3
XV. Base metals and articles thereof	4437539.5	22.0	3796558.2	18.3	3103075.6	16.7
XVI. Machines, equipment and mechanisms; electrical equipment	2859429.9	14.2	2825029.7	13.6	2746914.0	14.8

Note: * – compiled according to [19, 20]

According to the State Statistics Service of Ukraine [19], p. 18, foreign economic activity: in 2017. The export of goods amounted to 43,264.7 million USD, an increase of 19.0 % compared to last year. At the same time, the import figure was 49 607,2 million USD, an increase of 26.4 % over last year, causing a negative trade balance of 6342,5 million USD.

In 2018, the indicator of export of goods amounted to 47335.0 million USD, an increase of 9.4 % compared to the previous year. At the same time, the import figure was 57 187,6 million USD, an increase of 15.3 % over the previous year, causing a negative trade balance of 9 852, 60 million USD.

In 2019, the indicator of export of goods amounted to 50054,6 million USD, an increase of 5.7 % over last year. At the same time, the import figure was 60790,4 million USD, an increase of 6.3 % over the previous year, showing a negative trade balance of 10,745.60 million USD. These figures demonstrate a slowdown in the growth rate of export of goods, combined with an annual increase in the country's negative trade balance, increased by 4 403.1 million USD in two years.

During 2019, China became the country's main partner in the export of goods, with a share of 7.2 % in the entire array of exports, ahead of Poland with 6.6 % and the Russian Federation with 6.5 %. It should be noted that the share of the Russian Federation in the total structure of the export of Ukrainian goods in recent years has been declining: in 2017 – 9.1 %, in 2018 – 7, 7 %, in 2019 – the above – 6, 5 %. This is due to the political events of recent years in both countries and mutual trade sanctions for the annexation of the Crimean Peninsula by Russia and the unleashing of the conflict in Donbas. On April 18, 2019, the government of the Russian Federation introduced new economic sanctions against Ukraine, introducing a ban on the import of such goods into Russia: paper products, light industry products, metallurgical products, and engineering products.

Having considered the structure of exports of goods in 2019, by types and dynamics of growth/decline, let's observe a trend towards an increase in exports of certain types of products. These include: agricultural products, food and extractive industries, as evidenced by the growth in exports of grain crops by 33.0 %, fats and oils by 5.2 %, ores, slags and ash by 18.3 %. Note the catastrophic decrease in the size of exports of ferrous metals traditional for the Ukrainian industry, which amounted to in 2019 87.9 % of last year's level, reduction in exports of electrical machines (94.6 % of last year's export level).

At the same time, in the structure of imports of goods in 2019 there are steady trends towards an increase in imports of mechanical devices by 2.8 % compared to 2018, electrical devices by 21.5 %, ground vehicles by 37.3 %. Taking into account information about trade restrictions imposed by the Russian Federation, general tendencies towards a decrease in trade turnover with it, it is possible to predict further growth of the negative trade balance of Ukraine.

5. 4. Analysis of the most active innovative industries in the context of European integration

Enterprises, depending on the number of employees and income for the year, can be divided into microenterprises and small, medium and big businesses (Table 9).

Table 9

Classification signs of business entities in Ukraine

Business entities	Average number of employees for a calendar year, people	Annual income, million eur
Microbusiness	Less than 10	Less than 2,0
Small business	From 11 to 50	More than 2,0, but to 10,0
Medium-sized businesses	From 51 to 250	More than 10,0, but no more than 50,0
Big business	More than 250	More than 50,0

Note: * – compiled according to [19]

More innovations in Ukraine are used in the field of mechanical engineering. According to the State Statistics Service of Ukraine, posted on the official website during 2010–2019, the following dynamics is observed in the country in terms of the number of big medium and small businesses by type of economic activity (Tables 10, 11).

Table 10

The number of subjects of big, medium and small businesses in the field of mechanical engineering in 2010–2019

Directions	Business entities	Years									
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Manufacture of computers, electronic and optical products	Big	4	2	3	1	1	1	1	–	1	–
	Medium	124	128	110	110	104	93	94	94	90	99
	Small	1775	1680	1087	1091	1106	1202	1063	1054	1088	1158
Electrical equipment manufacturing	Big	7	8	9	9	6	3	5	5	6	8
	Medium	198	188	198	192	174	162	152	160	157	153
	Small	1376	1129	971	1086	1104	1248	1181	1241	1343	1399
Manufacture of machinery and equipment	Big	22	22	19	17	11	10	8	7	6	11
	Medium	438	440	427	412	342	306	307	315	325	332
	Small	4132	3673	2520	2682	2661	2796	2785	2885	3014	3174
Manufacture of motor vehicles, trailers and semi-trailers	Big	6	9	6	5	4	3	2	2	6	6
	Medium	82	82	86	81	72	68	76	81	76	76
	Small	460	384	349	344	346	376	349	319	334	357
Other vehicle production	Big	13	20	17	14	11	6	3	3	6	7
	Medium	79	82	116	109	94	92	89	88	90	86
	Small	479	473	491	571	443	499	487	428	427	438

Note: * – compiled according to [19, 20]

Data analysis of Table 10 indicates that in the pre-crisis period this area showed an upward trend. In 2010–2011, there is a positive trend and there is an increase in the number of entities. But gradually the number of subjects engaged in production is decreasing. This applies to the production of computers, electronic and optical products, machinery and equipment, vehicles, trailers and semi-trailers. Only the number of subjects of production of electrical equipment has slightly improved or remained at the level of 2010. This indicates that the most promising is the production of electrical equipment, while in other subsectors there is a reduction. These data are evidence of the deterioration of the situation in general in this area. The dynamics of production of certain types of industrial products for 2014–2019 is shown in Table 11.

Analysis of the numerical indicators of the Table 11 made it possible to identify the existence of stable trends towards a decrease in the number of business entities (big, medium and small) involved in the field of mechanical engineering. At the same time, there is also a decline in the total volume of products that are produced by enterprises in this area.

This situation is due to systemic problems that have existed in the industry throughout the entire period of independence, and the lack of a sufficient number of measures to modernize facilities. As a result, there is a gradual loss of foreign sales markets due to the low competitiveness of Ukrainian products, as well as a significant decrease in participation in the domestic market due to an increase in imports.

Table 11

Production of certain types of industrial products for 2014–2019

Name of product	Dimensions	Number of products					
		2014	2015	2016	2017	2018	2019
Electric motors and DC generators with a capacity of more than 37.5 W, but not more than 750 W (except for starters for starting internal combustion engines)	thousand units	24.8	10.5	7.8	11.6	10.4	0.6
Electric motors and DC generators with a capacity of more than 750 W, but not more than 75 kW (except for starters for starting internal combustion engines)	thousand units	2.7	4.9	6.6	2.0	2.7	0.5
Single-phase AC motors with a power not exceeding 750 W	thousand units	91.8	64.2	58.8	63.4	54.0	36.7
Multiphase AC motors with a power not exceeding 750 W	thousand units	71.2	127	146	123	96.7	54.4
Multiphase AC motors with a power of more than 0.75 kW, but not more than 7.5 kW	thousand units	19.9	27.3	35.0	27.2	17.0	12.9
Bridge cranes on fixed supports	thousand units	101	78	56	64	112	72
Tractors with an engine power of more than 59 kW (except for tractors driven by a driver who is walking alongside, wheeled tractors for semi-trailers, crawler tractors)	thousand units	2.7	2.8	3.3	3.3	2.4	1.4
Plows	thousand units	4.4	3.7	3.6	2.9	3.0	2.5
Rippers and cultivators	thousand units	3.7	3.4	3.8	4.0	2.9	3.9
Seeders, planters and transplanters	thousand units	4.4	4.2	4.8	5.3	3.8	3.2
Tractor mowers, including mounted plasma mechanisms, designed for driving or towing a tractor	thousand units	2.6	2.5	3.5	3.6	1.6	1.1
Combine harvesters	units	–	100	154	70	47	
Machines for working wood, cork, bone, ebonite, hard plastics and the like	–	0.9	1.1	1.1	1.0	1.0	0.9
Self-propelled boring and tunneling machines	units	77	–	–	21	29	16
Drilling and tunneling machines, other (including stationary platforms used for exploration or exploitation of oil or natural gas fields), other than self-propelled	units	431	291	92	58	94	48
New motor vehicles with diesel and semi-diesel internal combustion engines with a carrying capacity of more than 5 tons, but not more than 20 tons (including vans, except for dump trucks for off-road use, tractors)	units	682	965	215	–	327	156

Note: * – compiled according to [19, 20]

One of the main directions for solving this problem is the introduction of innovations, that is, new and technologically improved products (product innovation) and improved processes (innovation process). As it is known, an innovation is considered implemented if its result is presented on the market or used in the production process.

The innovative activity of the enterprise includes a complex of scientific, technological, organizational, financial and marketing activities aimed at creating and introducing innovations. Innovations include: conducting and acquiring scientific research, new technologies, industrial design, the introduction of new production methods, the acquisition of equipment, other fixed assets and capital costs associated with the introduction of innovations, marketing, advertising, and the like.

According to the State Statistics Service of Ukraine [19], during 2017–2019, the share of the number of innovatively active industrial enterprises is as follows (Table 12).

Table 12

Dynamics of changes in the share of innovative activities in areas

Areas of innovation	Percentage of the total		
	2017	2018	2019
Internal research work	2.8	4.6	2.5
External research projects	1.3	1.4	1.4
Purchase of machinery, equipment and software	10.6	6.8	10.2
Acquisition of external knowledge	0.9	0.8	0.7
Others	3.7	2.9	3.2
Total	16.2	16.4	15.8

Note: * – compiled according to [18–20]

So, the dynamics of innovative activity of industrial enterprises in our country is rather low, with a downward trend. The data presented also take into account the fact that “... the minimum level of novelty for the enrollment of any change to innovation is defined as new for the enterprise. The product can already be used (manufactured) by other enterprises, but if it is new or significantly improved for a given enterprise, then such a change is an innovation for it ... “[20].

Clustering is a significant stimulus for the development of innovative activity. The governing bodies of the European Union pay attention to innovation clusters. Active measures are being taken to unite European companies into strategic alliances, priority is given to cross-border spirits. In general, it should be noted that innovation clusters have become an important part of the economic development of the European Union and one of the components of the growth of its competitiveness. This is evidenced by the new EU development strategy “Europe-2020”, within the framework of which the European Commission formulated a number of initiatives aimed at increasing the competitiveness of the European economy [13].

5. 5. Methodology for assessing the state of security of the country’s innovative environment in the context of European integration

Analyzing Ukraine’s cooperation with the EU in recent years, one can cite some positive shifts.

Reform of secondary education “New Ukrainian School” and an increase in the presence of foreign institutions in the domestic education market. Ukraine is one of the largest beneficiaries of the Erasmus+ pro-

Table 13

Innovation indices of Ukraine

Year	Global Competitiveness Index *	Relative Innovation Index	Global Innovation Index **	Investment Activity Index***	General indicator of the state of security of the innovative environment
2013	0,446	0,5	0,5	0,424	0,219
2014	0,432	0,56	0,559	0,531	0,270
2015	0,436	0,55	0,546	0,515	0,261
2016	0,384	0,56	0,563	0,573	0,268
2017	0,409	0,61	0,606	0,618	0,312
2018	0,407	0,66	0,659	0,608	0,338
2019	0,596	0,64	0,636	0,58	0,376
2020	0,592	0,66	0,657	0,491	0,359

Note: * – the Global Competitiveness Index is calculated according to the “Rating of countries by the level of competitiveness” as a relative indicator, that is, subtract the occupied space from the total number of countries and divide the difference by the total number of countries under study [22]; ** – the Global Innovation Index is calculated according to the Global Innovation Index data as a relative indicator, that is, let’s subtract the occupied space from the total number of countries and divide the difference by the total number of countries under study [16]; *** – investment Activity Index is calculated according to the “Investment Index” [23] by dividing these data by the maximum value (5).

gram in the Eastern Partnership region (20 million EUR). The goal of this program is to strengthen the capacity of civil society to support and monitor the implementation of reforms.

Private Sector Development Program (110 million EUR) – assistance to the recovery of the Ukrainian economy by providing technical assistance to improve the legislative framework for SMEs, support for the establishment of business consulting centers in the regions, which facilitate access to finance.

Ukraine’s participation in the framework program of the European Union for research and innovation “Horizon 2020” is a kind of visiting card of scientific research European integration. The program provides for a Horizon 2020 budget of 80 billion Euros for the financial period 2014–2020.

Support for the modernization of the gas transportation system of Ukraine and the reconstruction of parts of transit pipelines in cooperation with partners and financial institutions such as the European Investment Bank, EBRD and the World Bank [14].

The process of integration into the single digital market of the EU includes the creation of a Roadmap, regulation of electronic communications and radio frequency resources, taking into account EU law, assistance for the development of digital infrastructure in the country.

The program for integrating the country into the EU energy market is to help the Government of the country to establish an independent regulatory body on energy issues, as well as to develop updated legislation to improve the efficiency of the energy sector.

To assess the state of security of the innovation environment in a particular country, it is proposed to calculate the overall indicator by combining four indices, each of which characterizes a certain block of factors. These include: resource provision and infrastructure development (global competitiveness index); efficiency of innovation activity (relative innovation index) state of the country’s innovation development (global innovation index); favorable state for investment (investment attractiveness index). A similar approach to determining the integral indicator was tested in the process of researching the security of the investment environment [21].

$$GI=(I_1 \times I_2 + I_2 \times I_3 + I_3 \times I_4 + I_4 \times I_1)/4, \quad (1)$$

where GI – a general indicator of the state of security of the country’s innovative environment; I_1 – global competitiveness index; I_2 – relative innovation index; I_3 – global innovation index; I_4 – index of investment activity.

This approach is simple and convenient. The general indicator of the state of security of the country’s innovative environment is calculated in Table 13.

The above calculations confirm that the current state of the introduction of new technologies in Ukraine is unsatisfactory. This also affects the composition of product exports. Basically, enterprises sell raw materials and low-tech products that have a small share of added value. This simultaneously reduces the filling of the state budget of the country.

6. Discussion of the research results of the general indicator of the safety of the innovative environment

As a research result, an assessment of the innovative activity of enterprises in the context of European integration was obtained. According to the proposed relative innovation index (Fig. 1), it can be seen that in the studied country there was a slight improvement in the conditions for the innovation activity of enterprises. This indicator is more illustrative in comparison with the global innovation index or the global competitiveness index (Table 1). This is confirmed by the summary grouping (Table 2).

The dynamics of changes in GDP over the past five years (Table 3) demonstrated the absence of economic growth in the studied country, since a slight increase in its physical volume is derived by inflationary processes. Further analysis of resources for innovation (Tables 4–6) revealed insufficient government support and, accordingly, a reduction in the number of scientists of different categories (Table 5).

The study of the commodity structure of Ukraine’s trade with the EU (Tables 7, 8) revealed that in recent years there has been an imbalance in export-import operations, which leads to a negative balance of foreign trade. Mainly, raw materials are exported from Ukraine, and goods with higher added value are imported.

Analysis of the number of business entities in the field of mechanical engineering (Table 10) demonstrates a significant decrease, which indicates a worsening of the situation in the most innovatively active industry of the country. This is confirmed by the data in Table 11, which indicates a decline in production and a gradual loss of sales markets. The dynamics of changes in the share of innovative activities in areas (Table 12) confirms the conclusion about the insufficient innovative activity of enterprises in Ukraine.

Consideration of cooperation programs with the EU confirms the promotion of innovative development of countries and allows the development of programs for further stimulation. The indicator of the state of security of the country’s innovative environment was calculated using the formula (1). The advantages of this indicator are its convenience, sim-

plicity of calculation, multidimensionality and the absence of data limitations for calculation. Also, this indicator takes into account the main factors influencing the innovative activity of enterprises.

The proposed methodology has been tested on the example of Ukraine (Table 13) and can be used to assess the potential of other countries seeking to integrate into the European space. The initial condition is to stimulate the innovative activity of enterprises and increase the share of medium- and high-tech processing goods in the total volume of exports.

The general indicator of the state of security of the country's innovation environment can be modified by increasing the blocks of factors, if necessary. The development of this study consists in the further development of recommendations for increasing the innovative activity of enterprises and the creation of additional centers for financing innovative partnerships. This experience can be used by scientists from countries that plan to cooperate with the EU.

7. Conclusions

1. According to the analysis of the ratings of the Global Innovation Index, the Global Competitiveness Index, the relative innovation index, there is a trend of gradual improvement in the conditions for the development of innovative activities of enterprises. Thus, the value of the relative innovation index in 2020 increased by 0.16 compared to 2013. When interpreting the results, it is necessary to take into account the number of analyzed countries in the above rankings. In case of a change, it is advisable to apply a correction factor.

2. An analysis of quantitative indicators of sources of financing for innovative activities of industrial enterprises and workers engaged in scientific activities established that the country under study does not have enough resources for stable economic development. Spending on innovation decreased by 47.97 % between 2016 and 2019, but there is an increase in the share of investments from the state budget (from 0.77 % in 2016 to 3.91 % in 2019), non-resident investors (from 0.1 % to 0.3 %), other sources (from 4.27 %

in 2016 to 8.07 % in 2019). These trends demonstrate the need for foreign direct investment and the implementation of programs to stimulate the economic development of countries in the context of European integration.

3. With the help of economic and statistical analysis of export-import operations and structural analysis of the trade turnover of partner countries, a tendency towards a chronic deficit of the country's trade balance was revealed (the balance in 2018 amounted to –3059.5 million USD, in 2019 it amounted to –4261, 5 million USD, in 2020 in accordance with –4844.8 million USD). This situation made it possible to formulate recommendations on the need to adjust the exchange rate with the EU in order to reduce the country's trade deficit and, in the long term, reach the surplus level.

4. With the help of statistical and analysis of the dynamics of changes in the number of subjects in the field of mechanical engineering, production volumes of the most significant types of industrial products, the share of innovation activity in the areas, it was determined that the dynamics of innovation activity is low with a downward trend. The production of electric motors fell by half (from 210.4 thousand units in 2014 to 105.1 thousand units in 2019), the production of drilling machines decreased eight times (in 2014 –508 units, in 2019 – 64 Units). This confirms the loss of external and internal sales markets due to a decrease in the competitiveness of innovative industries, in particular mechanical engineering. The data obtained make it possible to identify the most promising types of products for sale in the EU and provide economically sound recommendations for the introduction of innovations by enterprises.

5. By analyzing the results of cooperation with the EU, the need for assessing the security of the country's innovation environment was identified. This indicator is aggregate and takes into account the main factors influencing the state of innovation in the country. This method is universal, but based on data from a specific country, taking into account general and specific factors of the innovation environment. The trend towards a slow increase in the value of the overall indicator of the safety of the innovative environment (from 0.219 in 2013 to 0.359 in 2020) is a confirmation of the improvement of the innovative potential of Ukraine.

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