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INNOVATIVENESS OF THE UKRAINIAN ECONOMY ON THE WAY TO THE EU¹

The article is devoted to the assessment of the level of innovativeness of the Ukrainian economy in comparison with the innovativeness of the economies of the European Union countries based on the Global Innovation Index 2023 and the justification of ways to increase it in the course of advancing to full membership in the EU. In the course of the study, the hypothesis that there is a close connection between the level of the country's development, which is measured by the GDP per capita indicator in the model, and the absolute value of the global innovation index was confirmed (correlation coefficient is 0.868). However, Ukraine, which belongs to the group with a below-average GDP per capita indicator, is ahead of more than 30 countries with high and above-average GDP per capita indicators according to the Global innovation index. This strengthens the hope that the creation of the necessary conditions for the realization of innovative potential will be able to accelerate economic growth and lead to a significant increase in GDP in the post-war period. The comparison of the global index of innovativeness of Ukraine with the similar indicator of the EU countries carried out in the article showed a certain lag of our country, which arose in recent years, which can be explained by Russian aggression. However, this lag is not fundamental and can be overcome in a short time. Moreover, among the candidate countries for joining the EU, Ukraine ranks among the top three in terms of innovativeness. Therefore, such a lag should not become an obstacle on the way to the EU. A more detailed analysis of individual indicators that form the global index of innovativeness revealed significant heterogeneity of the innovative environment of the Ukrainian economy, because its rating according to these indicators ranges from 1 to 130. Ukraine's achievements in performance indicators, which are calculated in relation to GDP, are quite good, which once again confirmed the conclusion that there is a disproportion between the potential and actual volumes of production. The biggest lag is recorded in the indicators related to the business environment, its stability and the legal norms that regulate it. A serious problem for Ukraine is the lack of market and organizational infrastructure. These issues should become the object of special attention of the state on the way to the EU.

Keywords: Global index of innovation, GDP per capita, European Union, Ukraine, innovation environment

JEL classification: O11, O30, O38

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Стаття присвячена оцінці рівня інноваційності української економіки у порівнянні з інноваційністю економік країн Європейського Союзу на основі Global Innovation Index 2023 та обґрунтуванню шляхів його підвищення у ході просування до повноцінного членства у ЄС. У ході дослідження знайшла підтвердження гіпотеза про наявність тісного зв'язку між рівнем розвитку країни, який у моделі вимірюється показником ВВП на душу населення, та абсолютним значенням глобального індексу інноваційності (коефіцієнт кореляції 0,868). Однак Україна, яка належить до групи з показником ВВП на душу населення нижче середнього, випереджає за глобальним індексом інноваційності більше 30 країн, які мають високі та вищі за середні показники ВВП на душу населення. Це вселяє надію, що створення необхідних умов для реалізації інноваційного потенціалу зможе прискорити економічне зростання та призведе значного збільшення ВВП у повоєнний період. Проведене у статті співставлення глобального індексу інноваційності України з аналогічним показником країн ЄС показало певне відставання нашої країни, яке виникло в останні роки, що можна пояснити російською агресією. Однак це відставання не є кардинальним і зможе бути подоланим у короткі терміни. Тим більше, серед країн-кандидатів на вступ до ЄС за показником інноваційності Україна входить до трійки лідерів. Тому таке відставання не повинне стати перепоною на шляху до ЄС. Більш детальний аналіз окремих показників, які формують глобальний індекс інноваційності виявив значну неоднорідність інноваційного середовища української економіки, адже її рейтинг за цими показниками коливається від 1 до 130. Досить хорошими є досягнення України у результативних показниках, яку розраховуються по відношенню до ВВП, що ще раз підтвердило висновок про наявність диспропорції між потенціалом та фактичними обсягами виробництва. Найбільше ж відставання фіксується у показниках, які пов'язані з бізнес-середовищем, його стабільністю та правовими нормами, що його регулюють. Серйозною проблемою для України є не сформованість ринкової та організаційно інфраструктури. Саме ці питання мають стати об'єктом особливої уваги держави на шляху до ЄС.

Ключові слова: *Глобальний індекс інноваційності, ВВП на душу населення, Європейський Союз, Україна, інноваційне середовище*

JEL classification: *O11, O30, O38*

Statement of the problem and its connection with important scientific or practical problems. It is a universally recognized fact that the prospects of a country are determined by the degree of its innovativeness. The latter should not be understood limited only by the assessment of the degree of novelty of already used technologies or organizations, produced products and services. When it comes to the innovativeness of a country or its economy, special attention should be paid to the extent to which it is ready to accept this newness and create appropriate conditions for its spread. Therefore, innovativeness is not only an assessment of the state, but also of the potential.

The problem of innovativeness is cross-cutting: it can be studied starting from the household level and ending with large interstate regional associations. Of course, indicators and criteria for evaluating the degree of innovation will be different for different levels of the economy. However, a common requirement for them is the ability to reflect both achievement and perspective.

Today, the macroeconomic approach to the analysis of innovativeness deserves special attention, namely the evaluation of the innovativeness of the national economy as a whole. In order to get the maximum benefit from

the accession to the EU and not to harm this association by its accession, the Ukrainian economy must make significant progress in matters of its innovativeness. Therefore, conducting a comparative analysis of the level of innovativeness of the economy of the member countries and Ukraine will allow not only to identify differences, but also to formulate proposals for the development of a system of measures aimed at bringing these indicators closer together.

Analysis of recent studies and publications, which laid the foundation for solving the problem under study, and highlighting previously unresolved parts of the general problem, which are the subject of the article. A huge amount of scientific research is devoted to issues of innovation. Although almost 100 years have passed since the first use of this term by J. Schumpeter, discussions about the essence of innovation, innovativeness and innovative development continue actively. One should agree with the opinion of A.O. Knyazevich, O.V. Kraychuk and V.O. Ostapchuk that assessing «the level of innovativeness of the country, its potential and the state of the infrastructure is a very diverse scientific and practical task, in which it is quite difficult to measure and evaluate all the operating factors with mathematical precision» [1, c. 28]. That is why there is a huge number of definitions that highlight certain aspects of this extremely complex phenomenon. At the same time, all researchers practically agree that the future position of the country is largely determined by its innovation.

The authors [2] offer their interpretation of the concept of «innovative development model» and develop a system of indicators based on three components: work, productivity and cost. Many studies look for the relationship between individual indicators of innovativeness and economic development. Thus, Viju Raghupathi and Wullianallur Raghupathi build models where the ratio of patents held by foreign residents and the number of patent applications in each branch of the technology sector are used as variables. The resulting indicators include GDP, gross national income, labor costs, research and development expenditures, real minimum wages, tax revenues, etc. [3].

Quite interesting is the study conducted by the author's team on the impact of innovations on three macroeconomic indicators: GDP, self-employment and foreign direct investment. GDP per capita is considered by the authors as a general indicator of economic development, self-employment can characterize the development of entrepreneurship, and direct foreign investments show the degree of trust in the country and the assessment of its prospects. The obtained results do not allow us to assess the impact of innovations on the studied indicators as unequivocally positive [4].

Many researchers wonder why some countries are more innovative than others. In their opinion, a common feature of the world leaders of innovation is significant investment in an eco-environment that supports innovation and has strong institutions, policies and practices that allow using innovation for economic and social progress [5].

Of particular interest are studies devoted to a comparative analysis of the innovativeness of EU member states and candidates for this organization. And although the research was conducted during the period when Ukraine was not

yet a candidate for EU membership, the methodology and results of their implementation can be useful for assessing the current state [6].

Manzoor F, Wei L, Subhan QA. & Siraj M. examine the internal mechanisms for ensuring innovation in countries that are leaders in their groups, separated by the level of GDP per capita (high, above average, below average and low). They suggested introducing two indicators into scientific circulation: the index of innovative contribution and the index of innovative result. According to the results of the analysis, the authors conclude that innovativeness is one of the decisive factors of economic stability [7].

Most often, when it comes to the innovativeness of the national economy, various international ratings are used (Global Innovation Index [8], World Innovation Index according to Bloomberg [9], Innovation Index of the European Innovation Scoreboard [10]). There are studies that summarize Ukraine's position in these international rankings [11; 12].

At the same time, conducting a comparative analysis of the degree of innovativeness of the countries of the European Union and Ukraine is gaining special relevance today. First, it is due to the start of negotiations regarding Ukraine's accession to the EU. And it is the significant backwardness of our country according to some indicators that can become an obstacle to the success of these negotiations. Secondly, the war largely destroyed the old model of work with innovations, and in the post-war period Ukraine will be able to build a new model that would meet modern requirements.

Statement of the objectives of the article. The purpose of our research is to assess the level of innovativeness of the Ukrainian economy in comparison with the innovativeness of the economies of the countries of the European Union based on the Global Innovation Index 2023 and to substantiate ways of increasing it in the course of advancing to full membership in the EU.

Methodology. To achieve the set goal, we will use, first of all, methods of statistical analysis. The information base of the study consists of data from the Global Innovation Index for 2020-2023, as well as indicators that are available on the websites of other international economic organizations. Grouping and systematization methods, averaging methods, and methods of economic and statistical analysis were used for data processing.

Presentation of the main research material with full justification of the scientific results obtained. If we focus only on the name, we may get the false impression that the Global Innovation Index provides information only on purely innovative processes. In fact, it is a rather complex indicator, in which various aspects of society's activity are reflected in a generalized form. 82 indicators are combined into seven blocks: institutes; human capital and research; infrastructure; sophistication of the market; sophistication of business; knowledge and technology results, and creative results. Therefore, the analysis cannot be limited only to the comparison of the final rating. It must be complemented by a study of the value of individual indicators, as this is how it will be possible to identify reserves for improving the overall result.

As noted in the Global Innovation Index 2023 report, modern innovation processes are affected by two waves. The first of them is related to digitalization, the emergence and comprehensive use of artificial intelligence, computerization

and automation. The other finds its manifestation in the spread of the use of bio- and nanotechnologies [8, c. 6]. Its place in the global innovation rating depends on the extent to which this or that country is able to ensure its activities in the direction of these waves.

Even the first reading of the rating gives reason to formulate the hypothesis that there is a close connection between the level of innovation and the level of economic development, because the most developed countries are at the top of the rating, while the countries with the lowest level of development close the table. To test this hypothesis, we will make a sample of countries to which we will include the top ten ranked countries from each group selected according to the criterion of GDP per capita (high level, higher than average, lower than average, low). The results of the sample are presented in the table. 1. To characterize the country's level of innovation, the absolute value of the index is included in the table. GDP per capita (in US dollars at the current exchange rate) was used as an indicator of the country's economic development.

Table 1

Interdependence of the value of the Global Innovation Index and the level of development of the country*

Country	Score	GDP per capita	Country	Score	GDP per capita
Switzerland	67.6	93.3	India	38.1	2.4
Sweden	64.2	56.4	Viet Nam	36.0	4.2
USA	63.5	76.3	Ukraine	32.8	4.5
UK	62.4	46.1	Philippines	32.2	3.5
Singapore	61.5	82.8	Indonesia	30.3	4.8
Finland	61.2	50.9	Iran	30.1	4.7
Netherland	60.4	57.0	Moldovia	30.3	5.7
Germany	58.8	48.7	Morocco	28.4	3.4
Denmark	58.7	67.8	Tunisia	26.9	3.7
Republic of Korea	58.6	32.4	Uzbekistan	26.2	2.3
China	55.3	12.7	Rwanda	20.6	1.0
Malaysia	40.9	12.0	Madagascar	19.1	0.5
Bulgaria	39.0	14.0	Togo	16.9	0.9
Türkiye	38.6	10.7	Zambia	16.4	1.5
Thailand	37.1	6.9	Uganda	16.0	1.0
Brazil	33.6	8.9	Burkina Faso	14.5	0.8
Russian Federation	33.3	15.5	Ethiopia	14.3	1.0
Serbia	33.1	9.5	Mozambique	13.6	0.6
North Macedonia	33.0	6.6	Guinea	13.3	1.5
Mauritius	33.1	10.3	Mali	12.9	0.8

* Calculated on: [8; 16]

At the first stage of identifying the relationship between the innovation index and the level of economic development of the country, it is sufficient to calculate the average value of the index for each of the groups. The calculations gave the following results: countries with a high level - 5.5; countries with an above-average level - 43.2; countries with a level below the average - 61.9; countries with a low level - 119.5.

In order to quantify the closeness of the relationship between the studied indicators, we will calculate the correlation coefficient. For this sample of countries, this coefficient is 0.868 with the value of $R^2 = 0.753$. This gives reason to claim that the analysis of empirical data confirms the validity of the proposed hypothesis.

The graphically indicated connection is shown in the graph in fig. 1. It is easy to see that the curve with acceleration more accurately reflects the actual relationship. Of course, correlational analysis does not provide enough information about the causal direction of the relationship: whether the level of development is a factor of innovativeness, or innovativeness is a factor of the level of development. In our opinion, there is no unequivocal answer at all. In fact, under certain conditions in the studied relationship, the factor and the result can change places. However, it can be argued that the more innovative a country's economic system is, the more chances it has to accelerate economic development. And the greater the country's success in terms of economic development, the more opportunities it has to give its economy an innovative character.

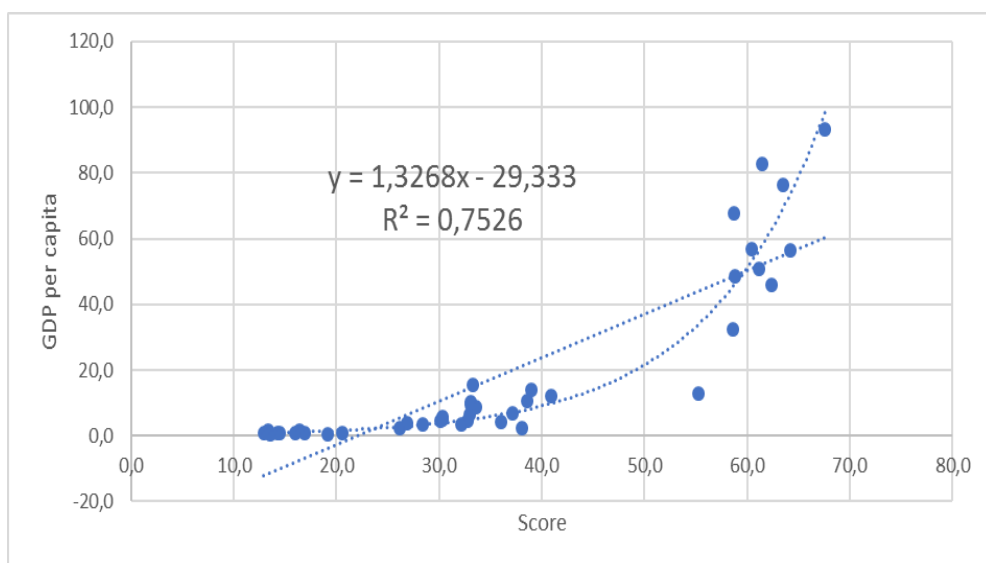


Fig. 1. The relationship between the innovativeness index and the country's level of development

It should be noted that Ukraine's position in the global ranking of innovativeness has somewhat deteriorated in recent years. If in the rating of 2021 it was forty-ninth, then in 2023 its position was 55. The absolute value

of the indicator also deteriorated from 35.6 to 32.8. Despite this, our country is consistently among the top three in its income group (below the average).

However, today, it is not so much the assessment of the position in the overall ranking that is of particular importance, but the comparison with the countries of the European Union, to which Ukraine is moving towards membership. The ranking of EU countries and Ukraine for the last three years is shown in Table 2.

Table 2

Global Innovation Index of EU countries and Ukraine*

	Country	2023		2022		2021	
		rank	score	rank	score	rank	score
1	Sweden	2	64,2	3	61,6	2	63,1
2	Finland	6	61,2	9	56,9	7	58,4
3	Netherlands	7	60,4	5	58,0	6	58,6
4	Germany	8	58,8	8	57,2	10	57,3
5	Denmark	9	58,7	10	55,9	9	57,3
6	France	11	56,0	12	55,0	11	55,0
7	Estonia	16	53,4	18	50,2	21	49,9
8	Austria	18	53,2	17	50,2	18	50,9
9	Luxemburg	21	50,6	19	49,8	23	49,0
10	Ireland	22	50,4	23	48,5	19	50,7
11	Belgium	23	49,9	26	46,9	22	49,2
12	Malta	25	49,1	21	49,2	27	47,1
13	Italy	26	46,6	28	46,1	29	45,7
14	Cyprus	28	46,3	27	46,2	28	46,7
15	Spain	29	45,9	29	44,6	30	45,4
16	Portugal	30	44,9	32	42,1	31	44,2
17	Czech Republic	31	44,8	30	42,8	24	49,0
18	Slovenia	33	42,2	33	40,0	32	44,1
19	Lithuania	34	42,0	39	37,3	39	39,9
20	Hungary	35	41,3	34	39,8	34	42,7
21	Latvia	37	39,7	41	36,5	35	42,4
22	Bulgaria	38	39,0	35	39,5	40	39,9
23	Poland	41	37,7	38	37,5	40	39,9
24	Greece	42	37,5	44	34,5	47	36,3
25	Croatia	44	37,1	42	35,6	42	37,3
26	Slovakia	45	36,2	46	34,3	37	40,2
27	Romania	47	34,7	49	34,1	48	35,6
28	Ukraine	55	32,8	57	31,0	49	35,6

* Calculated on [8; 13; 14]

Its analysis allows us to draw several conclusions:

1. The positions in the ranking of the EU countries also confirm the previous hypothesis about the existence of a close relationship between the level of development of the country and its innovation index: the «old» EU members are

placed at the top of the table, while the countries that joined the Union in the last 20 years close the table. The only exception is Estonia, which is rapidly increasing the value of its indicator and now ranks among the TOP-10 EU countries according to the innovativeness index.

2. The European Union is quite heterogeneous according to the global innovation index. The positions of its members range from second place (Sweden) to 47 (Romania), and the absolute value of the leader's indicator is almost twice the value of the outsider's indicator. Moreover, this gap has been increasing in recent years: if in 2020 the «leader/outsider» ratio was 1.76, then in 2023 it increased to 1.85 [8; 15]. At the same time, such significant differences between countries are not an obstacle for them to find one integration union.

3. The average value of the innovativeness index for the EU has a steady upward trend: 45.4 in 2021 and 47.5 in 2023. However, this growth is mainly due to the countries that occupy the upper part of the table (these are countries with a high level of GDP per capita), while countries from the last ten are losing their positions. This allows us to suggest that more innovative and more developed countries are less vulnerable to the upheavals that have occurred in Europe in recent years (COVID-2019, the war in Ukraine, etc.).

4. According to the innovation index, Ukraine will be inferior to all EU members in 2023. However, this lag is not critical: the EU outsider is ahead of Ukraine by only 1.9 points. Moreover, in previous years (2020 and 2021), the value of the innovativeness index for Ukraine was even higher than for Romania. However, in recent years, Ukraine has worsened its indicator, which can be explained by Russia's aggression against our country.

5. In 2020, Ukraine, occupying the 45th position, was the leader in terms of innovativeness among the current candidates for EU membership. However, even now, after two years of war, it is ahead of many candidates not only from the Eastern Partnership, but also from the Balkan countries: 53 Serbia; 54 North Macedonia; **55 Ukraine**; 60 Moldova; 65 Georgia; 75 Montenegro; 83 Albania [8].

Thus, there is no reason to believe that Ukraine's lagging behind the EU countries is catastrophic and should stand in the way of our country joining this integration association. However, this does not mean that special attention should not be paid to issues of innovation. As already mentioned, innovativeness can be an important factor in accelerating economic development, which is so necessary for Ukraine in the period of war and post-war reconstruction. Therefore, the analysis of reserves for improving the innovativeness indicator requires additional attention.

To identify these reserves, let's turn to the study of individual components that form the indicator of innovation, using the data of the "Global Innovation Index 2023. Innovation in the face of uncertainty" [8]. As already mentioned, 82 individual indicators are combined into 7 groups. A rating is established for each indicator. It should be noted that these ratings for Ukraine are extremely different: they range from 1 to 130. This is evidence of the significant heterogeneity of the innovation environment and the presence of significant reserves. Therefore, we will analyze the situation by groups and individual indicators of the innovativeness index.

Ukraine has the best result in the Creative outputs group (37th position). Especially in the “Intangible assets” subgroup. Here, Ukraine ranks 19th in the ranking. And although the absolute number of created original brands and trademarks is not too large, in relation to the volume of GDP (which is how indicators in this subgroup are determined). Such a discrepancy between creative results and the volume of national production can be considered, on the one hand, as evidence of the presence of significant creative potential, and on the other hand, as an inability to turn it into a real increase in the gross product. Therefore, it is unlikely to be considered positive if our rating will increase according to this group. Even its possible decrease due to the accelerated growth of the denominator is more desirable here. But it already depends on other indicators of this index.

The results of the “Knowledge and technology outputs” group of indicators are also not bad (44th position in the rating). In the “Knowledge outputs” subgroup, which, in particular, is formed by indicators of the number of patents and useful models in relation to GDP, Ukraine took 22nd place. And according to the last indicator, it is generally the first in the world! However, in relation to this section, they will be the same as in relation to the previous one: the actual volumes of the GDP of our country are much smaller than the potentially possible ones. Therefore, first of all, attention should be paid to those sections on which GDP growth depends. But the situation there does not look the best.

The result in the group of indicators related to human capital can be considered more or less satisfactory. The rating for this group is 47. But there are high achievements in the indicator of education expenses in GDP (24th place), the ratio of teachers to the number of population (14th place), state funding of secondary schools (10th place). At the same time, the indicators characterizing Research and development (R&D) are significantly worse than the average rating of Ukraine.

The rating of Ukraine according to indicators characterizing the business environment is the worst: Institutions - 100th position; Infrastructure – 77th position, Market sophistication – 104th position. The institutional environment as a whole (126th place) and the stability of the business environment (130th position) are extremely unfavorable. The same can be said about the credit system (124th place) and investments (107th place). Most of these indicators are characteristics of the quality of public administration. It is here that we should look for reserves to increase the innovativeness index. And it is the imperfection of the environment that will have the greatest impact on the success or failure of attracting investors in the post-war period.

Conclusions.

Thus, in the course of the conducted research, the hypothesis put forward regarding the existence of a close relationship between the level of economic development of the country, expressed by the GDP per capita indicator, and the global index of innovativeness was confirmed. Ukraine somewhat does not fit into this pattern. In the overall rating of 2023, it took 55th place, and among countries with incomes below average - 3rd place. At the same time, it surpassed 7 countries with high incomes and 24 countries with incomes above the average level. Therefore, it would be reasonable to believe that Ukraine has a more significant innovation potential than that which corresponds to the level of its GDP.

A comparison of the level of innovativeness of the Ukrainian economy with similar indicators of the countries of the European Union allows us to assert that a certain lag that arose due to the war in Ukraine should not stand in the way of its movement towards the EU. Moreover, even under such conditions, our country has one of the best indicators of innovativeness among candidates for joining the EU.

At the same time, a more detailed analysis of the indicators that make up the global innovation index revealed significant reserves for improving the situation. They are mainly in the sphere of responsibility of the state. Therefore, non-targeted actions that would ensure the improvement of the business environment and the formation of the appropriate organizational and market infrastructure are important. Not just the global innovativeness index depends on this, but also the success of Ukraine's post-war reconstruction.

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INNOVATIVENESS OF THE UKRAINIAN ECONOMY ON THE WAY TO THE EU

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The article is devoted to the assessment of the level of innovativeness of the Ukrainian economy in comparison with the innovativeness of the economies of the European Union countries based on the Global Innovation Index 2023 and the justification of ways to increase it in the course of advancing to full membership in the EU. In the course of the study, the hypothesis that there is a close connection between the level of the country's development, which is measured by the GDP per capita indicator in the model, and the absolute value of the global innovation index was confirmed (correlation coefficient is 0.868). However, Ukraine, which belongs to the group with a below-average GDP per capita indicator, is ahead of more than 30 countries with high and above-average GDP per capita indicators according to the Global innovation index. This strengthens the hope that the creation of the necessary conditions for the realization of innovative potential will be able to accelerate economic growth and lead to a significant increase in GDP in the post-war period. The comparison of the global index of innovativeness of Ukraine with the similar indicator of the EU countries carried out in the

article showed a certain lag of our country, which arose in recent years, which can be explained by Russian aggression. However, this lag is not fundamental and can be overcome in a short time. Moreover, among the candidate countries for joining the EU, Ukraine ranks among the top three in terms of innovativeness. Therefore, such a lag should not become an obstacle on the way to the EU. A more detailed analysis of individual indicators that form the global index of innovativeness revealed significant heterogeneity of the innovative environment of the Ukrainian economy, because its rating according to these indicators ranges from 1 to 130. Ukraine's achievements in performance indicators, which are calculated in relation to GDP, are quite good, which once again confirmed the conclusion that there is a disproportion between the potential and actual volumes of production. The biggest lag is recorded in the indicators related to the business environment, its stability and the legal norms that regulate it. A serious problem for Ukraine is the lack of market and organizational infrastructure. These issues should become the object of special attention of the state on the way to the EU.

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