

INNOVATIVENESS OF THE ECONOMY AND ITS PRIORITY SECTORS AS A FACTOR OF UKRAINE'S INTEGRATION WITH THE EU

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Abstract. The *purpose of the article* is to substantiate the positions of Ukraine in the world and European rankings compared to European countries regarding the level of innovation and its trends. This is achieved by means of methodological analysis, determining the innovativeness of the external sector of the economy according to the proposed comprehensive indicator for establishing directions for the implementation of European integration aspirations. *Methodology.* The study was conducted using a combination of general scientific methods and more specialised approaches, including abstract-logical analysis, system-structural analysis, statistical analysis, comparative analysis, grouping, systematization and generalization. *Results.* A comparison was conducted of the methodology for assessing the innovativeness of countries' economies in both world and European rankings. The investigation revealed that methodological approaches differ in single and group indicators in terms of quantity and essence. However, the calculation of a complex indicator in points is common. According to the Global Innovation Index 2024, Switzerland (for 14 years), Sweden (occupying this rank for the second year in a row), the United States of America, Singapore, and the United Kingdom are recognised as leaders. Since 2021, Ukraine's GI ranking has exhibited a discernible downward trend, attributable to the challenging military-political and economic conditions the country has experienced. The trend established by the correlation and regression analysis also indicates a further decline in the rank. However, the increase in the innovation coefficient is positive. The Summary Innovation Index, as presented in the European Innovation Scoreboard, indicates that the leading countries are Denmark, Sweden, Finland, the Netherlands, and Belgium, thereby substantiating the substantial discrepancy in the rankings. The prevailing sentiment regarding Ukraine is one of negativity. Ukraine's EIT score is three times worse than the EU-27 average. The priority sector in terms of integration is exports. The European Innovation Scoreboard is a comprehensive list of indicators that includes exports of medium- and high-tech products, as well as science-intensive services. The average value of exports is widely regarded as a comprehensive indicator of a nation's export capabilities. Ukraine was positioned 29th among 32 European countries in this regard. Primarily, there is a necessity for enhancement in the domain of exporting medium and high-tech products. *Practical implications.* The analysis of the innovativeness of the Ukrainian economy within the framework of global and European ratings allows for the identification of promising directions for the development of its priority sectors. Furthermore, the utilisation of the proposed comprehensive indicator of export innovativeness will create an analytical basis for the decision-making process concerning European integration. *Value / Originality.* A list of indicators of economic innovation is proposed to expand the ones used in domestic statistics, and the use of a comprehensive indicator of export innovation is suggested for comparison with European countries.

Keywords: European integration, economic innovation, global and European rankings, comparison of methodologies, Ukraine's position in relation to European countries, foreign economic sector, single indicators, comprehensive indicators.

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1. Introduction

In the 21st century, the role of the innovation sector in the stable socio-economic development of the country, in the growth of its national income and increasing competitiveness is decisive. The development and implementation of technical, technological and managerial innovations are pivotal to the establishment of competitive advantages in domestic and foreign markets, as well as to sustainable development (Tomashuk et al., 2023; Growth and competitiveness, 2025). This has been demonstrated to result in increased incomes and profits for business entities (Medase et al., 2022; Obrimah, 2024), and, consequently, the national income of the country.

The transition to an innovation model is justified, according to the experience of developed countries – world leaders, since innovation processes create the basis for the total penetration and active implementation of innovations and high technologies in the economic, environmental and social spheres (Brodny et al., 2023). Ukraine has recognised the importance of sustainable growth processes based on innovation. Consequently, in 2019, the Strategy for the Development of the Sphere of Innovation Activity for the Period Until 2030 was endorsed. It is important to note that even in the pre-war period, a decrease in innovation activity was statistically confirmed in Ukraine. This dynamic has resulted in Ukraine's gradual shift towards a periphery position within the global innovation process, a trajectory that does not align with its resource capabilities.

In order to achieve its aspiration of integrating into the Single European Space, Ukraine must address issues related to the innovation sphere, in particular its infrastructure (Stroiko et al., 2024). The basis for the integration process, it is argued, is the changes in the economy and its priority sectors, such as foreign trade, which forms the country's global image (Kurpayanidi, 2021).

The degree of innovation in Ukraine is determined by global and regional rankings, with the European ranking being of particular significance. The methodological approaches employed in the context of rating calculations necessitate a scientific comprehension and further analytical research, given that their outcomes serve as the foundation for effective strategic decision-making at various levels of management. These decisions pertain to the enhancement of the innovativeness of the economy within specific sectors and domains, notably one that is of paramount importance in the cultivation of competitiveness and the assurance of security, namely foreign economic security.

The purpose of the present article is to provide substantiated evidence to support Ukraine's positions in the global and European rankings, in relation

to those of other European countries, with regard to the level of innovation and its trends. This is achieved by means of an analysis of the methodology, the purpose of which is to determine the innovativeness of the external sector of the economy according to a comprehensive indicator that has been proposed for the purpose of establishing directions for the implementation of European integration aspirations.

2. Ukraine in the World Ranking of Innovations and Features of the Methodology

The level of innovative development of countries, including Ukraine, is determined by world and European rankings. In order to implement integration aspirations and ensure that innovation processes comply with global and European trends, a comparison of the innovative development of Ukraine with that of other countries is necessary.

The establishment of ratings is a crucial aspect of the assessment process, as it enables the determination of the level of innovative development. In particular, countries are assessed by the level of innovative development according to the following integrated indicators: The Global Innovation Index, the Global Competitiveness Index and the Innovation Index according to the European Innovation Scoreboard. At the regional level of countries, in particular the EU and the USA, there is a tendency to utilise such methods of assessing innovative development as the Regional Innovation Index according to the European Regional Innovation Scoreboard, and a ranking of US states according to various criteria, including innovation. Furthermore, a plethora of methodologies exist for the evaluation of innovative development at the level of individual countries and their regions. Ukraine is not subject to any exceptions in this regard. The assessment of innovativeness is subject to variation in the list of indicators and methodological approaches to its determination, based on the calculated indices.

Thus, the calculation of the Global Innovation Index (GII) is a multidimensional assessment of the development of a country's national innovation system and makes it possible to determine the country's place in innovative development in the global world economy. This calculation method has been used since 2007 and currently covers more than 130 countries around the world. Unfortunately, it is not possible to study innovative development according to the GII for all countries in the world because the statistical reporting of countries does not meet all the established requirements – the availability of statistical data for calculation is less than 60%.

In light of the intricacy and multifaceted character of the innovation sector, the GII calculation methodology encompasses a plethora of over 80 fundamental

indicators, drawing from a diverse array of statistical origins. Two-thirds of this number are derived from official statistical data provided by countries, while the remainder are estimates by certain international institutions and experts – business leaders, which are established by the World Economic Forum through a survey.

In consideration of the divergent economic scales of nations worldwide, relative values are employed in the computations of GII indicators to ensure data comparability. Illustrative of this approach are the calculation of the proportion of education expenditure to the country's GDP, and the proportion of high-tech exports to the total exports of the nation. The list of basic indicators for calculating the index is subject to periodic revision, given the high degree of dynamism characteristic of the innovation sector in the temporal dimension.

It is evident that the number of countries participating in the ranking is increasing. Consequently, the GII 2024 ranking was conducted among 133 countries. As in the previous 14 years, Switzerland was recognised as the most innovative economy. The top five of the GII also includes Sweden, the USA, Singapore and the United Kingdom (the latter two countries have swapped ranks compared to 2023). Singapore's entry into the top five most innovative economies for the first time was recorded in 2023, with the country initially occupying fifth position. Consequently, Sweden, as a member of the EU, is the world leader in terms of innovative development (Global Innovation Index, 2024).

Since 2021, Ukraine's GII rank has exhibited a discernible downward trend, attributable to the prevailing challenging military-political and economic conditions. The second-order polynomial dependence that describes the trend has a high correlation coefficient, indicating a further decline in the rank (Figure 1).

It is important to acknowledge that correlation and regression analysis are frequently employed by scientists to ascertain the relationship between innovation processes and a specific factor, in addition to forecasting (Kraus et al., 2024).

The conditions established in Ukraine for the implementation of the adopted Innovation Strategy were likely not sufficiently effective, and the influence of external negative factors was significant. The decline in the GII rating since 2021 can be attributed to Ukraine's transition to the group of countries from the sixth dozen for the second time in 2023, a development that was further solidified by the results of the GII 2024 (Global Innovation Index, 2024). This is attributable to the diminished innovative activity of business entities in comparison with the period preceding the hostilities, a finding corroborated by statistical data. According to the Global Innovation Index (GII) 2023, Ukraine has achieved a higher ranking in terms of innovation outcomes (position 42) compared to innovation resources (position 78). Ukraine has been ranked relatively highly in terms of creative outputs (37th position) and knowledge and technology outputs (45th position). However, in Ukraine, the market is not conducive to innovation (position 104), institutions are not at the appropriate level (position 100), and infrastructure (position 77) is inadequate. As a consequence of these positions, Ukraine was placed 34th among 39 European countries in the GII 2023.

The positive trend is evident: innovation results (the level of production of innovative products) received a higher rating than innovation resources (the level of investment in innovation). Furthermore, during the 2021-2024 period, there has been an increase in the number of innovative results, whilst the number of resources has decreased. This assertion is substantiated by the innovation coefficient (innovation efficiency), which is calculated as the ratio of the

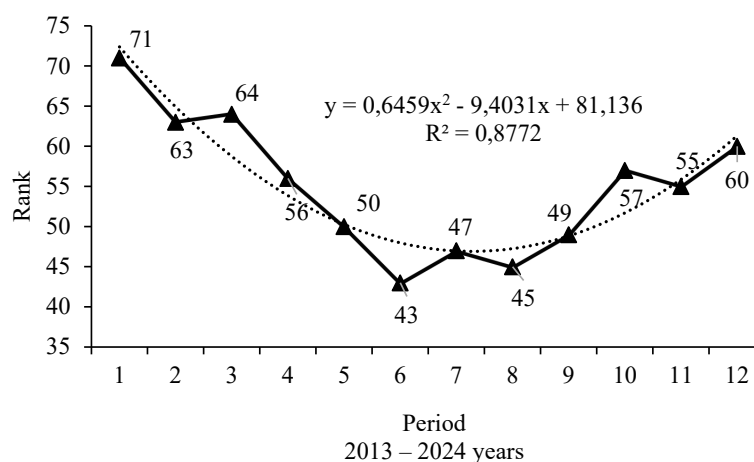


Figure 1. Trend of change in Ukraine's rank in the GII for 2013-2024.

Source: compiled on the basis of data from the source (Global Innovation Index) and calculated by the authors

output (results) and input (resources) sub-indices. Consequently, the coefficient was determined to be 48.8% in 2021, 64.0% in 2022, 53.8% in 2023, and 69.2% in 2024.

3. Ukraine's Positioning in European Innovation Rankings and Differences in Methodology

To compare European countries, data from the European Innovation Scoreboard and its Summary Innovation Index (SII) are used, which is calculated as a relative index for a given European country and the EU. The composite index has four main categories of indicators (framework conditions, investment, innovation activity and impact) with 12 innovation dimensions covering 32 indicators (European Innovation Scoreboard, 2024). The objective of this evaluation is twofold: firstly, to assess the innovative development of EU countries, and secondly, to develop measures to improve it. The evaluation also aims to establish intergovernmental co-operation within the Union and to provide targeted financial assistance (Brodny et al., 2023). The implementation of this rating has been pursued by EU Member States as a means of maintaining a rational strategy and achieving harmonious development within the framework of the "Single Europe". The European Innovation Scoreboard is a tool used to assess the innovation performance of EU Member States and other European countries, including Ukraine.

The dynamics of the Summary Innovation Index for the EU-27 countries in 2014-2024 are positive. The trend is characterised by a linear relationship, as evidenced by the high correlation coefficient (Figure 2). The trend in Ukraine is predominantly negative, indicating a substantially lower level (more than threefold) than the EU-27 average. The linear

relationship between changes resulting from existing fluctuations over time is characterised by an average correlation coefficient.

According to the European Innovation Scoreboard, the average innovation score of European economies in 2024 was estimated at 41.8 points. The growth, when compared with the year 2014, was equivalent to 10.0%. Switzerland is the most innovative country among those analysed (Figure 3), a finding that corresponds with the GII ranking. According to the components of the Summary Innovation Index, Switzerland is the leader in four group indicators, such as "human resources", "attractive research systems", "firm investments", and "intellectual assets" (European Innovation Scoreboard, 2024).

Among the EU Member States, Denmark has the highest innovation index, which is due to the high values of the group indicators, but it leads only in one – "environmental sustainability". Also, among the EU Member States, Denmark leads the rating in such a group indicator as "linkages". The leaders, according to individual group indicators, in addition to those mentioned, are: "digitalisation" – the Netherlands, "finance and support" – France, "use of IT" – Finland, "innovators" – Cyprus, "linkages" – Norway, "employment impacts" – Sweden, "sales impact" – Ireland, "environmental sustainability" – Malta.

In the context of Ukraine's aspirations to integrate into the EU, a comprehensive analysis of the values of indicators is imperative, with a particular focus on those that lag behind among European countries. On further consideration, it is evident that the indicator of business financing of R&D since 2014 has been awarded a low score. However, there are indications that have deteriorated significantly, including environmental sustainability, which in 2014 was comparable to that of European countries.

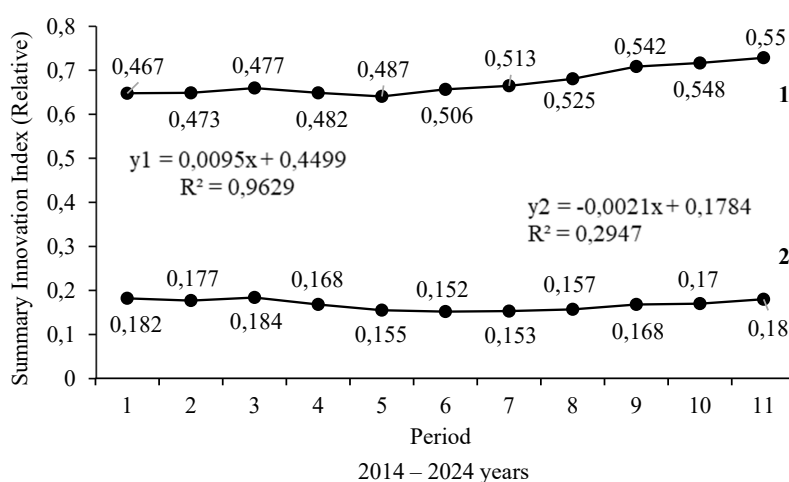


Figure 2. Trends of changes in the Summary Innovation Index of the EU-27 (1) and Ukraine (2)

Source: compiled on the basis of data from the source (European Innovation Scoreboard 2024)

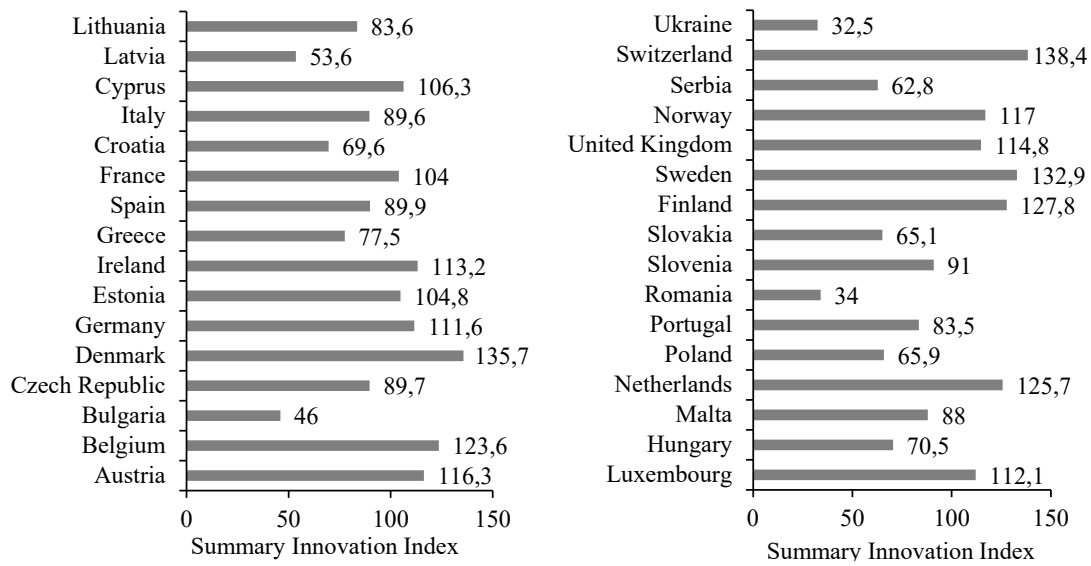


Figure 3. Summary Innovation Index 2024 of the European countries and Ukraine

Source: compiled on the basis of data from the source (European Innovation Scoreboard 2024)

For a subset of indicators (12 out of 32), Ukraine's failure to provide information resulted in the exclusion of the indicator from the rating process and the subsequent exclusion of the associated data from the composite indicator. This led to a reduction in the composite indicator and the obtained rank.

It should be noted that the methodology for calculating the Summary Innovation Index, like the GII, is subject to modification (Nawrocki et al., 2024). This approach fosters sustained research endeavours aimed at elucidating the innovative capacities of European economies.

The EU also calculates the Regional Innovation Index (RII), which complements the EIC to identify differences not only between countries, but also between their regions according to a smaller list of indicators (21 out of 32). This ranking includes 22 EU countries in 2023 (except Estonia, Cyprus, Latvia, Luxembourg and Malta) plus the United Kingdom, Norway, Serbia and Switzerland (Regional innovation scoreboard, 2023). European countries vary considerably in terms of the RII level, and

consequently, they have been categorised into four distinct groups (see Figure 4): innovation leaders (score above 125% of the EU average); active or strong innovators (score between 100-125%); moderate innovators (score between 70-100%); and emerging innovators or beginners (less than 100%). Ukraine is positioned within the group of emerging innovators or beginners, a category that encompasses eight other European countries.

As demonstrated by the calculations, the increase in the Regional Innovation Index (RII) for 2023 in comparison with 2016 varies according to country and group. A substantial increase in the index (up to 15%) is observed in certain countries that are classified as innovation leaders, strong, moderate, and emerging innovators. A marginal increase in the index (up to 5%) is observed in countries that are classified as strong, moderate, and emerging innovators. France, a nation recognised for its robust innovation capacity, and Switzerland, a country that has established itself as a global leader in innovation, exhibited negative growth. Consequently, the rate of innovation

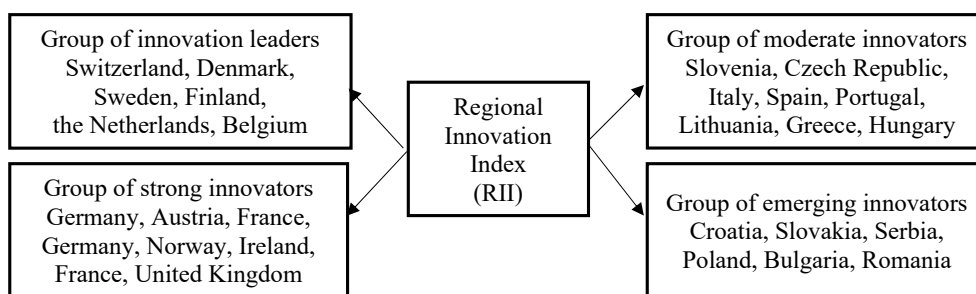


Figure 4. Grouping of countries by the Regional Innovation Index

Source: compiled on the basis of data from the source (Regional innovation scoreboard 2023)

development, as indicated by the RII, is contingent on both the degree of innovation and the conditions established within countries.

4. Assessment of the Innovativeness of the External Sector of the Economy of European Countries and Ukraine

It is an irrefutable fact that innovation and competitiveness are concomitant characteristics of the modern economy, particularly in its external sector. The foreign economic activity of Ukraine has exhibited an unfavourable trend for an extended period (Diatlova et al., 2019), a development that has been substantially influenced by the political and economic situation since 2014. In the contemporary context of military aggression, the situation has deteriorated. In 2023, exports increased in quantity (by 112 thousand tons, amounting to 100 million tons) and decreased in value (to 35.8 billion USD, representing a 18.7% decrease). This is primarily attributable to the fundamental nature of exports, which are derived from raw materials. In 2024, exports totalled 41.6 billion USD, representing an increase of 15.3% compared to the previous year.

At the national and regional levels, Ukraine is creating conditions for the activation of innovative activity, which is very important for priority sectors of the economy, in particular metallurgy (Cooke et al., 2020), energy (Petryk et al., 2019; Wheatley, 2024), which require restoration in the post-war years, taking into account European experience and export opportunities.

In order to facilitate a comparison of the innovativeness of the external sector of the economy, it is proposed that indicators be used, with particular reference to the share of innovative products in

total exports. This share can be calculated according to data from the Ukrainian statistical collection on innovation activity. Statistically, data on the innovative component of foreign economic activity is also accumulated, including: the number of new technologies purchased outside Ukraine; the number of new technologies transferred outside Ukraine; the number of enterprises that purchased new technologies outside Ukraine; the number of enterprises that transferred new technologies outside Ukraine; the number of enterprises that sold innovative products outside Ukraine; the volume of innovative products sold outside Ukraine; the share of innovative products sold outside Ukraine in the total volume of innovative products sold. The proposal to utilise an indicator such as the index of high-tech net exports at the country level (Diatlova et al., 2019), and the coefficients of export-oriented production, import independence of the economic system, and innovativeness of export products at the regional level, is justified. However, these indicators are not universally available in the statistical collections of countries or taken into account when ranking.

The European Innovation Scoreboard contains a group indicator entitled "sales impacts", the purpose of which is to relate to export activity. This group indicator comprises such individual indicators as exports of medium and high-tech products, as well as exports of knowledge-intensive services. Ukraine has the worst first indicator among European countries (Slovakia has the best). According to the second indicator, Ukraine is ranked 12th (Ireland is the best). The average value of the sum of these exports is proposed as a composite indicator of innovation in exports. According to the comprehensive indicator,

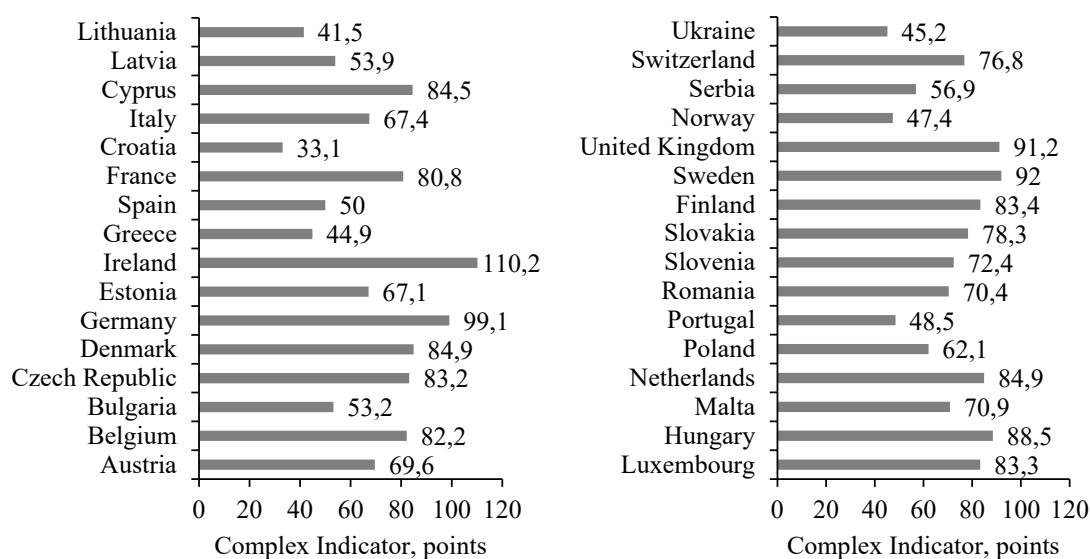


Figure 5. Composite indicator of export innovations in Europe and Ukraine according to EIT 2024

Source: compiled on the basis of data from the source (European Innovation Scoreboard 2024)

Ukraine was positioned 29th among 32 European countries (Figure 5). The least accomplished of these are Croatia, Lithuania and Greece. Ireland is regarded as the leading European country in this regard. The mean value of the composite indicator for European countries is 71.4. In order to achieve an average level of export innovation on the European and global markets, Ukraine must introduce measures to increase the innovation of exports of medium and high-tech products.

Consequently, the results of the ranking serve as a guide to the necessary prospects for Ukraine in the innovation sphere, in particular with regard to export activities. Markers may, for instance, be the values of indicators for leaders or their mean value by country, as employed in European rankings.

5. Conclusions

The article undertakes a thorough analysis of the methodology employed to assess the innovativeness of countries' economies in the context of their ranking in both global and European contexts. The Global Innovation Index, the Summary Innovation Index and the Regional Innovation Index are the key indicators used in this analysis. The assessment methodology has been determined to be based on a general approach to calculating a certain list of single and group indicators. These indicators are then used to establish a composite index for the country (Global Innovation Index, Summary Innovation Index) or its administrative-territorial units (Regional Innovation Index). Composite and group indicators are mainly scored. At the same time, the value of a given list of indicators is determined by experts, which introduces subjectivity into the assessment results. It has been found that the individual and group indicators used in the methods differ in number and in their essence. For example, the Global Innovation Index assesses 80 basic indicators, the Summary Innovation Index assesses 32 indicators and the Regional Innovation Index assesses only 21 of the indicators used in the European Innovation Scoreboard. The different

nature of the indicators has led to some differences in the ranking results.

Ukraine's low ranking in the Global Innovation Index has been established. Consequently, Ukraine's rank, which had shown an improvement during the period 2013-2018, has been undergoing a gradual decline since 2021, particularly from 43rd place to 60th in 2024, as a result of alterations in the business environment influenced by challenging military-political and economic circumstances. The trend established by the correlation-regression analysis also indicates a further decline in the rank. However, a positive development is the increase in the innovation coefficient (the ratio of innovation results to resources).

The Summary Innovation Index indicates an overall negative trend in Ukraine for the period 2014-2023. In 2023, Ukraine's index level was more than three times lower than the EU-27 average. In the Regional Innovation Index, Ukraine is classified as a group of emerging innovators or beginners. The analysis demonstrated that the pace of innovative development, as evidenced by the RII, is contingent on two factors: the level of innovation within the economy and the conditions created in the respective countries.

In light of Ukraine's European integration aspirations, a methodology is proposed for assessing the innovativeness of the external sector of the economy. As illustrated by the European Innovation Scoreboard, a number of key indicators have been identified, including exports of both medium and high-tech products, and knowledge-intensive services. The average value of exports is widely regarded as a comprehensive indicator of a nation's export capabilities. Ukraine was positioned 29th among 32 European countries in this regard. Primarily, there is a necessity for enhancement in the domain of exporting medium and high-tech products.

The aggregation of indicators, derived from the outcomes of the ranking at the global and European levels, will facilitate the establishment of an analytical foundation for the innovative development of the economy in the post-war era and the European integration processes of Ukraine.

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