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COMPARATIVE ANALYSIS OF THE INNOVATION STRUCTURE OF EUROPEAN UNION COUNTRIES IN 2017-2024

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Purpose: The aim of this work is to analyze and assess the innovativeness of EU countries and regions in the years 2017-2024, which allows for determining its level and comparing it in various aspects.
Design/methodology/approach: The work uses a number of research methods, including the method of analysis and criticism of literature, statistical methods and the method of analysis and logical construction.
Findings: The article presents the results of a comparative analysis of the level of innovation of the European Union Member States. It indicates the leaders of innovation in the group of countries and regions and presents the growth and decline in the most important dimensions. The analysis shows that the leaders of innovation in the EU are: Denmark, Sweden, Finland and the Netherlands, with the largest increase in the summary innovation indicator recorded in Lithuania, Cyprus and Poland (EIS 2024).
Research limitations/implications: In the future, the analysis could be expanded to include a comparison of the level of overall innovation with the level of eco-innovation in individual countries. Such an approach would allow for a better understanding of how EU countries cope with implementing innovations that support environmental protection and sustainable development.
Practical implications: The presented analysis of the innovativeness of the European Union countries allows not only to identify the strengths and weaknesses of individual countries, but also to indicate possible directions of development, the implementation of which may contribute to increasing their competitiveness and efficiency. The conclusions drawn from the analysis also support better use of the research and development potential in practice, supporting the implementation of innovative solutions in the area of economy and environment.
Social implications: The analysis of innovation in the European Union states indicates areas requiring support and development, which are key to improving the quality of life of citizens. Research enables better use of research and development potential, which translates into economic progress, environmental protection and increased innovation in society.
Originality/value: The article brings new value to the analysis of innovation in EU countries and regions, presenting the level of innovation in EU Member States over the years 2017-2024. Analysis of the level of innovation in individual countries, based on appropriate indicators, allows to identify areas requiring intervention and assess the effectiveness of previous actions

for the development of innovation. Thanks to this, it is possible to indicate specific directions of development and recommendations that can contribute to increasing the competitiveness of individual countries on the international arena.
Keywords: innovations, European Innovation Scoreboard, Regional Innovation Index.
Category of the paper: Research paper.

1. Introduction

Innovations are used in all areas of human activity, from product development, management methods, ways of performing work, etc.

The concept of innovation was introduced to economic sciences by J.A. Schumpeter at the beginning of the last century (Schumpeter, 1912). Joseph Schumpeter defined innovation as a key factor of economic change, emphasizing that innovation, entrepreneurship and market power are central to development. He considered innovation as one of the basic factors driving competitiveness (Porter, 1999). He believed that innovation is "a process of industrial mutation which continually revolutionizes the economic structure from within, continually destroying the old, continually creating the new" (Schumpeter, 1939). J.A. Schumpeter's views on the definition of innovation have changed, but in his works he has always emphasized the unique role of innovation in economic and civilizational development. There are many definitions of innovation **(**Rowe et al., 1974; Drucer, 2014; Kogabayev et al., 2017). The definition still seems to be relevant and comprehensive. „Innovation consists of the generation of a new idea and its implementation into a new product, process or service, leading to the dynamic growth of the national economy and the increase of employment as well as to a creation of pure profit for the innovative business enterprise. Innovation is never a one-time phenomenon, but a long and cumulative process (..)" (Urabe et al., 1988). According to Twiss, „innovation is a process that combines science, technology, economics and management, as it is to achieve novelty and extends from the emergence of idea to its commercialization in the form of production, Exchange, consumption (Twiss, 1989). Tohidi introduces innovation as the creation, development and successful introduction of products, processes or new services (Tohidi, 2011). Kalinowski presents innovation as "the introduction of new things, ideas or methods of conduct into use. Colloquially, innovation is most often identified with technical changes and understood as conducting research and development activities by economic entities, the result of which are inventions, which are then introduced to the market" (Kalinowski, 2010). According to Repetowski "(...) the concept of innovation is understood as a certain complex of processes and phenomena covering not only the creation and implementation of innovation, but also its economic and social effectiveness" (Repetowski, 2008). Innovations do not lend themselves to strict classification; they are often the result of a combination of many different types of innovations (including technological, marketing and organizational), an example of which is the Apple iPod (Śpionek, 2010). Gybenz's concept, innovation in companies is the

application of ideas for companies, regardless of whether they were used in products, processes, services, marketing systems or management.

In a broad sense, innovations are understood as deliberately introduced changes consisting in replacing existing solutions with others, improved ones that bring economic and social benefits (Kaczmarska et al., 2018; Chapman et al., 2001) Innovation is the key to success for an organization. Enterprise innovation can be defined as the ability and motivation of enterprises to search for and commercially exploit all the results of scientific research, new concepts, ideas and inventions leading to an increase in the level of modernity and strengthening the competitive position of enterprises or realization of the technical ambitions of the entrepreneur (Łuczka et al., 2010).

Innovations translate into an increase in revenues, the number of customers, and thus the competitiveness of the enterprise, and their role in the development and coordination of the market is enormous. The measurement of innovation has long been a serious challenge and has been the subject of extensive scientific research. There are various definitions and measures of innovation, and each approach to measurement has its limitations. There are many ideas for measuring innovation. Some authors believe that innovation at every stage should be measured and assessed. Some authors suggest assessing new and improved products (Elenkov, Manev, 2009), others recommend measuring improvements in processes and methods (Akgüni et al., 2009), and still others (Czarnitzki, Kraft, 2004) they talk about the market success of innovation, suggesting measuring innovation as „ratio of innovative product sold in the market to Total sales".

Innovation research is carried out at three levels of the economy: macro, meso and micro (Kałowski, Wysocki, 2015). Macro-level research focuses on innovation at the level of the entire country. It aims to assess the innovation performance of individual countries, emphasizing what conditions are conducive to innovation at the state level (European Commission, 2024; Gierulski et al., 2013). They may concern government policy, R&D spending, education levels, research infrastructure, and general economic conditions. The aim of such studies is to create rankings based on general indicators, such as the summary innovation index, which measures the innovative competitiveness of countries.

Meso-level studies focus on individual regions or sectors of the economy. Their aim is to analyze the level of innovation in individual regions. Analysis at this level includes indicators such as investment in R&D in a given region, the availability of a skilled workforce, or cooperation between universities and enterprises (European Commission, 2023; Kumor-Sulerz, 2021).

Micro-level research focuses on the innovativeness of individual companies. It assesses the ability of companies to implement innovations, their innovation strategies, and internal processes supporting the development of new products, services, or technologies. The aim is to diagnose the state of innovation of the company and to determine the factors that affect its innovativeness. Examples of indicators include research and development expenditures, the number of patents filed, the pace of introducing new products to the market, or the level of

cooperation with other companies and research institutions (Kaczmarska, 2015; Kumor-Sulerz, Michta, 2022; Kumor-Sulerz et al., 2021).

Each of the above levels of research presents the issue of innovation from a different perspective, using different indicators and measurement mechanisms. Contemporary approaches to innovation often combine results from different levels to obtain a more comprehensive picture of the dynamics of innovation in the economy.

The aim of this work is to analyze and assess the innovativeness of EU countries and regions in the years 2017-2024, which allows for determining its level and comparing it in various aspects. The work uses a number of research methods, including the method of analysis and criticism of literature, statistical methods and the method of analysis and logical construction.

Due to the fact that the innovativeness of countries and regions is characterized by high variability and multi-level factors influencing it, its analysis is of great importance. In the analysis of innovativeness, various aspects can be taken into account. The authors presented an analysis of the innovativeness of countries and regions in an original way, selecting the assessment parameters that are important to them.

2. Materials and methods. EIS research methodology

The general innovation studies presented in the literature allow for the assessment of the state of innovation on an international scale, focusing on individual countries and regions. Such studies aim to present the current level of innovation of a given country, enable the comparison of results of different countries and the assessment of the effectiveness of their innovation policy. An example of such a study is the European Innovation Scoreboard (EIS), which in the years 2010-2015 was published under the name Innovation Union Scoreboard (IUS). It allows for the assessment of the innovation of the European Union member states, as well as selected countries outside the EU, such as the USA, Japan, Croatia, Turkey, Iceland, Norway and Switzerland. The main objective of the EIS is to monitor and compare the results of innovation activity in different countries, which allows for the assessment of the effectiveness of the innovation policy of countries and regions in local, regional and global terms.

In this methodology, the innovativeness of countries is assessed based on the Summary Innovation Index (SII). This is an indicator calculated as a weighted arithmetic average of partial indicators that concern various factors conducive to the development of innovation, such as research and development expenditure, the number of patents, the level of education or the availability of capital for innovation. Finally, the SII is compared with the average indicator for the EU, and on its basis, a ranking of the innovativeness of countries is created, which are classified into one of four groups (so-called performance groups). This allows for the assessment of their position in the context of the development of innovation in Europe and the

world. Thanks to such studies, it is possible not only to indicate the leaders in the field of innovation, but also to analyze which countries need to improve their position to achieve better results in this area. The EIS methodology is characterized by high dynamics of changes in terms of the indicators used. For the analysis in the first edition of the EIS in 2000, 16 indicators were adopted, in 2004 the number of indicators was increased to 22, in 2007 to 26, and in the last edition from 2024 to 32 (European Commission, 2024). In the 2024 edition of the EIS, the indicators were grouped into 12 dimensions of innovation and 4 main types of activity (Table 1).

Table 1.
EIS 2024 Indicators

EIS 2024 Indicators			
1. Framework conditions – include factors that influence innovations that are beyond the company's control. They take into account three dimensions of innovation	**2. Investments – means public and private investments in research and innovation. They take into account three dimensions**	**3. Innovation activities – reflect innovation efforts at the enterprise level, encompassed in three dimensions of innovation**	**4. Impact – the effects of innovation activities in three areas of innovation**
1.1. human resources, 1.1.1. people who have obtained a PhD in science, technology, engineering and mathematics (STEM) per 1000 inhabitants aged 25-34, 1.1.2. percentage of people with higher education in the age group 25-34, 1.1.3. percentage of people aged 25-64 participating in education or training to improve their skills and competences, 1.2. attractive research systems, 1.2.1. number of international publications per million inhabitants, 1.2.2. scientific publications among the 10% most cited publications in the world as a percentage of all scientific publications in the country, 1.2.3. foreign doctoral students as a percentage of all doctoral students, 1.3. digital transformation, 1.3.1. enterprises providing training to develop or upgrade ICT skills of their employees, 1.3.2. ICT specialists (as a percentage of total employment), 1.3.3. broadband penetration (% share), 1.3.4. people who have general digital skills above basic (% share)	2.1. financing and support, 2.1.1. share of public expenditure on R&D as a percentage of GDP (gross domestic product), 2.1.2. Venture capital investments as a percentage of GDP, 2.1.3. direct government funding and government tax support for R&D of enterprises (percentage of GDP), 2.2. business investment, 2.2.1. share of business expenditure on research and development as a percentage of GDP, 2.2.2. other business expenditure on innovation as a percentage of total turnover, 2.2.3. businesses providing training to develop or improve employees' IT skills, 2.3. use of information technologies, 2.3.1. number of patent applications per billion GDP, 2.3.2. number of new Community trademarks per billion GDP, 2.3.3. number of new Community designs per billion GDP	3.1. innovators, 3.1.1. share of small and medium-sized enterprises (SMEs) introducing product innovations, 3.1.2. share of small and medium-sized enterprises (SMEs) introducing innovations in the business process, 3.2. linkages, 3.2.1. share of innovative SMEs collaborating with others in innovation, as a percentage of all SMEs, 3.2.2. number of public-private publications per million inhabitants, 3.2.3. mobility of workers in science and technology, 3.3. intellectual assets, 3.3.1. number of patent applications per billion GDP, 3.3.2. number of new Community trademarks per billion GDP, 3.3.3. number of new Community designs per billion GDP,	4.1. impact on employment levels, 4.1.1. share in basic knowledge activities as a percentage of total employment, 4.1.2. share in innovative ventures, 4.2. impact on sales volume, 4.2.1. share of exports of medium and high-tech products in the trade balance, as a percentage of total exports, 4.2.2. exports of services requiring specialized knowledge, as a percentage of total exports of services, 4.2.3. share of sales of new or modernized products in total sales of enterprises, 4.3. impact on environmental sustainability 4.3.1. resource efficiency measured as domestic material consumption (DMC) in relation to GDP, 4.3.2. Air emissions of particulate matter (PM 2.5) in industry, 4.3.3. development of environmental technologies, percentage of all technologies

Source: Own study based on (European Commission, 2024).

3. Results and discussions

The EIS 2024 study uses 32 indicators presented in Table 1. Based on the summary SII and its share in relation to the average EU indicator, EU Member States are assigned to one of four groups: Innovation Leaders, Strong Innovators, Moderate Innovators and Emerging Innovators (Table 2). Innovation Leaders – these are countries that achieve the highest level of innovation in the EU. They are characterized by the highest SII results. These are countries that make the best use of innovation opportunities by investing in research, development and modern technologies. Strong Innovators – these are countries that achieve results above the EU average, but not as high as innovation leaders. They have a strong economy based on innovation, although there may still be areas requiring improvement. Moderate Innovators – countries whose innovation performance is around the EU average. They may be less developed in terms of technology and research compared to innovation leaders, but they still show some progress in this area. Emerging Innovators – countries that are below the EU average in terms of innovation. Their SII is lower and their innovation-based economy is only just beginning to develop. They often have less access to the resources needed to support innovation. According to the EIS 2024 study, the innovation leaders in the EU are: Denmark, Sweden, Finland and the Netherlands (Fig. 1). The remaining countries are assigned to groups according to Table 2 (European Commission, 2024).

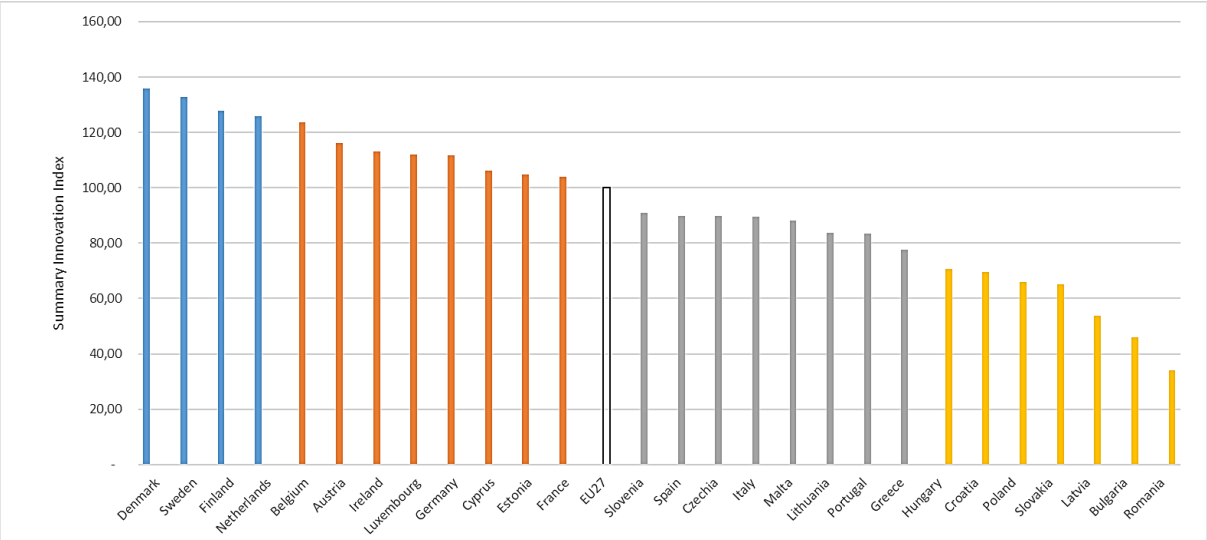

Figure 1. Innovation of EU countries in the EIS 2024 study.

Source: Own study based on (European Commission, 2024).

Table 2.
EIS 2024 Results

Group	Countries
Innovation leaders Summary innovation index above 125% of the EU average	Denmark, Sweden, Finland, Netherlands
Strong innovators Summary innovation index in the range of 100-125% of the average indicator for the EU	Belgium, Austria, Ireland, Luxembourg, Germany, Cyprus, Estonia, France
Moderate innovators Summary innovation index in the range of 70-100% of the average indicator for the EU	Slovenia, Spain, Czech Republic, Italy, Malta, Lithuania, Portugal, Greece, Hungary
Beginning innovators Summary innovation index below 70% of the EU average	Croatia, Poland, Slovakia, Latvia, Bulgaria, Romania

Source: (European Commission, 2024).

Denmark, like last year, is the leader in innovation among the European Union countries, overtaking Sweden, which was in first place in the ranking in 2017-2022. The largest increase compared to 2017 was recorded in Estonia. It advanced from the group of moderate innovators to become a strong innovator (11th place in the EIS 2024 ranking). The broader analysis of the EIS survey, covering other European countries and selected global competitors, shows that Switzerland has consistently been the most innovative European country since 2017, and South Korea has remained the most innovative global competitor since 2017, while China has surpassed Japan and is gradually closing the gap with the EU. The EU has an advantage over China, Japan, Brazil, Chile, India, South Africa and Mexico, but has a lower level of innovation than South Korea, Canada, the United States and Australia (Figure 2) (European Commission, 2024).

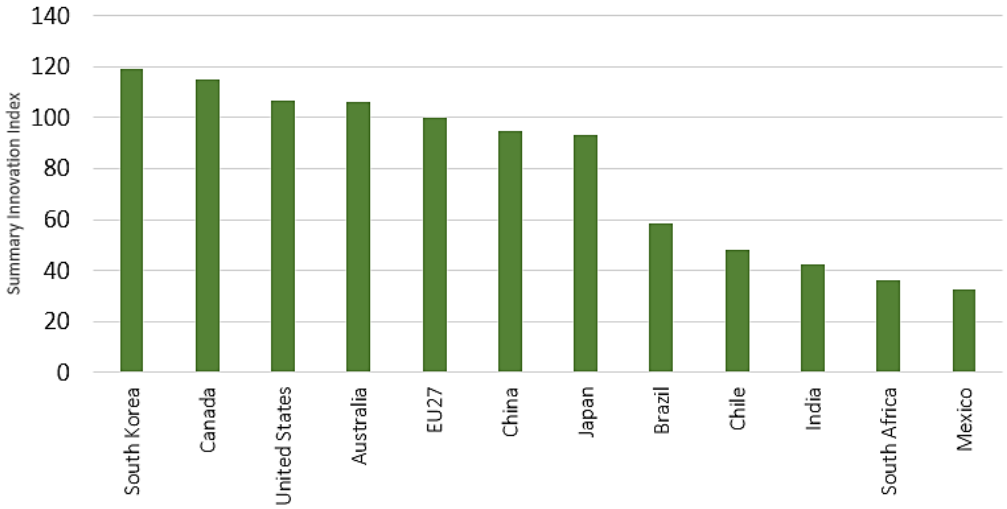

Figure 2. EU innovation performance compared to other countries in the EIS 2024 study.
Source: Own study based on (European Commission, 2024).

Analyzing the innovativeness of EU countries over the years 2017-2024, it can be noticed that the SII for the EU is constantly growing (Figure 3) (European Commission 2017a-2024).

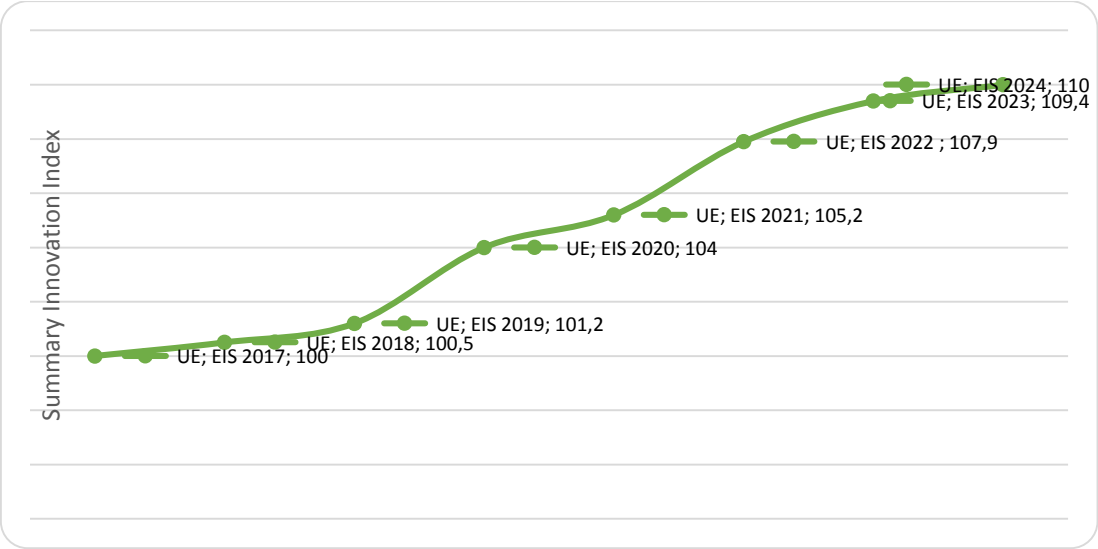

Figure 3. EU innovation in EIS 2017-EIS 2024 studies.

Source: Own study based on (European Commission, 2017a-2024).

In the EIS 2024 survey, the summary innovation index increased in 11 Member States compared to the previous year. The largest increases were recorded in Lithuania, Cyprus and Poland (Figure 4).

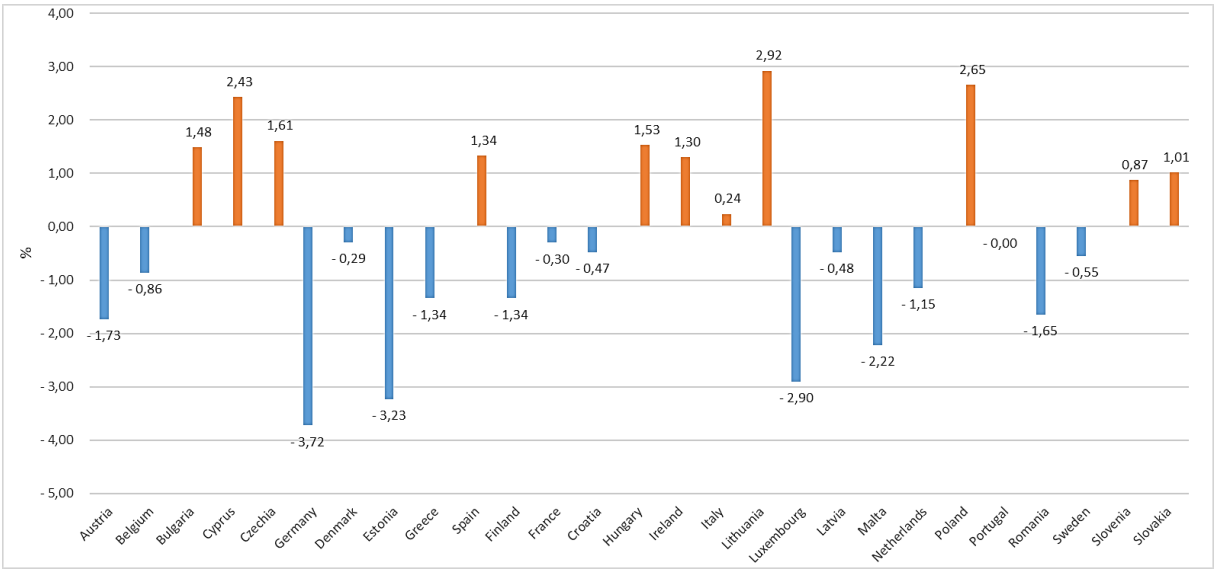

Figure 4. Dynamics of changes in the level of innovation of EU countries in the EIS 2023-EIS 2024 studies.

Source: Own study based on (European Commission, 2017a-2024).

Analyzing the summary innovation index over the years 2017-2024, the largest increase in this indicator can be seen in Cyprus, Estonia, Lithuania and Greece (Figure 5). Thus, countries with a low level of innovation record greater increases in the summary innovation index than countries that achieve higher results.

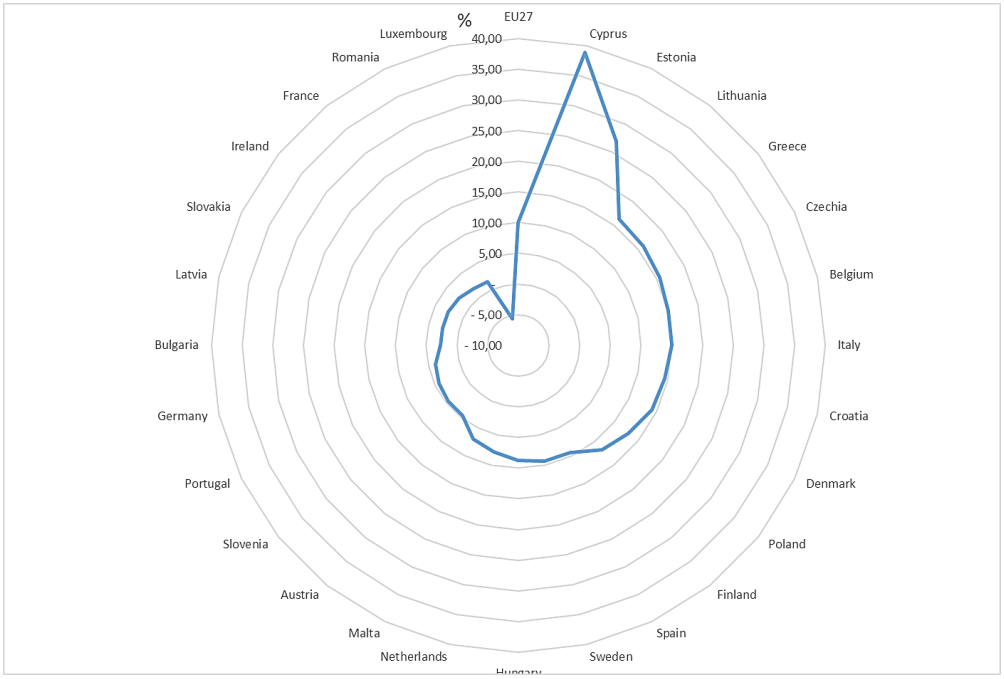

Figure 5. Growth of the EU countries' summary innovation index in the EIS study over the years 2017-2024.

Source: Own study based on (European Commission, 2017a-2024).

Analyzing the individual dimensions of innovation, it can be seen that in most dimensions the EU countries achieved better results compared to 2017. Only in the Intellectual assets dimension the result worsened compared to 2017 (Figure 6).

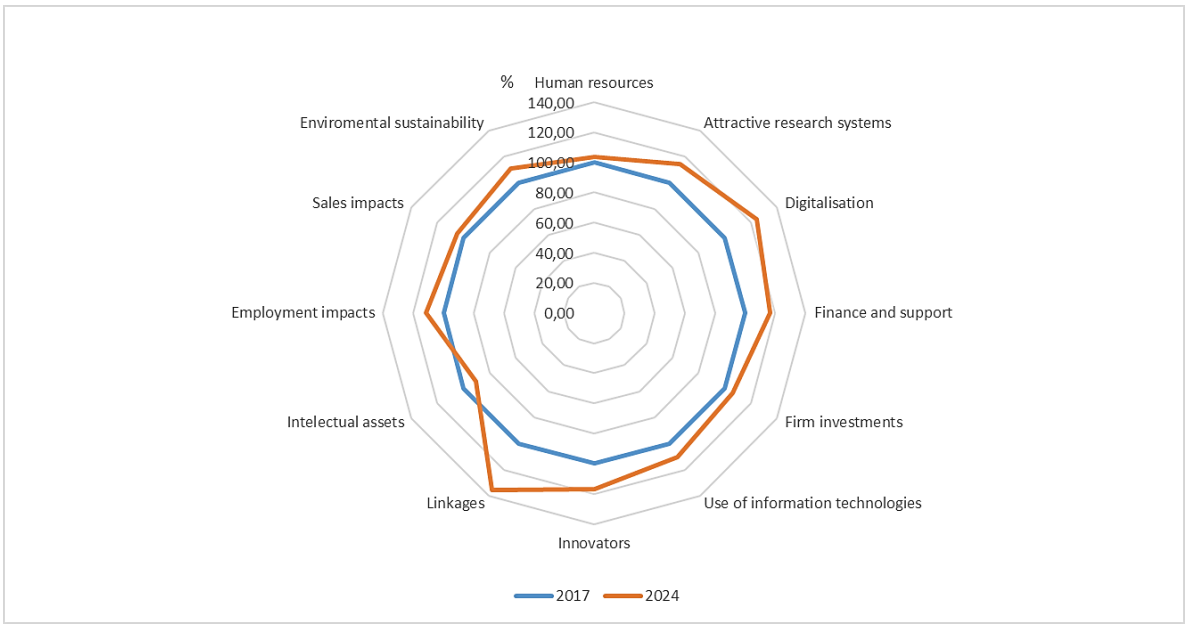

Figure 6. Dimensions of EU innovation in the EIS 2017 and EIS 2024 studies.

Source: Own study based on (European Commission, 2017a-2024).

Some countries, although not innovation leaders in the EIS 2024 ranking, were highly rated in terms of innovation in selected indicators. For example, in the EIS 2024 study, Romania is a leader among EU countries in the indicator - enterprises conducting training to develop or

improve employee skills in the field of ICT, and Lithuania is a leader in the categories – other innovation expenditures of enterprises as a percentage of total turnover and employee mobility in the field of science and technology (Figure 7).

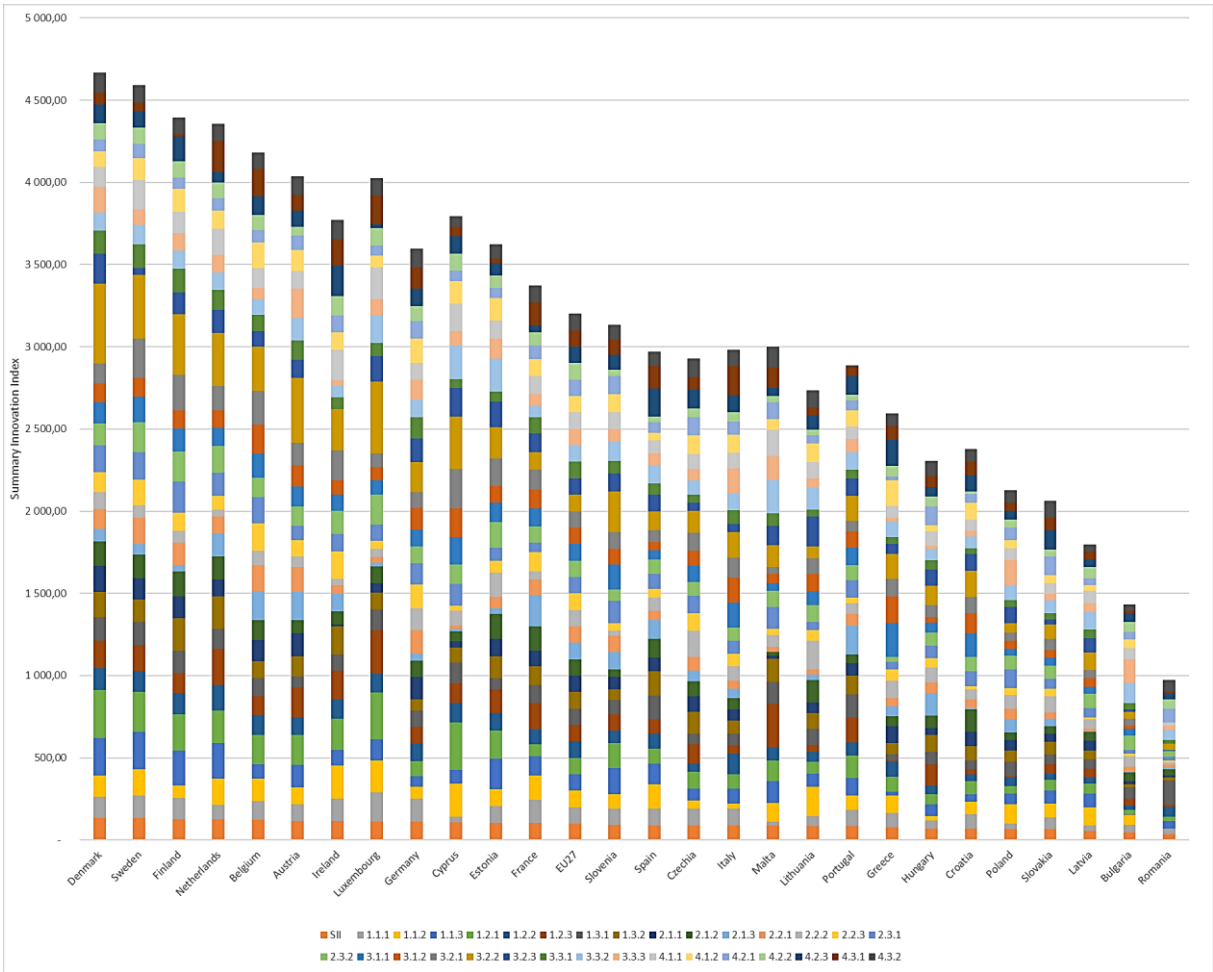

Figure 7. Dimensions of innovation in EU countries in EIS 2024 studies.

Source: Own study based on (European Commission, 2024).

Regional Innovation Scoreboard (RIS) is an extension of EIS research, focusing on the assessment of innovation in individual regions of the European Union. Similarly to EIS, RIS uses an innovation indicator, which allows for the assessment of the innovation capacity of regions in the EU. In the case of RIS, this assessment is carried out using the Regional Innovation Index (RII), which is calculated as the arithmetic mean of standardized partial indicators. In a similar way as in EIS, the RII indicator is analyzed in the context of the EU average, which allows for assigning the region to the appropriate category. Thanks to this, a ranking of regional innovation is created.

The RIS studies tried to achieve the greatest possible compliance with the EIS in order to maintain consistency in the assessment of innovation at the national and regional levels. However, due to the limitations of available data, the scope of indicators in the regional studies was smaller than in the EIS. A certain weakness of the conducted analysis is the fact that the

results of the RIS study are published with a certain delay in relation to the EIS study, which makes their analysis and comparison difficult.

The first edition of the study took place in 2002, covering 148 regions of the EU-15 (i.e. 15 Member States before the enlargement of the EU). In subsequent years, as new data became available and the methodology developed, the study expanded both the number of regions and indicators, which allowed for a more precise assessment of the innovation performance of EU regions. Thus, in the RIS study, the number of indicators was increased to 13 in 2003, to 16 in 2009, and in the last edition from 2023 to 21 (European Commission, 2017b-2021b).

The RIS 2023 study covers 239 regions from: 22 EU countries, Norway, Serbia, Switzerland and the United Kingdom. Smaller EU countries such as Cyprus, Estonia, Latvia, Luxembourg and Malta are treated as one region in the RIS study (European Commission, 2021b). Similar to the EIS study, the indicators in the RIS 2023 study were grouped into 12 dimensions of innovation and 4 main types of activity. Based on the RII index and its share in relation to the average EU indicator, the European regions were divided into 4 groups: Innovation Leaders, Strong Innovators, Moderate Innovators and Emerging Innovators (Table 3) (European Commission, 2023b). 36 regions were assigned to the group of innovation leaders, 72 regions to the group of strong innovators, 71 regions to the group of moderate innovators and 65 regions to the group of early innovators.

Table 3.
RIS 2023 results

Group	Regions
Innovation leaders Regional innovation index above 125% of the EU average	Région lémanique, Ostösterreich, Limburg, Stuttgart, Östra, Mellansverige, Gelderland, Praha, Trøndelag, Région de Bruxelles-Capitale/Brussels, Hoofdstedelijk Gewest, Île de France, Nordjylland, Noord, Brabant, Mittelfranken, Vlaams Gewest, South East, Tübingen, Oslo og Viken, Köln, Ostschweiz, Zuid-Holland, London, Utrecht, Sydsverige, Hamburg, Noord-Holland, Nordwestschweiz, Västsverige, Ticino, Midtjylland, Karlsruhe, Zürich, Berlin, Stockholm, Oberbayern, Helsinki-Uusimaa, Hovedstaden
Strong innovators Regional innovation index in the range of 100-125% of the average indicator for the EU	Saarland, Friesland, Provincia Autonoma Trento, Jihovýchod,, Friuli-Venezia Giulia, Emilia-Romagna, Budapest, Drenthe, Comunidad Foral de Navarra, North East, Grad Zagreb, Brandenburg, Sostinės regionas, Provence-Alpes-Côte d'Azur, Bretagne, Småland med öarna, Northern and Western,North West, Schleswig-Holstein, Sjælland, Southern, Zahodna Slovenija, Zeeland,Thüringen, WalesCataluña, Comunidad de Madrid, Hannover, Koblenz, Schwaben, Scotland, Yorkshire and The Humber, Nord-Norge, Arnsberg, País Vasco, Occitanie, Düsseldorf, Agder og Sør-Østlandet, Detmold, Auvergne - Rhône-Alpes, Oberfranken, Oberpfalz, West Midlands, Syddanmark, East Midlands, Vestlandet, Région Wallonne, Unterfranken, Bremen, Westösterreich, Övre Norrland, Südösterreich, South West , Overijssel, Flevoland, Leipzig, East of England, Rheinhessen-Pfalz, Etelä-Suomi, Darmstadt, Pohjois- ja Itä-Suomi, Espace Mittelland, Zentralschweiz, Länsi-Suomi, Eastern and Midland, Dresden, Gießen, Braunschweig, Freiburg, Groningen

Cont. table 3.

Moderate innovators Regional innovation index in the range of 70-100% of the average indicator for the EU	Alentejo, Vidurio ir vakarų Lietuvos regionas , Peloponnisos, Andalucía, Illes Balears, Thessalia, Valle d'Aosta/Vallée d'Aoste, Åland, Calabria, Basilicata, Normandie, Dytiki Ellada, Puglia, Región de Murcia, Principado de Asturias, Cantabria, Molise, Ipeiros, Castilla y León, Kentriki Makedonia, Malopolskie, Galicia, Jihozápad, Campania, Belgrade, Hauts-de-France, Kriti, La Rioja, Aragón, Mecklenburg-Vorpommern, Centro, Vzhodna Slovenija, Norte, Moravskoslezsko, Střední Morava, Severovýchod, Provincia Autonoma Bolzano/Bozen, Centre - Val de Loire, Střední Cechy, Liguria, Abruzzo, Sachsen-Anhalt, Bourgogne - Franche-Comté, Attiki, Trier, Bratislavský kraj, Norra Mellansverige, Nouvelle-Aquitaine, Kassel, Weser-Ems, Innlandet, Toscana, Grand Est, Mellersta Norrland, Comunidad Valenciana, Northern Ireland, Warszawski stoleczny, Piemonte, Pays de la Loire, Niederbayern,, Lüneburg, Münster, Lombardia, Lazio, Veneto, Umbria, Chemnitz, Marche, Lisboa
Beginning innovators Regional innovation index below 70% of the EU average	Sud-Est, Sud-Vest Oltenia, Sud – Muntenia, Centru, Severozapaden, Vest, Yugoiztochen, Nord-Vest, Ciudad Autónoma de Ceuta, Nord-Est, Severoiztochen, Mazowiecki regionalny, Severen tsentralen, Yuzhen tsentralen, Swietokrzyskie, Lubuskie, Ciudad Autónoma de Melilla, Corse, Opolskie, Šumadija and Western Serbia, Southern and Eastern Serbia, Zachodniopomorskie, Warminsko-Mazurskie, Észak-Alföld, Notio Aigaio, Região Autónoma dos Açores, Kujawsko-Pomorskie, Ionia Nisia, Západné Slovensko, Wielkopolskie, Podkarpackie, Canarias, Voreio Aigaio, Slaskie, Dél-Dunántúl, Podlaskie, Észak-Magyarország, Lubelskie, Lódzkie, Dél-Alföld, Bucuresti – Ilfov, Nyugat-Dunántúl, Közép-Dunántúl, Panonska Hrvatska, Yugozapaden, Região Autónoma da Madeira, Stredné Slovensko, Východné Slovensko, Vojvodina, Régions ultra-périphériques françaises, Extremadura, Severozápad, Pomorskie, Jadranska Hrvatska, Castilla-la Mancha, Pest, Sicilia, Algarve, Sjeverna Hrvatska, Anatoliki Makedonia, Thraki, Sterea Ellada, Dytiki Makedonia, Dolnoslaskie, Sardegna

Source: Own study based on (European Commission, 2023b).

Analyzing the RIS results over the years 2017-2023, it can be seen that Europe's innovativeness has increased (Fig. 8). In the latest RIS 2023 study, the most innovative region in Europe is Hovedstaden in Denmark. In the previous edition of RIS 2021, the most innovative region was Stockholm in Sweden, and in RIS 2019 – Zurich (Switzerland) (European Commission, 2019b-2023b).

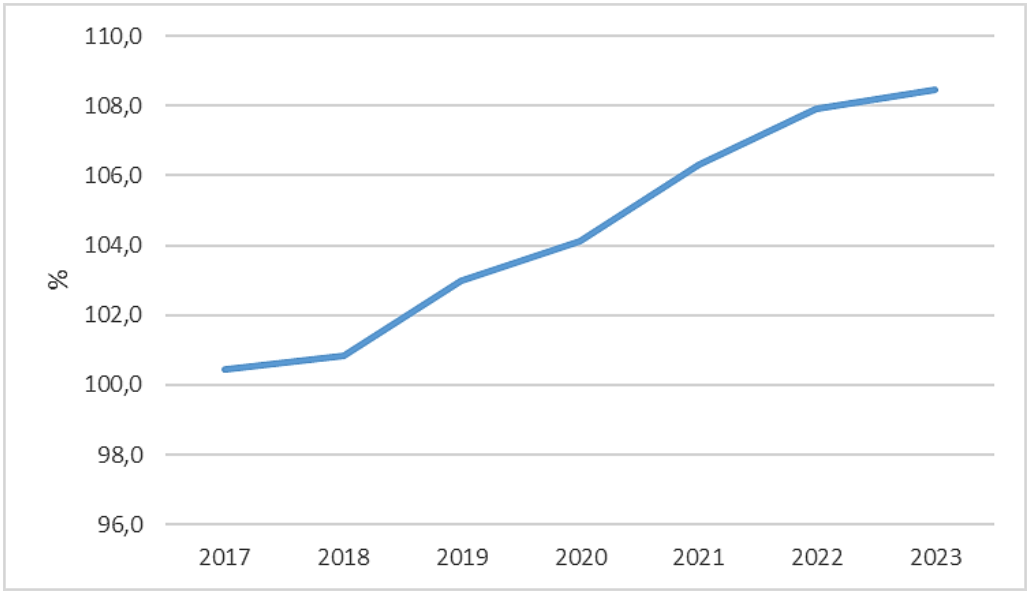

Figure 8. Innovation of EU regions in the RIS study in 2017-2023.

Source: Own study based on (European Commission, 2017b, 2019b, 2021b, 2023b).

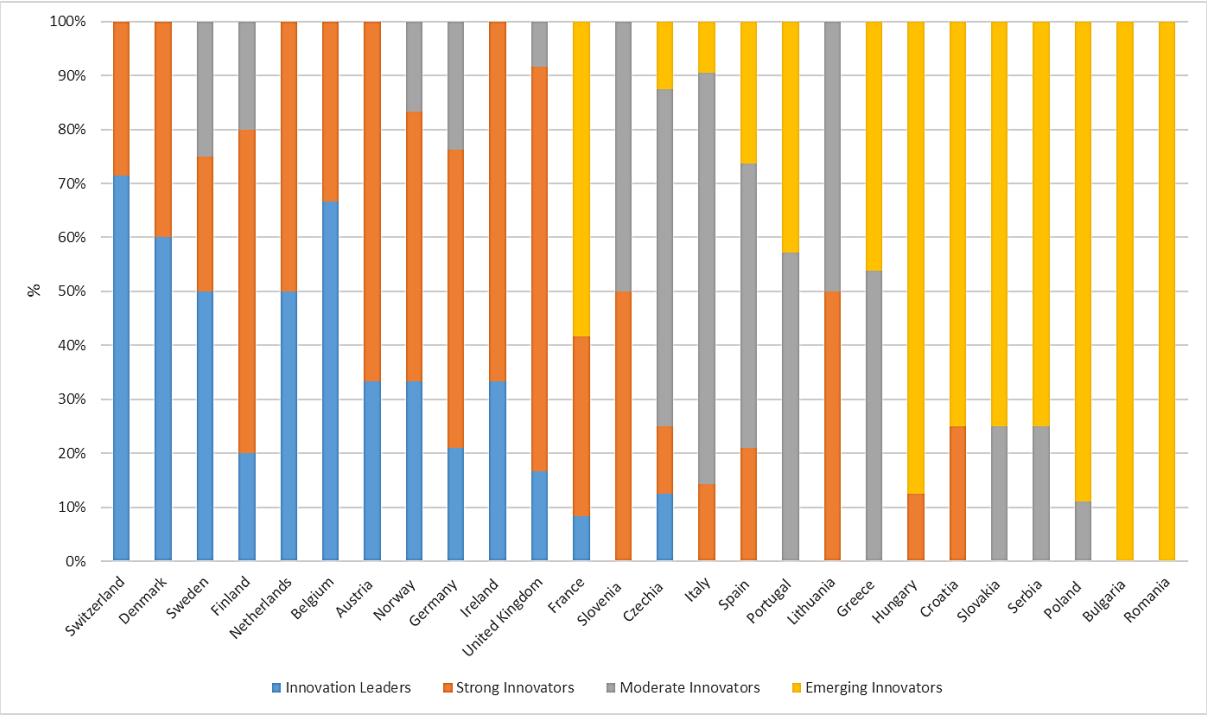

Figure 9. Innovation of European countries and regions in the RIS 2023 study.

Source: Own study based on (European Commission, 2023b).

In most European countries, the most innovative regions are located in the most innovative countries (Figure 9). However, in some countries that are classified in the EIS study as Moderate Innovators, there are regions that show a clear advantage in innovation and are considered regional Strong Innovators, e.g. Spain, which as a country is classified as a moderate innovator, but regions such as Catalonia or Madrid are considered strong innovators due to their developed economy based on innovation, numerous technology parks, start-ups, as well as developed cooperation with the academic and industrial sectors (Figure 10) (European Commission, 2023b). In the RIS study, similarly to the EIS study, it can be seen that regions with a low level of innovation record greater increases in the regional innovation indicator than the so-called regional innovation leaders.

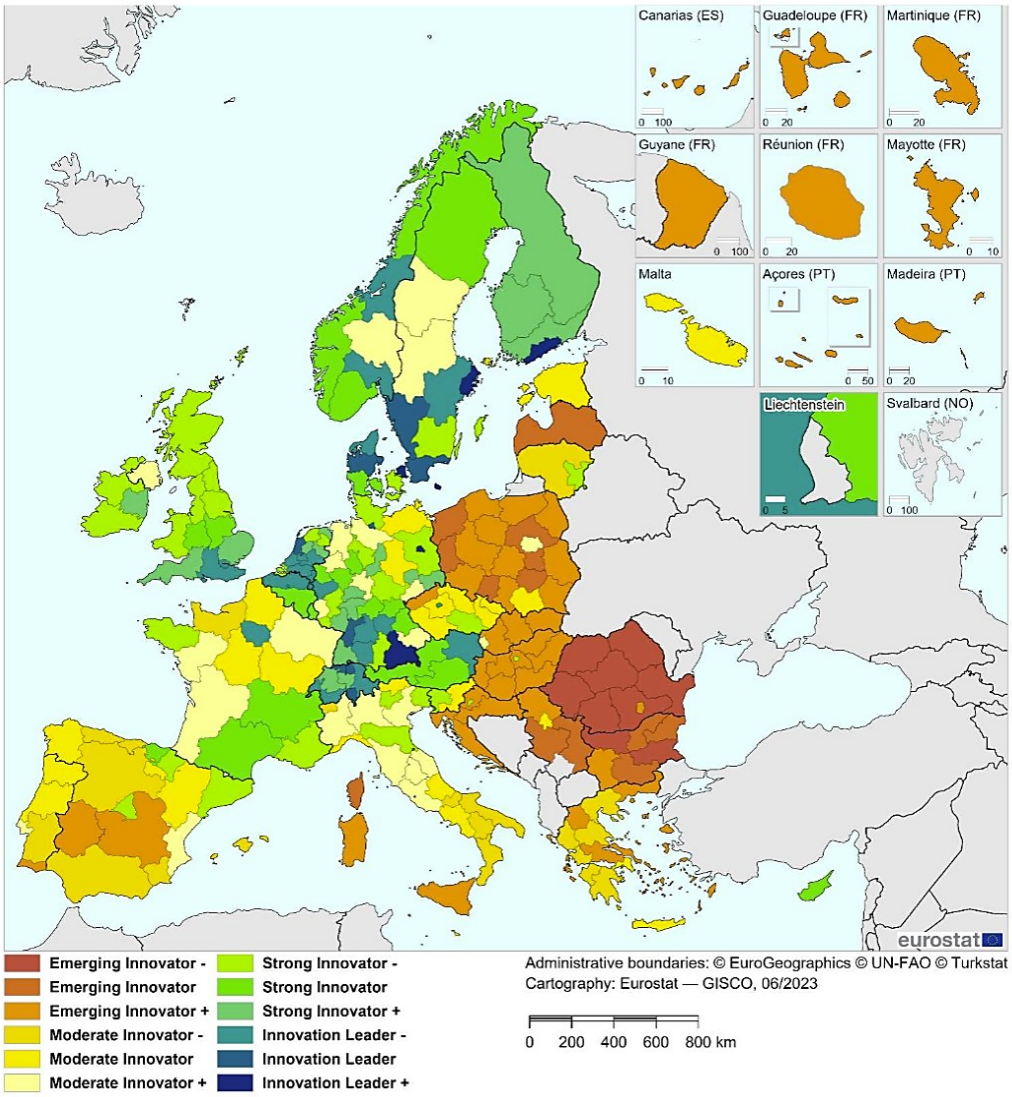

Figure 10. Regional innovation in the RIS 2023 study.

Source: (European Commission, 2023b).

There are also regions that, although they are not innovation leaders, were highly rated in terms of the innovativeness of selected indicators - for example, the Warsaw region in the EIS 2019 study was first among EU countries in the number of people aged 25-34 with higher education.

4. Conclusion

The analyses presented show that the innovation leaders in the EU are: Denmark, Sweden, Finland and the Netherlands. Denmark is the innovation leader of the European Union countries for the second year in a row, overtaking Sweden, which was in first place in the ranking in 2017-2022. Switzerland has been the most innovative European country since 2017. Estonia

has advanced from the moderate innovators group to become a strong innovator, which gives it 11th place in the EIS 2024 ranking. The analyses carried out show that the European Union has an advantage over China, Japan, Brazil, Chile, India, South Africa and Mexico, and the SII index for the EU is growing year by year. It is worth noting that in the EIS 2024 study there was an increase in the summary innovation index in 11 member states compared to the previous year. The largest increase was recorded in Lithuania, Cyprus and Poland. Analyzing the individual dimensions of innovation, it can be seen that EU countries achieved better results compared to 2017 in the following dimensions: human resources, attractive research system, digitalisation, finance and support, firm investments, use of information technologies, innovators, linkages, employment impacts, sales impacts, environmental sustainability. Only in the Intellectual assets dimension has this result deteriorated compared to 2017. It happens that a given country is highly rated in terms of innovation only in selected indicators, e.g. Romania is the leader among EU countries in the indicator - companies conducting training to develop or improve employee skills in the field of ICT, and Lithuania is the leader in the categories - other business expenditure on innovation, as a percentage of total turnover and employee mobility in the field of science and technology. The analysis of the innovation of European regions shows that it is also growing year by year. In the latest RIS 2023 study, the most innovative region in Europe is Hovedstaden in Denmark, ahead of Stockholm in Sweden and Zurich (Switzerland). Most often, the most innovative regions are located in the most innovative countries. However, in countries classified in the EIS study as Moderate Innovators, there are regions that show a clear advantage in innovation and are considered regional Strong Innovators, e.g. Catalonia in Spain. The analysis of the research shows that regions with a low level of innovation record greater increases in the regional innovation index than the so-called regional innovation leaders (RIS research). Both in micro and macro terms, innovative activities must be subject to verification and evaluation in order to speak of their beneficial impact on the creation of competitive advantages and the economic development of entities or countries.

Based on the innovation assessment indicators presented in the article, in accordance with the European Innovation Scoreboard (EIS) and Regional Innovation Scoreboard (RIS) research methodology, recommendations can be formulated for countries lagging behind in terms of innovation. In particular, these countries should focus their activities on the following areas:

- Strengthening investments in research and development (R&D).
- Improving cooperation between science and industry.
- Development of human capital - investing in the education system and programs supporting the development of future competences.
- Implementation of digital technologies and development of infrastructure.
- Development of financial support programs for startups and SMEs.

Implementation of the above recommendations will increase the level of innovation in these countries and contribute to their better competitiveness on the global market.

The article presents a comprehensive analysis of the level of innovation in countries and regions in the years 2017-2024, taking into account both changing economic, social and technological conditions and the dynamics of innovation policies. This analysis allows not only to identify the strengths and weaknesses of individual countries, but also to indicate possible directions of development, the implementation of which can contribute to increasing the competitiveness and efficiency of individual countries and better use of research and development potential in practice.

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