

The Impact of Innovation on Business Development. The Example of Moderate Innovators and the Visegrad Group Countries

Małgorzata Jabłońska  <https://orcid.org/0000-0003-1465-8818>

Ph.D., University of Lodz, Faculty of Economics and Sociology, Department of Finance and Accounting of SMEs
e-mail: malgorzata.jablonska@eksoc.uni.lodz.pl

Abstract

The paper analyzes the relationship between innovation dimensions, according to the European Innovation Scoreboard, and the entrepreneurship rate in a group of moderate innovator countries. Using the Pearson linear correlation, the author conducted a data analysis based on an empirical study using open data from the Summary Innovation Index – European Innovation Scoreboard (SII-EIS) and Eurostat for 2013–2019. This period covers the moment when all the countries of the Visegrad Group (i.e., the Czech Republic, Hungary, Poland, and Slovakia – the V4) were classified into the same innovation group according to EIS. However, due to the volume limitations of the article, it was decided that Moderate Innovators from 2019 would be included in the comparative analysis, i.e., when the V4 were last collectively classified as Moderate Innovators. The results of the research positively verify the initial research hypothesis that the EIS indicators show a different strength of relationships with the entrepreneurship rate in the V4 and among other economies classified as Moderate Innovators (according to SII–2020).

The variables that describe the quantity and quality of entrepreneurs' innovations strongly and positively impact the V4 countries' entrepreneurship rate. In other countries, the variables derived from the investment attractiveness of economies show a significant and positive correlation with the entrepreneurship rate. Based on the analysis of the results, it can be concluded that there is a strong positive correlation between the entrepreneurship rate and the total innovation index, which is compiled each year based on a set of variables for the European Union countries. The study showed that the entrepreneurship rate in these countries is strongly impacted by indicators representing the following groups: Innovators (small and medium-sized enterprises (SMEs) with product or process innovations; SMEs with marketing or organizational innovations,



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and SMEs innovating in-house), Attractive research systems (international scientific co-publications), Finance and support (Venture capital expenditures), Firm investments (Enterprises that provide training to develop or upgrade their personnel's ICT skills), and Linkages (Innovative SMEs that collaborate with others). The impact of these factors on the development of entrepreneurship in the V4 means that pro-innovative activities undertaken in operating enterprises strongly correlate with deciding to start one's own business. Therefore, it can be concluded that entrepreneurship in these countries has an entirely different development basis than in other countries that are Moderate Innovators, where the factors mentioned above were irrelevant.

Keywords: innovations, entrepreneurship, moderate innovators, the Visegrad Group, economic development, finance

JEL: G30, G10, K40, O16

Introduction

The literature on the subject continues to try to explain the impact of innovation on new business ventures. Research on the innovativeness of economies is conducted on a large scale in the European Union (EU). One of the main reports showing the state of innovation among European countries is the European Innovation Scoreboard (EIS). The summary innovation index is based on 27 indicators grouped into ten main categories that demonstrate significant innovation differences among the EU countries. These countries are divided into Innovation Leaders, Strong Innovators, Moderate Innovators, and Emerging Innovators. The report for 2020 shows that Visegrad Group countries (i.e., the Czech Republic, Hungary, Poland, and Slovakia – the V4) were Moderate Innovators, along with Cyprus, Croatia, Spain, Lithuania, Latvia, Malta, Slovenia, and Italy. Grouping the V4 into the same category of innovators creates a unique opportunity to conduct a comparative analysis between the dimensions of innovation according to the EIS and the entrepreneurship index. In 2021 and 2022, the V4 countries were in different groups in the innovation ranking. In both years, only the Czech Republic was among the Moderate Innovators; the others had been downgraded to Emerging Innovators (European Commission 2022, pp. 6–7).

The paper analyzes the relationship between the dimensions of innovation (according to the EIS) and the entrepreneurship rate in the group of Moderate Innovators, with the V4 separated for analytical purposes. Using the Pearson linear correlation, the author conducted a data analysis based on an empirical study using open data from the Summary Innovation Index – European Innovation Scoreboard (SII-EIS) and Eurostat for 2013–2019. Based on the preliminary analysis of the research problem, a research hypothesis was formulated. It states that the EIS variables have a different impact on the development of entrepreneurship in the V4 than in other countries classified as Moderate Innovators, according to EIS–2020.

The paper is divided into three parts. Part one presents a short analysis of the literature on the subject describing the impact of innovation on entrepreneurship, understood as the ability to create new business ventures. Part two presents the research method and the results of the Pearson linear correlation between the SII components and the entrepreneurship rate in 2013–2019. Part three presents the conclusions.

Literature review

There are many definitions of innovation (Polverari 2018, p. 5), and innovations can be classified and subdivided into different types in different ways (Wach, Maciejewski, and Głodowska 2022, p. 1048). There is a growing recognition that entrepreneurial employees, or intrapreneurs, are part of the main cast in the story of innovation and economic growth (Elert and Stenkula 2022, p. 1423). Customers' growing expectations drive improvements in products and services, not only in the commercial sector but also in the public sector, provided by local and regional authorities. This contributes to the growing importance of the concepts of innovation and innovativeness (Czupich 2018, p. 17).

Recently, the evolution of economies has accelerated considerably, and Europe is struggling with many problems. The driving force behind further development is innovations that are the best means to put the European economy on the right track and solve social issues in the global economy (Będzik and Gołąb 2021, p. 1). Innovation and identifying its main determinants have been of interest at the EU level since its inception as the European Community. Numerous analyses of European economies have identified innovation as a defining factor in the progress that has enabled the transition to a knowledge-based economy. Many of these studies identified the R&D sector as a vector of economic development because it ensures the transfer of technological innovations to the economy (Dobrota et al. 2019, pp. 174–184) and influences entrepreneurship development, which is stimulated through innovation.

In today's economic reality, entrepreneurship is the key to creating innovation (Pangsy-Kania and Stobiecka 2018, pp. 30–43). In terms of economic practice, innovation means implementing a new or significantly improved product, service or process that has an impact on the development of entrepreneurship (Avram and Hysa 2022, pp. 181–206). Innovation and entrepreneurship are not the same phenomenon, though they may overlap (Kahn 2022, p. 468). A country or region's innovative capacity can be considered its ability to produce and commercialize innovations to drive long-term economic growth and wealth creation (Hudec and Prochádzková 2015, p. 56).

The ongoing economic growth has contributed to changes in the perception of innovation, especially concerning small and medium-sized enterprises, which are its main

carrier. Innovative development is the basis of the competitiveness of modern economies (Ressin 2022, p. 190). Innovation is currently understood as development based on new challenges, particularly regarding changes in technology and workmanship. In a broader sense, innovativeness should be considered the continuous search for solutions whose implementation will contribute to the success of the company in the form of increased sales, increased market share, or increased efficiency. By innovating, companies achieve a competitive advantage in the market.

In recent years, the role of innovations and innovativeness in the development of the economy of the region has been increasingly appreciated compared to that of the country. They are the factors that play a special role in a region's development policy, and their importance is visible in policy documents that set out government policy in the context of a region's long-term development, as well as in EU policy documents.

Innovation and innovativeness are major factors that determine the social and economic development of regions. On a regional level, innovation plays a particularly important role. In recent years, regions have become more important in shaping the socio-politico-economic development of the country. The increasing significance of regions as distinct economic entities is one of the most important phenomena of modern economy (Jabłońska and Fila 2021, p. 44). At a regional level, it seems to be more appropriate to create pro-innovative policies that are correlated with specific conditions of the region. Innovations in the regions are the result of associating information with knowledge and transforming it into new products, services, and market solutions.

Innovation is the driving force of regional development (Klomp and Roelandt 2004, pp. 365–374), contributing to general growth and international competitiveness (Dziuba 2014, p. 225). Therefore, in recent years, entrepreneurship has become one of the most important issues related to the economic growth of regions, alongside competitiveness and innovation (Jabłońska, Dziuba, and Hurak 2018, p. 58). The most important sources of competitive advantage are new and innovative products, services, and production processes (Hudáková and Maroš 2019, p. 147).

These processes would not take place without entrepreneurship, i.e., the creation of new economic entities. Entrepreneurship develops where there are appropriate conditions for it. One of them is the ability to create innovation and transfer it quickly to the economy. A new look at innovation is necessary, and its impact on the development of entrepreneurship should be analyzed from different points of view. For example, if a region is rich in technology, discerning customers, and an educated workforce, it will be suitable for companies to develop new products and services (Teece 2000, pp. 35–54). There is a good chance of stimulating entrepreneurial behavior. The development of entrepreneurship may also be fostered by creating local networks that comprise enterprises, research and development centers, and local and regional business environment institutions (Pater and Lewandowska 2015, p. 32). Science and access to knowledge help

enterprises cooperate, creating conditions conducive to developing knowledge and innovation (Copus, Skuras, and Tsegenidi 2015, pp. 51–82). Another important issue that should be addressed when analyzing the relationship between innovation and entrepreneurship is the differences in economies' regional development (Gossling and Rutten 2007, pp. 253–270). It means that there is a specific space for the development of innovation, regardless of its scale. Consequently, innovation can lead to the dissemination of knowledge.

Over the last three decades, the Visegrad countries have undergone a transformation (Turro, Urbano, and Persi-Oritz 2014, pp. 360–369; Holienka, Pilková, and Ostapenko 2016, pp. 54–63) by strengthening local enterprise, improving the quality of infrastructure, and initiating regional cooperation aimed at strengthening the Central and Eastern European countries economically on the international stage (Będzik and Gołąb 2020, p. 163). The selection of countries in which the investigated regions are located was determined by several factors: all are located in Central and Eastern Europe, and all transformed from a centrally planned economy to a market economy in the early 1990s. They all joined the EU on 1 May 2004, thus becoming beneficiaries of assistance from the Structural Funds or the EU Cohesion Fund, which encouraged the development of entrepreneurship at many levels. It can, therefore, be concluded that all these countries were in a similar situation as regards the conditions for the construction and development of the small and medium-sized enterprises (SME) sector. They are also a separate area of support from the perspective of the EU regional policy (Jabłońska and Fila 2021, p. 2).

The group of Moderate Innovators includes the V4, which are similar in terms of political, legal, and economic convergence due to their membership in the EU. They have common historical features, i.e., they belong to the former Eastern Bloc and have undergone a political transformation. They are also similar in terms of the area they cover on the map of Europe, as they are medium-sized countries. These countries show a relatively high level of entrepreneurship, which may be a lever for developing this region in the future. The increase in R&D expenditures in the V4 in the last five years and the increase in labor costs, combined with still-low productivity, stimulate innovative solutions in the region. However, analysis of the EIS data shows that they still rank relatively low in international innovation rankings compared to the rest of the EU.

Between 2013 and 2019, all V4 countries were classified as Moderate Innovators in the annual innovation report. This situation changed only in 2021 when only the Czech Republic remained a moderate innovator while the other countries were demoted to Emerging Innovators, i.e., among the least innovative countries.

Table 1. V4 countries by innovation level, 2013–2022

Classification Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Emerging Innovators	PL								PL HU SK	PL HU SK
Moderate Innovators	HU SK CZ	PL HR SK CZ	PL HU SK CZ	PL HU SK CZ	PL HU SK CZ	PL HU SK CZ	PL HU SK CZ	PL HU SK CZ	CZ	CZ
Innovation Followers	-	-	-	-	-	-	-	-	-	-
Innovation Leaders	-	-	-	-	-	-	-	-	-	-

Note: CZ – Czech Republic, HU – Hungary, PL- Poland, SK – Slovakia.

Source: own elaboration based on European Commission, Directorate-General for Enterprise and Industry, 2013; 2014; European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, 2015; 2016; 2017; 2018, 2019; 2020, 2021; European Commission, 2022.

Building a modern economy requires the development of a complete ecosystem of innovation. It provides the ability not only to transfer but primarily to create new technologies, thereby increasing productivity. Meanwhile, both the level of economic productivity that results from technological advancements and the level of capital are relatively low in the Central European countries. This is the legacy of the intermittent history of their statehood, the times of communism, and the relatively brief period of economic transformation in the region (Polska Agencja Rozwoju Przedsiębiorczości 2017, pp. 1–3).

Innovations need an innovative environment supported by the private and public sectors. This includes investment in research and development generated primarily by the private sector, the presence of research institutions and universities, their collaboration with industry, and the protection of intellectual property (Golejewska 2012, p. 98; Levie et al. 2014, pp. 434–444; Holienka, Gál, and Kovačičová 2017, pp. 54–63). Therefore, we should verify which innovation aspects should be strengthened in the V4 to accelerate the generation of new business ventures in the shortest possible time and return to the Moderate Innovators group, which the V4 left two years ago after a lengthy seven-year membership.

Methodology

Theoretical framework

The study uses analytical and descriptive research methods based on the correlation index analysis between 27 EIS indicators aggregated in 10 groups and the entrepreneurship rate from 2013–2019 in countries classified as Moderate Innovators¹. The analysis uses EIS and Eurostat data, which are complete and comparable in the adopted research period. Table 2 presents a synthetic description of the indicators covered by the study.

Table 2. Indicators that determine the level of the SII index according to the EIS

	Innovation dimension	Description
Groups of indicators	Attractive research systems	This dimension measures the international competitiveness of the science base and includes three indicators: a) International scientific co-publications (per million population); b) Scientific publications among the 10% most cited publications in the world as a percentage of all scientific publications in the country; c) Foreign doctorate students as a percentage of all doctorate students.
	Human resources	a) New doctorate graduates; b) Percentage population aged 25–34 having completed tertiary education; c) Population aged 25–64 participating in lifelong learning.
	Innovation-friendly environment	a) Broadband penetration; b) Opportunity-driven entrepreneurship (years shown refer to three-yearly averages).
	Finance and support	a) R&D expenditure in the public sector; b) Venture capital expenditures.
	Firm investments	a) R&D expenditure in the business sector; b) Non-R&D innovation expenditures; c) Enterprises providing training to develop or upgrade ICT skills of their personnel.
	Innovators	a) SMEs introducing product or process innovations; b) SMEs introducing marketing or organizational innovations; c) SMEs innovating in-house.
	Linkages	a) Innovative SMEs collaborating with others; b) Public-private co-publications; c) Private co-funding of public R&D expenditures.
	Intellectual assets	a) PCT patent applications; b) Trademark applications; c) Design applications.
	Employment impacts	a) Employment in knowledge-intensive activities; b) Employment in fast-growing enterprises in innovative sectors.
	Sales impacts	a) Medium and high technology product exports; b) Knowledge-intensive services export; c) Sales of new-to-market and new-to-firm innovations.

Source: own elaboration based on European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs 2020, p. 8.

¹ Group of moderate innovators according to EIS 2020.

The methodology for calculating this indicator is detailed below.

Step 1: Identifying and Replacing Atypical Values (Outliers)

Positive outliers are identified as relative scores that are greater than the mean of all countries plus two standard deviations. Negative outliers are defined as those relative outcomes that are less than the all-country mean minus two standard deviations. These outliers are replaced with the maximum and minimum values observed over all years and for all countries, respectively.

Step 2: Establish a reference year

For each indicator, the reference year is identified based on data availability of at least 75% for all countries.

Step 3: Replace values that are missing.

If there are no data for an intermediate year, we can substitute the value from the previous year. If data for the year at the beginning of the time series are not available, we can replace the missing value with one from the last available year.

Step 4: Determine the maximum and minimum scores

The maximum score is the highest relative score found for the entire period among countries minus any positive outliers. Similarly, the minimum score is the relatively lowest score found for the entire period among all countries, disregarding negative outliers.

Step 5: Data transformation in case of high skewness.

Most of the indicators are fractional indicators ranging from 0% to 100%. For the above indices, the skewness is greater than 1, and the data were transformed using the square-root transformation. The square root transformation uses the square root of the indicator value instead of its original value (European Commission, Directorate-General for Enterprise and Industry 2013, p. 65).

Step 6: Calculating the resized results

The re-scaled values of the relative results for all years are calculated by first subtracting the minimum result from the relative result before dividing the difference between the two by the difference between the maximum and minimum results. The maximum scaled result is then equal to 1, and the minimum scaled result is equal to 0. For positive and negative outliers and small countries, where the value of the relative results is above the maximum result or below the minimum result, the value of the scaled result is set to 1 and 0, respectively.

Step 7: Calculating composite indexes of innovation SII index for each year.

They are calculated as the unweighted average of the re-scaled results for all indicators (Mikołajczyk 2016, p. 113).

The European economies selected for the study were divided into two subgroups. Thus, the following research hypothesis was formulated:

H0: The Innovation Union Scoreboard variables have a different impact on the development of entrepreneurship in the Visegrad Group countries than in other countries included in the group of Moderate Innovators, according to EIS–2020.

The first group includes the V4. The second one comprises other economies classified as Moderate Innovators according to the 2020 EIS ranking (i.e., Cyprus, Greece, Spain, Croatia, Italy, Lithuania, Latvia, Malta, and Slovenia). Entrepreneurship in the surveyed countries was measured using a basic entrepreneurship measure, i.e., entrepreneurship rate (the rate of involvement in new economic ventures). The entrepreneurship rate is the ratio of active enterprises to the number of working-age people.

$$\text{Entrepreneurship rate} = \frac{\text{number of active enterprises}}{\text{number of working – age people}} \times 100\%$$

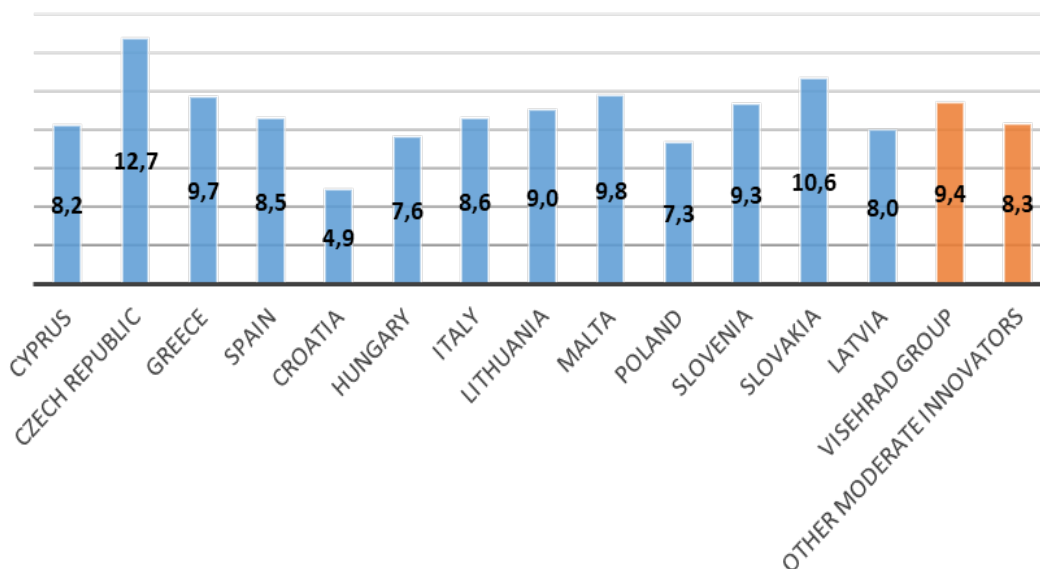


Chart 1. Average level of entrepreneurship rate 2013–2019 and the average for Moderate Innovators (%)

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography*...

The chart shows how the average level of the indicator in individual countries developed in 2013–2019. The Czech Republic, Slovakia, and Malta had the highest level among Moderate Innovators. Croatia, Poland, and Latvia are the least enterprising countries. In the analyzed years, the level of entrepreneurship in the V4 was above the average

for Moderate Innovators, at 9.5%. It means that as many as 95 people (on average) per 1000 working-age inhabitants run their own businesses. The rate of entrepreneurship in the other group of Moderate Innovators is significantly lower, at 8.3%, indicating that, on average, 83 people per 1,000 working-age people run their own businesses.

Correlation analysis is commonly used in economic sciences because it answers the following questions: a) Are there any dependencies between the analyzed variables? b) What is their strength? and c) What is their form and direction? The Pearson correlation coefficient describes the rectilinear relationships between the investigated variables of measurable features. This linear correlation implies that an increase in the value of one variable causes a proportional change, either increase or decrease, in the mean values of the other variable across the entire range of variability. The correlation coefficient is a unitless quantity, i.e., independent of the units used for variables X and Y (Skrabek 2013, p. 133). The strength of the linear relationship between two variables is the correlation coefficient from sample R. It assumes values from the closed interval $[-1; 1]$. A value of -1 indicates a perfect negative correlation (the points are exactly on the downward straight line). A value of 1 indicates a perfect positive correlation (the points are exactly on an upward straight line). A value of 0 means there is no linear correlation.

The formula used to calculate the correlation coefficient is as follows:

$$R = \frac{\sum (X_i - \bar{X}) \cdot (Y_i - \bar{Y})}{\sqrt{(\sum (x_i - \bar{X})^2) - (\sum (Y_i - \bar{Y})^2)}}$$

X_i and Y_i denote the values of the variables x and y, respectively, while \bar{X} and \bar{Y} are their mean values.

The correlation scale used in the study is given in Table 3.

Table 3. Correlation scale used in the data analysis

The level of the Pearson correlation coefficient	Strength of the correlation
$R_{xy} = -1$ $R_{xy} = 1$	Perfect negative correlation Perfect positive correlation
$-1 \geq R_{xy} \geq -0.9$ $1 \leq R_{xy} \leq 0.9$	Very high negative Very high positive
$-0.7 \geq R_{xy} \geq -0.5$ $0.7 \leq R_{xy} \leq 0.5$	High negative High positive
$-0.5 \geq R_{xy} \geq -0.3$ $0.5 \leq R_{xy} \leq 0.3$	Negative significant Positive significant

The level of the Pearson correlation coefficient	Strength of the correlation
$-0.3 \geq R_{xy} \geq 0$ $0.3 \leq R_{xy} \leq 0$	Negative weak Positive weak
$R_{xy} = 0$	No correlation

Source: Skrabek 2013, p. 133.

Empirical data and analysis

The analysis of the correlation between the factors that directly affect the level of innovation in the surveyed countries (according to the EIS) and the entrepreneurship index revealed significant differences between the V4 and the other Moderate Innovators. We will now focus on the most important differences that result from the analysis of the Pearson linear correlation index between the previously described variables in the V4 and the other Moderate Innovators.

Firstly, attention should be paid to the strength and direction of the correlation between the entrepreneurship rate and the innovation index value calculated annually for each country. In general, there is a significant and positive correlation between the innovation index (SII) and the entrepreneurship rate in the Moderate Innovators. In the V4 countries, this correlation is stronger, at 0.89. In other countries, this parameter is slightly lower at 0.61. The obtained indicators, with $t(70) = 6.8$ for countries outside the V4 and $t(30) = 8.15613$ for the V4, both with a two-sided critical area of $p = 0.0000$, indicate a high level of significance. These results indicate with a high probability that the entrepreneurship rate increases along with the total innovation index. It is reflected in the literature on the subject. Numerous studies and analyses indicate a strong connection between innovation and entrepreneurship. The main relationships between the entrepreneurship rate and the SII indicators will be described later in the article.

Innovation Index

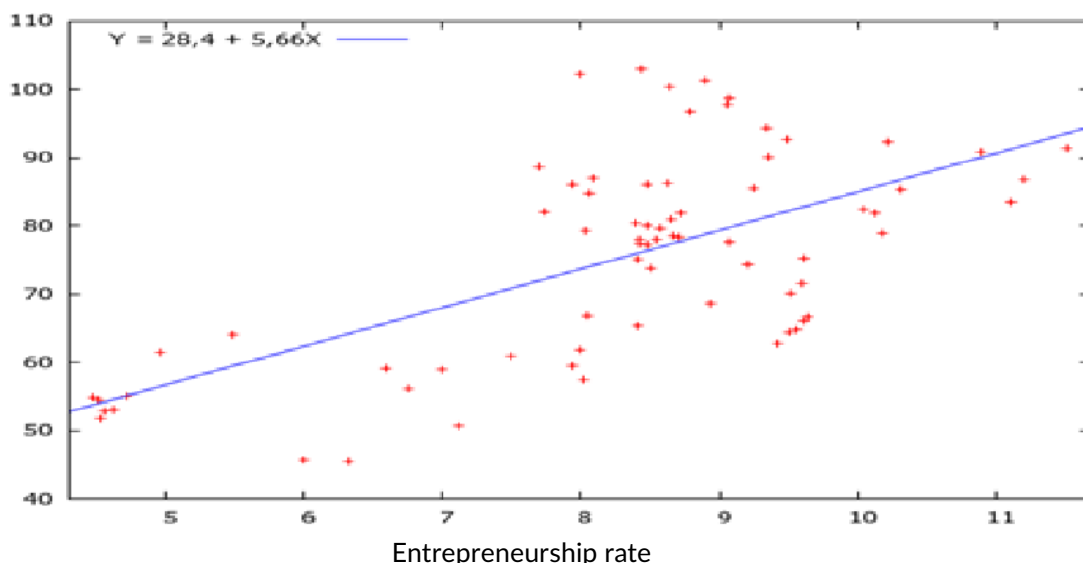


Chart 2. The spread between the entrepreneurship rate and the innovation index in Cyprus, Greece, Spain, Croatia, Lithuania, Latvia, Malta, Italy, and Slovenia. On the chart: Innovation Index and Entrepreneurship rate (with linear regression), 2013–2019

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography...*, using the GRETl program.

Innovation Index

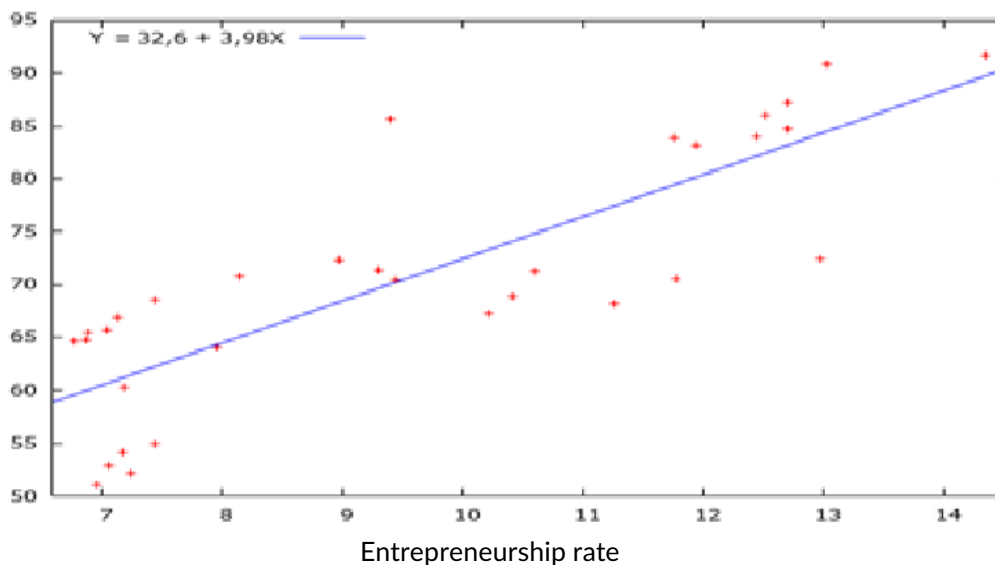


Chart 3. The spread between the entrepreneurship rate and the innovation index in the Visegrad countries. On the chart: Innovation Index and Entrepreneurship rate (with linear regression), 2013–2019

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography...*, using the GRETl program.

Secondly, among the non-V4 Moderate Innovators, there is a significant and positive correlation between the entrepreneurship rate, but only with employment impact (0.62) and design application index (0.51). In both cases, the established significance level is high (design application – $t(70) = 3.73005$, with the two-sided critical area $p = 0.0004$ and employment impact – $t(70) = 5.44963$, with the two-sided critical area $p = 0,0000$). In the remaining cases, the correlation, both negative and positive, is weak and insignificant.

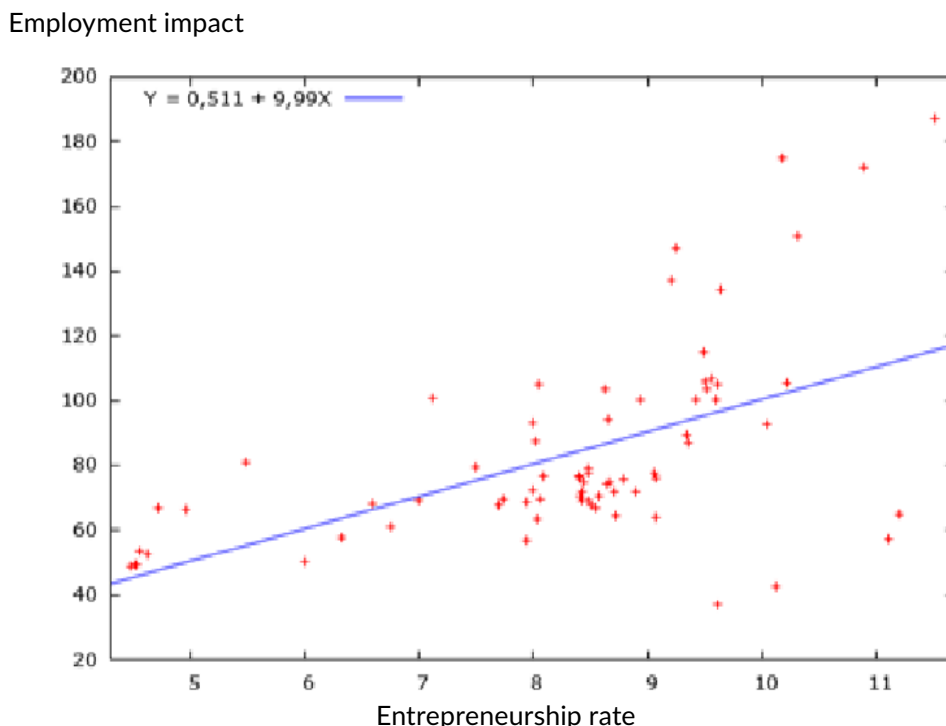


Chart 4. The spread between the entrepreneurship rate and the employment impact in Cyprus, Greece, Spain, Croatia, Lithuania, Latvia, Malta, Italy, and Slovenia; 2013–2019

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography...*, using the GRETL program.

In the V4, other variables that determine innovation have an impact on the level of entrepreneurship. The following factors show a very strong positive correlation with the entrepreneurship rate: Enterprises that provide ICT training (0.94), Innovative SMEs that collaborate (0.95), Innovators (0.95), International co-publications (0.90), and Marketing or organizational innovators (0.93). By contrast, there is a strong negative correlation between the entrepreneurship rate and the Venture Capital variable (–0.87). The scatterplots for each variable are shown below. All variables are significant (Venture Capital – $t(30) = -6.00103$, with the two-sided critical area $p = 0.0000$; Enterprises that provide ICT training – $t(30) = 6.84629$, with the two-sided critical area $p = 0.0000$; Innovative SMEs that collaborate – $t(30) = 10.2497$, with a two-sided critical area $p = 0.0000$; Innovators – $t(30) = 6.79268$, with a two-sided critical

area $p = 0.0000$; International co-publications – $t(30) = 9.94413$, with a two-sided critical area $p = 0.0000$; Marketing or organizational innovators – $t(30) = 3.82877$, with a two-sided critical area $p = 0.0006$).

Venture Capital

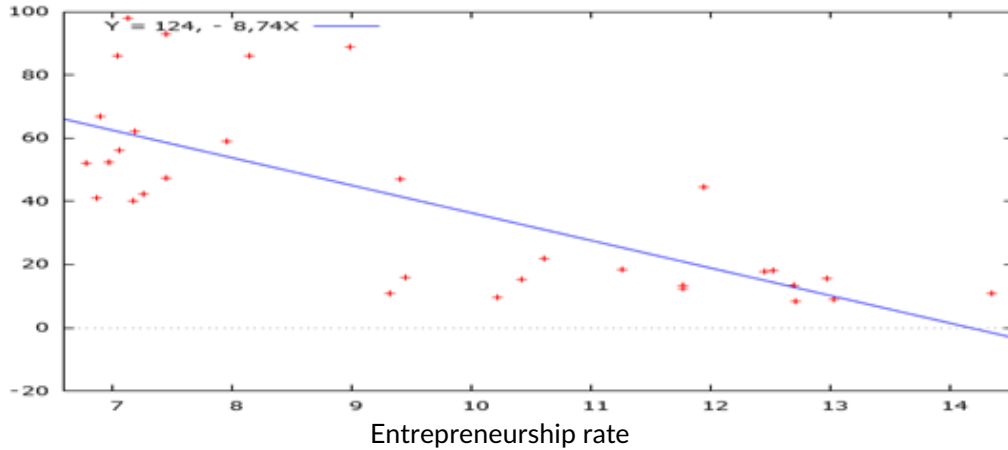


Chart 5. The spread between the entrepreneurship rate and the variable venture capital in the Visegrad countries; 2013–2019

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography...*, using the GRETl program.

Enterprises providing ICT training

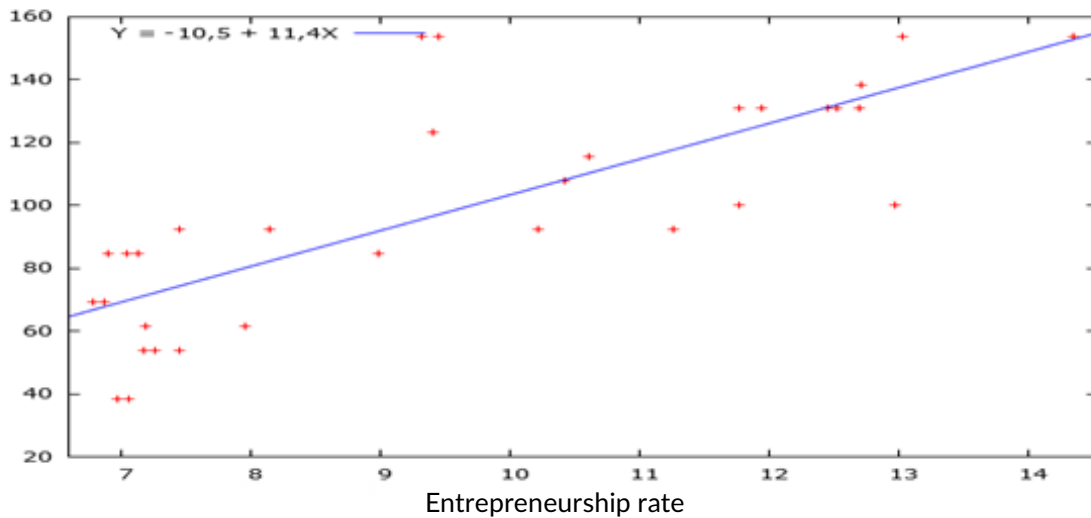


Chart 6. The spread between the entrepreneurship rate and the variable enterprises that provide ICT training in Visegrad countries; 2013–2019

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography...*, using the GRETl program.

International co-publications

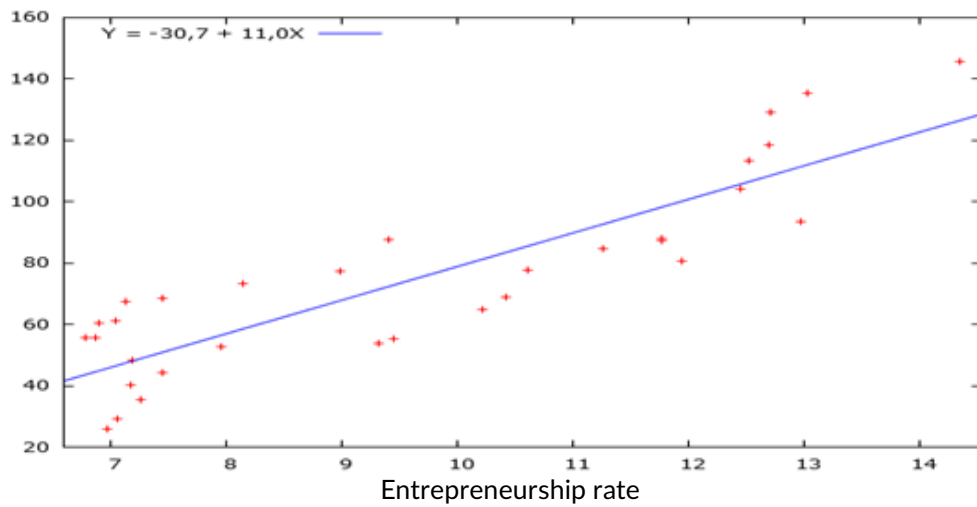


Chart 7. The spread between the entrepreneurship rate and the variable international co-publications in the Visegrad countries, 2013–2019

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography...*, using the GRETL program.

Innovative SMEs

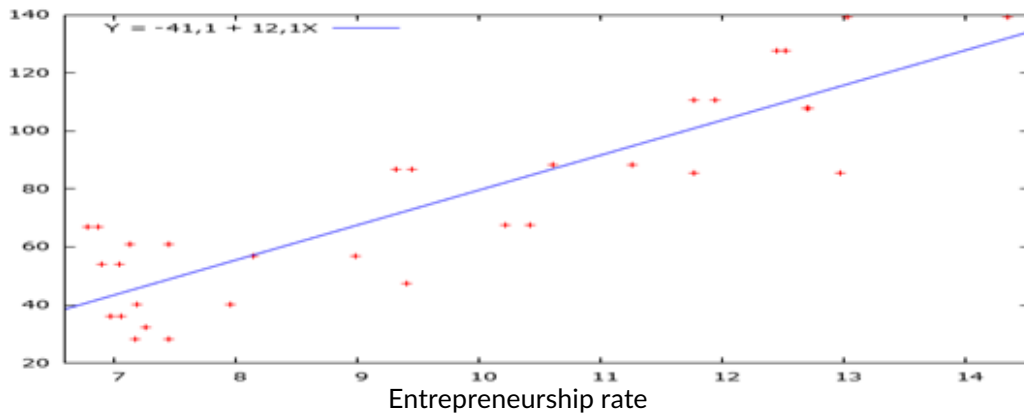


Chart 8. The spread between the entrepreneurship rate and the variable innovative SMEs that collaborate in the Visegrad countries; 2013–2019

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography...*, using the GRETL program.

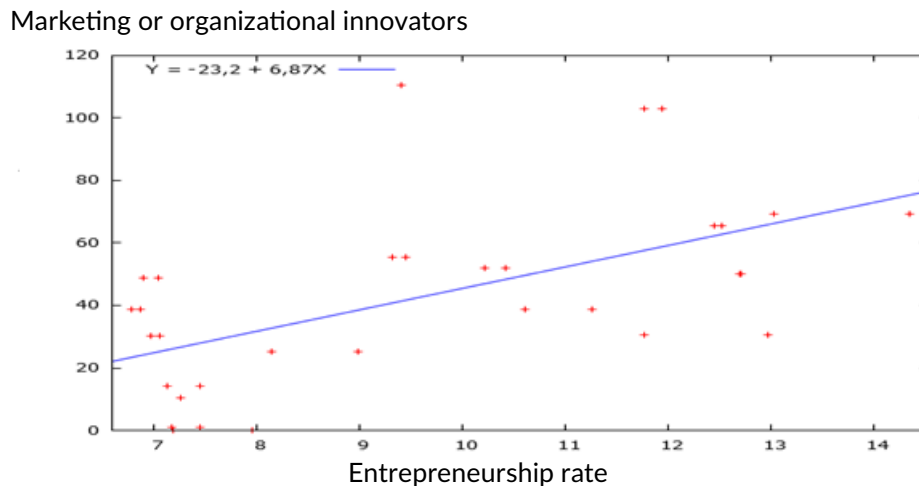


Chart 9. The spread between the entrepreneurship rate and the variable marketing or organizational innovators in the Visegrad Group countries; 2013–2019

Source: own elaboration based on European Commission 2023; Eurostat n.d., *Population and Demography...*, using the GRETl program.

The correlations showed that in the V4, entrepreneurship develops the fastest when the indicators from the “innovators” group increase (SMEs with product or process innovations, SMEs with marketing or organizational innovations, SMEs that innovate in-house). Knowledge-based entrepreneurship, using tools such as innovation, is now an indispensable factor in companies’ success. In this context, reference should be made to the achievements of Schumpeter, one of the precursors of considerations on innovation. He points out that when creating “new combinations” of means of production, the entrepreneur is of key importance because his ingenuity allows him to organize a new enterprise. The following have a slightly weaker (positive) influence on the entrepreneurship index: attractive research systems (international scientific co-publications, top 10% most cited publications, foreign doctorate students); firm investments (R&D expenditure in the business sector, non-R&D innovation expenditures, enterprises that provide training to develop or upgrade their personnel’s ICT skills), human resources (new doctorate graduates, population aged 25–34 with tertiary education, lifelong learning) and linkages (innovative SMEs that collaborate with others, public-private co-publications, private co-funding of public R&D expenditures).

The values of these correlation indicators are certainly influenced by global competition. They simultaneously shorten product life cycles while using more and more advanced technologies. The functions of enterprises, especially those reliant on extensive knowledge, are experiencing increasing internationalization. The following key indicators are relatively weak in the countries under study: employment impacts (Employment in knowledge-intensive activities, Employment in fast-growing enterprises in innovative sectors), finance and support (R&D expenditure in the public sector, Venture capital expenditures), an innovation-friendly environment (Broadband penetration,

Opportunity-driven entrepreneurship), and sales impacts (Medium and high-tech product exports, Knowledge-intensive services exports, Sales of new-to-market and new-to-firm product innovations).

The above indicators' weak impact on entrepreneurship in the V4 countries is because those economies basically have no high-technology sectors. They are among the countries with the highest share of basic research in the structure of current expenditure on R&D, which is characteristic of less developed countries, where R&D is largely state-financed. The last analyzed group of indicators is intellectual assets (PCT patent applications, Trademark applications, Design applications). Their impact on entrepreneurship was negatively insignificant (-0.10). Despite the increase in patents, the V4 countries still have among the highest shares of basic research in the structure of current expenditure on R&D.

As previously stated, the SII measures have a different impact on entrepreneurship in countries outside the V4. The article highlights the significance of "employment impact" factors on entrepreneurship within the remaining Moderate Innovator countries. Nevertheless, Cyprus, Greece, Spain, Croatia, Lithuania, Latvia, Malta, Italy, and Slovenia saw entrepreneurship increase with a moderate increase in the following SII variables: Attractive research systems, Human resources, Innovation-friendly environment, Intellectual assets and sales impacts. All indicators for Moderate Innovators are below the EU average, except for overall R&D innovation expenditure in the SME sector. However, companies in these regions are innovative not thanks to the development of their own innovative products and technologies but the use of innovations developed elsewhere. This is indicated by low expenditure on research and development itself and high expenditure on innovative products. The following factors show virtually no correlation: Finance and support, Linkages, and Firm investments. Investments in sectors related to computer production, electronics, biotechnology, medicine, and industrial automation are burdened with high risk, which makes it difficult to find an investor. Nevertheless, they are important sectors that stimulate economic growth and innovation.

Conclusions

The correlation analysis investigated the strength of relationships between EIS indicators and the entrepreneurship rate between 2013 and 2019 in moderate innovator countries. The V4 countries were separated for analytical purposes, it made it possible to positively verify the main research hypothesis that the EIS variables have a different impact on the development of entrepreneurship in the V4 than in other countries classified as Moderate Innovators according to IUS-2020.

Based on the analysis of the results, it can be concluded that:

- The correlation between the entrepreneurship rate and the total innovation index, which is compiled each year based on a set of variables for the EU countries, is positive and strong. Particularly strong relationships can be observed in the V4, characterized by a higher level of entrepreneurship than other Moderate Innovators. The relationship between the entrepreneurship rate and the innovation index at the regional level is particularly interesting because a high entrepreneurship rate characterizes countries with regions classified as strong innovators (e.g., the Prague region in the Czech Republic in the V4, and in the remaining Moderate Innovators, the Kriti region in Greece, and the Venice region in Italy).
- The relationship between the entrepreneurship rate and the variables defined by the EIS in the V4 is significantly different than in other Moderate Innovators.
- The entrepreneurship rate in these countries is strongly impacted by indicators representing the following groups: Innovators (SMEs with product or process innovations; SMEs with marketing or organizational innovations and SMEs innovating in-house), Attractive research systems (international scientific co-publications, Finance and support (Venture capital expenditures), Firm investments (Enterprises that provide training to develop or upgrade their personnel's ICT skills), and Linkages (Innovative SMEs that collaborate with others). The impact of these factors on the development of entrepreneurship in the V4 means there is a strong correlation between pro-innovative activities undertaken in operating enterprises and deciding to start one's own business. Therefore, it can be concluded that entrepreneurship in these countries has an entirely different development basis than in other moderate innovator countries, where those factors were irrelevant.
- It is justified to accept the argumentation that the development of entrepreneurship in the Visegrad countries is based on knowledge to a greater extent than in other Moderate Innovators. Physical and financial capital plays a minor role, and the key resource is knowledge combined with the ability to adapt and cooperate quickly (as indicated by a strong negative correlation with the Venture Capital variable).
- The responsible development of entrepreneurship needs many changes in the innovation support system in the V4. An active economic policy is required to build a competitive and innovative economy. The priority should be high-quality education and science, a friendly regulatory environment for business, a complete financial market, and direct public financing or incentives for the private sector to invest in research and development and new technologies.
- In other moderate innovator countries (i.e., Cyprus, Spain, Croatia, Lithuania, Latvia, Malta, Italy, and Slovenia), a significant and positive correlation between the variables mentioned in the previous parts of the study and the entrepreneurship rate occurs

only in Intellectual assets (Design applications variable) and employment impact (variables: Employment in knowledge-intensive activities² and Employment in fast-growing enterprises in innovative sectors.

- The development of entrepreneurship in these countries may largely depend on their investment attractiveness, i.e., on the possibility of attracting large innovative ventures from fast-developing sectors of the economy. In any case, new technologies and the creation of a supporting ecosystem of a modern economy are indispensable for creating new economic ventures. Five essential perspectives must also be included: science and research, entrepreneurs, investment funds, human resources, and a transparent legal environment.
- Differences in the approach to entrepreneurship may result from economic differences in the analyzed countries. The Visegrad countries, unlike other innovators, are not focused on tourism. Therefore, innovations that stimulate entrepreneurship in these countries arise “inside” enterprises, initiating the development of entrepreneurship “outside”. The other Moderate Innovators (e.g., Croatia, Italy, Spain, Malta, Cyprus) are dominated by the tourism sector. Innovation is not a domain of the tourism sector. Therefore, creating new enterprises in these economies will only be weakly correlated with innovation.
- The Czech Republic maintained a stable Moderate innovators position in the ranking due to the improvement of SME performance through product and business process innovations and venture capital spending.

Performance for SMEs with business process innovations and employment in innovative enterprises – these indicators largely determine the return of Poland, Hungary and Slovakia to Moderate Innovators in the following years.

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² Employment in knowledge-intensive activities – Employment in knowledge-intensive activities (percentage of total employment).

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Wpływ innowacji na rozwój biznesu. Przykład umiarkowanych innowatorów i krajów Grupy Wyszehradzkiej

W artykule przeanalizowano związek pomiędzy wymiarami innowacyjności według European Innovation Scoreboard, a wskaźnikiem przedsiębiorczości w grupie krajów umiarkowanych innowatorów. Wykorzystując korelację liniową Pearsona, autor przeprowadził analizę danych opartą na badaniu empirycznym z wykorzystaniem otwartych danych z Sumarycznego Indeksu Innowacji – European Innovation Scoreboard (SII-EIS) oraz Eurostatu za lata 2013–2019. Okres ten obejmuje moment, w którym wszystkie kraje Grupy Wyszehradzkiej (tj. Czechy, Węgry, Polska i Słowacja – V4) zostały zaliczone do tej samej grupy innowacji według EIS. Ze względu jednak na ograniczenia objętościowe artykułu zdecydowano, że do analizy porównawczej zostaną uwzględnieni Umiarkowani Innowatorzy z 2019 r., czyli z okresu, w którym V4 ostatni raz były łącznie klasyfikowane jako Umiarkowani Innowatorzy. Wyniki badań pozytywnie weryfikują wyjściową hipotezę badawczą, że wskaźniki EIS wykazują różną siłę powiązań ze wskaźnikiem przedsiębiorczości w krajach V4 oraz wśród innych gospodarek zaliczanych do kategorii Umiarkowanych Innowatorów (wg SII-2020). Zmienne opisujące ilość i jakość innowacji przedsiębiorców silnie i pozytywnie wpływają na poziom przedsiębiorczości krajów V4. W pozostałych krajach zmienne pochodzące z atrakcyjności inwestycyjnej gospodarek wykazują istotną i dodatnią korelację ze wskaźnikiem przedsiębiorczości. Na podstawie analizy wyników można stwierdzić, że istnieje silna dodatnia korelacja pomiędzy wskaźnikiem przedsiębiorczości, a wskaźnikiem innowacyjności ogółem, który co roku zestawiany jest na podstawie zestawu zmiennych dla krajów Unii Europejskiej. Badanie wykazało, że na wskaźnik przedsiębiorczości w tych krajach duży wpływ mają wskaźniki reprezentujące następujące grupy czynników: innowatorzy (małe i średnie przedsiębiorstwa (MŚP) posiadające innowacje produktowe lub procesowe; MŚP posiadające innowacje marketingowe lub organizacyjne oraz MŚP wprowadzające innowacje we własnym zakresie; atrakcyjne systemy badawcze (międzynarodowe współpublikacje naukowe (Anderson, Ejerme, 2004)); finansowanie i wsparcie (nakłady na kapitał wysokiego ryzyka), inwestycje firmowe (przedsiębiorstwa zapewniające szkolenia w celu rozwijania lub podnoszenia umiejętności swoich pracowników w zakresie ICT) oraz powiązania (innowacyjne MŚP współpracujące z innymi). Wpływ powyższych czynników na rozwój przedsiębiorczości w krajach V4 powoduje, że działania proinnowacyjne podejmowane w działających przedsiębiorstwach silnie korelują z podjęciem decyzji o rozpoczęciu własnej działalności gospodarczej. Można zatem stwierdzić, że przedsiębiorczość w tych krajach ma zupełnie inne podstawy rozwoju niż w pozostałych krajach będących Umiarkowanymi Innowatorami, gdzie powyższe czynniki nie miały znaczenia.

Słowa kluczowe: innowacje, przedsiębiorczość, umiarkowani innowatorzy, Grupa Wyszehradzka, rozwój gospodarczy, finanse