

Regional Innovation System in the Podkarpackie against selected Polish and EU regions

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Abstract. Innovation and innovativeness should be seen as a vast and internally complex set of measures carried out to improve management efficiency, build strong competitive positions and obtain economic benefits from enterprises, national economies and societies. A possibility of achieving these benefits is the category of competitiveness, hence, relative position of a region is measured using various indicators. The aim of the study is to analyze the level of the selected RIS indicators of the Podkarpackie against selected EU regions. The study will make it possible to understand in which area Podkarpackie performs better and in which worse? The analysis is carried out at the regional level NUTS 2. The most important approach in which quantitative indicators have been used comprehensively is EIS, which makes it possible to compare the Podkarpackie with the selected regions of Poland and the EU. Seven regions were selected for our analysis: 1 in Denmark, Germany, the United Kingdom, Czech Republic and 3 in Poland. When it comes to innovativeness, the Podkarpackie region is a Moderate Innovator. The results of our research show that the relative strengths in the regional innovation system are design applications, sales new-to-market/firm innovations, R&D expenditures business sector, non-R&D innovation expenditures, and tertiary education. Relative weaknesses are: marketing or organizational innovations, and also life-long learning.

Keywords: regional innovation system, innovation drivers, policy effects, NUTS-2 region.

JEL Classification: L11, L26, O31, O33

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1. INTRODUCTION

Innovation-driven socioeconomic development in Europe gives away to the superiority of the United States, what, at some point, was widely recognized by various European institutions. The basic long-run development perspective of the European Union (EU) reflected in the documents such as “Europe 2020” emphasized that promotion of “smart growth” and “Union of Innovation” should be the key strategies in maintaining sustainable growth. This has led to a major shift among the Member States to promote knowledge-based branches of their economies. In Poland, this shift created the nexus of legal and organizational solutions to seek competitive advantages by higher innovation. RIS became a crucial element in maintaining international competitiveness of regions and thus of the EU as a whole.

When it comes to the performance of RIS, empirical evidence is rare. Very little is also known about the institutional conditions that favour innovation on the regional level. Most of the research efforts are focused on the country-level determinants of knowledge-based growth. Therefore, the author assumes that constantly amended policies can help improve the functioning of RIS, thus leading to innovative growth.

Innovations are considered one of the main drivers of growth and competitive advantage, especially in a regional perspective, whereas institutional environment is regarded as a key factor supporting innovativeness of enterprises. The level of innovation varies across regions (Hlaváček and Siviček, 2017; Pater and Lewandowska, 2015; Świadek, 2013; Buerger *et al.*, 2012; Hunady *et al.*, 2017; Moreno *et al.*, 2005; Paci and Usai, 2000). On the one hand, this can result in the availability and quality of local inputs, as well as limitations in the geographical penetration of knowledge (Greunz, 2003). On the other hand, differences may result from different “quality” or “efficiency” of regional innovation systems (RIS), which leads to different levels of innovative output, even if the inputs are identical in quantitative as well as qualitative terms (Bai, 2013; Fritsch and Slavtchev, 2011).

The Podkarpackie region, where the research was carried out, was not long ago considered to be dormant and underdeveloped. Some recent studies, however, provide evidence that innovative companies emerge in this region (Lewandowska and Stopa, 2013, 2019). These successful case studies occurred in the period of the EU economic policy instruments’ application. The aim of the study is to analyze the level of the selected RIS indicators of the Podkarpackie against selected EU regions. The study will make it possible to understand in which Podkarpackie performs better and in which worse? The analysis is carried out at the regional level NUTS 2 in Poland. The analysis is based on thee Eurostat statistical data on the selected sights of innovativeness.

The article is organized as follows. In the next section, the author provides literature review on institutional factors related to innovativeness along with a brief description of the Podkarpackie region. In the third section, the author presents the description of methods. Section four presents and discusses the results. The paper ends with the concluding remarks.

2. LITERATURE REVIEW

The discussion on innovation is very vivid and sometimes contradicting. For instance, there are different concepts and perspectives on what makes the activities innovative and what stimulates them (see, for instance, Vaz *et al.*, 2014; Sivak, Caplanova, and Hudson, 2011; Doloreux and Dionne, 2008; Inzelt and Szerb, 2006; Bhattacharya and Bloch, 2004); in other words, on factors that define and determine innovativeness. Some researchers point out that understanding of “knowledge and innovation” is essential in developing effective innovation strategies and approaches. On the other hand, Nazarov and Akhmedjonov (2012) attempted an analysis of the effect of human capital on a firm’s decision to innovate in transition economies of Eastern Europe. Their main findings shed light on how local authorities may allocate scarce resources if their main goal is to boost innovation activities in their countries. This

understanding is key, if more localised and specific interventions are to be made within the “regional systems of innovation”. Smith and Waters (2011) and Melnikas (2008) show the need for horizontal networks between firms, an institutional system of vocational training, and substantial public and private investment in innovation in peripheral regions. However, Michael and Pearce (2009) who tried contrasting approach, in relation to the abovementioned previous attempts, and analysed aiding entrepreneurship without commitment to study innovation, suggested that following their steps would be unsuccessful. We therefore decided to pick one of the accepted definitions of innovation. According to the Oslo Manual (2005:8) innovation is described by:

(...) changes which involve a significant degree of novelty for the firm’.

The latest studies move away from perceiving innovation as a one standing-alone event. In author's opinion it is a number of events that create new patterns, and thus, as the result, new goods or technologies in the area of production and services. Innovations are made within a specified area with a system of linkages called innovation system. There is characterized by the level of innovativeness of the region (Grosse, 2007). The Regional Innovation System was created as a product of the decentralization of decision-making structures – from the EU to national and then to regional level. The aim of the Regional Innovation System is to enforce regional policymaking, and acceleration of innovation process in enterprises and other organizations. It defines and implements the institutional framework to stimulate innovation in the region (Asheim et al., 2011). The most important element of the innovation system are enterprises, which in developed economies are the main source of innovation, which is also reflected in the share of business expenditure on R&D in total expenditure on R&D.

What factors create and determine innovativeness? Lengyel and Leydesdorff (2011), Hansen (1992), and Acs and Audretsch (1987) link innovation with the size, age and development dynamics of the enterprise. Heunks (1998) found out that the companies’ age influences innovation, and Huergo and Jaumaderu (2004) showed that innovation is rather related to the companies’ life-cycle, and that younger companies do better at implementing innovations than older ones. Empirical studies examining the relationship between the companies’ dynamics of growth, their self-assessed economic situation and innovation are scarce. Baldwin, Chandler, and Papailiads (1994) showed that innovation is the key factor that determines company’s success. Baldwin and Johnson (1999) suggested that faster-growing companies are more innovative than slower-growing companies. Jermolajeva et al. (2017) showed smart growth as a tool for regional convergence based on the Baltic countries.

Some studies of sources and determinants of innovation, for instance Cooke, Uranga, and Etxebarria (1997); van Hemert et al. (2013), used an ‘integrated approach’ to study innovative SMEs. This means that they assumed that actions taken by governmental organizations can influence the innovative potential of regions. Doloreux and Dionne (2008) showed that a high level of concentrated and specialized knowledge infrastructure, efficient technology transfer, and strong human capital are the key factors leading to innovative actions. They suggested that cooperation between various institutions could have a positive impact on the innovativeness. Next, Rodriguez-Pose and Di Cataldo (2015) link the capacity of regions to innovate with the quality of government. In particular, ineffective and corrupt governments represent a fundamental barrier for the innovative capacity of the periphery of the EU. In this paper we provide the model that brings us closer to understanding the strength and weakness of Podkarpackie on innovation level. Pater et al. (2019) confirmed that the Regional Innovation System induces innovation for very specific instruments, such as the tailor-made consulting and financial help from local, public and specialized organizations.

Why was the Regional Innovation System important from the policy perspective? Podkarpackie is among the least developed regions in Poland in terms of GDP per capita, labour productivity, wages, and infrastructure. Podkarpackie is on the fifteenth position in Poland (for sixteen regions) in terms of GDP

per capita. In 1997-2016, GDP per capita grew slower than the Polish average. In consequence the distance between Podkarpackie and the rest regions of Poland increased. The share of industry in the Gross Value Added (GVA) is estimated at 28.3 percent which is the eighth highest result – above the national average (25.6 percent). However, services are poorly developed. The region is characterized by high share of unprofitable and fragmented agriculture.

3. METHODOLOGY

The most important approach in which quantitative indicators have been used comprehensively is EIS, which makes it possible to compare the Podkarpackie with selected regions of Poland and the EU. The 2019 edition is currently in development, while the EIS 2019 region is available from 2002 to 2018, allowing us to assess the dynamics of the changes over the period (RIS 2019). Seven regions were selected for analysis: 1 in Denmark, Germany, the United Kingdom, the Czech Republic and 3 in Poland.

In order to determine the situation in the Podkarpackie against the background of the situation in the EU regions, indicators of innovation were identified in line with the recommendations of the Regional Innovation Strategy and Eurostat¹. The data was selected and classified according to the Regional Innovation Scoreboard (RIS) (Hollanders, Tarantola, and Loschky, 2009). This arrangement makes it possible to compare their results with those of other EU regions. These figures are quantitative. Of the available Eurostat data, those that according to the author were the ones who determined the degree of innovativeness of the voivodship. These indicators are:

Enablers

Human resources

- Population having completed tertiary education (*number of persons in age class with some form of post-secondary education (ISCED 5 and 6)*);
- Participation rate in education and training (last 4 weeks);

Finance and support

- R&D expenditure in the public sector (*all R&D expenditures in the government sector (GOVERD) and the higher education sector (HERD)*);

Firm activities

Firm investments

- R&D expenditure in the business sector (*all R&D expenditures in the business sector (BERD)*);

Intellectual Assets

- EPO patents (*number of patents applied for at the European Patent Office (EPO), by year of filing. The national distribution of the patent applications is assigned according to the address of the inventor*);

Outputs

Economic effects

- Employment in medium-high/high-tech manufacturing+ knowledge-intensive services (*number of employed persons in the medium-high and high-tech manufacturing sectors*);

¹ The EIS approach uses a synthetic indicator that serves as a useful tool both for conducting innovation policy and for its evaluation (especially in the context of the achievements of other countries, i.e. the so-called 'ranking of innovation countries'). The use of this approach to assess the effectiveness of implemented innovation policy can take place both in the context of the overall level of achievement (SII) and individual components of this synthetic indicator. The use of individual source indicators seems to be more adequate to measuring the effectiveness of individual policy actions. [por. European Innovation Scoreboard. Comparative analysis of Innovation Performance, Pro inno Europe – Inno Metrics, January 2009].

The above indicators were presented in relation to the EU average. In addition, the author presented synthetic / composite indicators:

- RNSII – regional index of innovation within the country - average value of residual index relative to country
- REUSII – regional synthetic innovation index in 28 EU countries - average residual value index relative to EU28

For analysis, the following regions were adopted:

- Denmark | Hovedstaden
- Germany | Nordrhein-Westfalen
- United Kingdom | Yorkshire and The Humber
- Czech Republic | Moravskoslezsko
- Poland | Dolnośląskie
- Poland | Podkarpackie
- Poland | Wielkopolskie.

The starting point for the selection of these regions was a highly industrialized nature concentrated in the main urban centers, where SMEs operate in the environment of large industrial enterprises. The Moravskoslezsko region achieves similar innovation results as the Podkarpackie region (according to EIS). It will be worth identifying differences in the dynamics of indicators as well as differences in the shaping of analogical indicators.

4. EMPIRICAL RESULTS AND DISCUSSION

According to RNSII, in the context of the countries to which the studied regions belong, the Podkarpackie Voivodeship (0.83) is the lowest in the region (0.83), i.e. Hovedstaden in Denmark (1.19) and Nordrhein-Westfalen (0.94). Podkarpackie is close to Yorkshire in the United Kingdom (0.94). Moravskoslezsko in the Czech Republic (0.70) falls below the Podkarpackie Region.

The profiles of the individual regions according to the selected indicators (Population having completed tertiary education, Participation rate in education and training, R&D expenditure in the public sector, R&D expenditure in the business sector, EPO patents, Employment in medium-high/high-tech manufacturing + knowledge-intensive services) are presented in Figure 1.

In Poland, Dolnośląskie (1.05) is much better than Podkarpackie. In turn, Wielkopolskie has a similar result as Podkarpackie (slightly higher - 0.88).

It is worth stressing that Podkarpackie is characterized by the lowest level of RNSII growth among all studied regions, similarly as the Nordrhein-Westfalen region (decrease by 0.19). The Hovedstaden region with the best results loses its advantage (decrease by 0.03), similarly as the Yorkshire and The Humber region (decrease by 0.01).

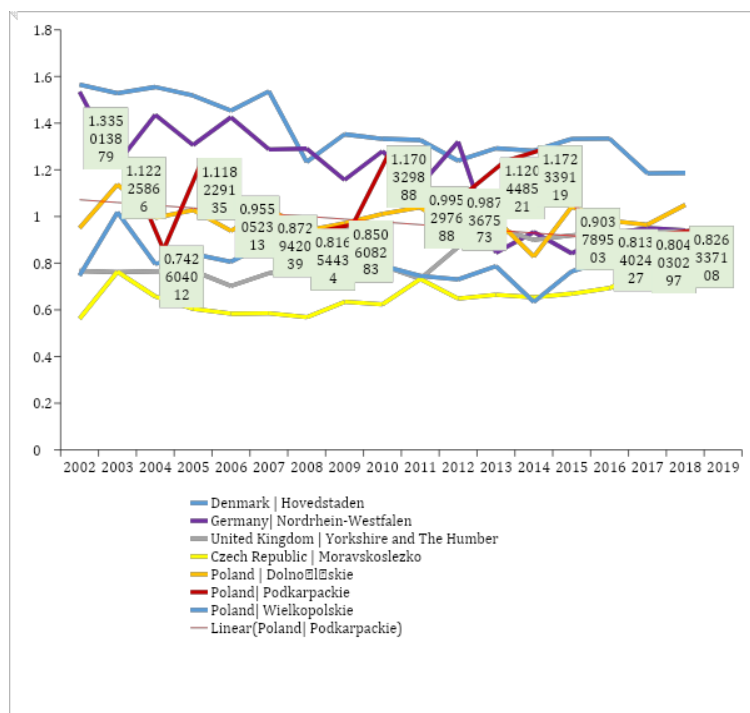


Figure 1. Regional index of innovation within the country (RNSII) for Podkarpackie against selected Polish and EU regions - average value of residual index relative to country
Source: Own research based on regional EIS indicators, European Regional Innovation Scoreboard (RIS 2019) and Eurostat.

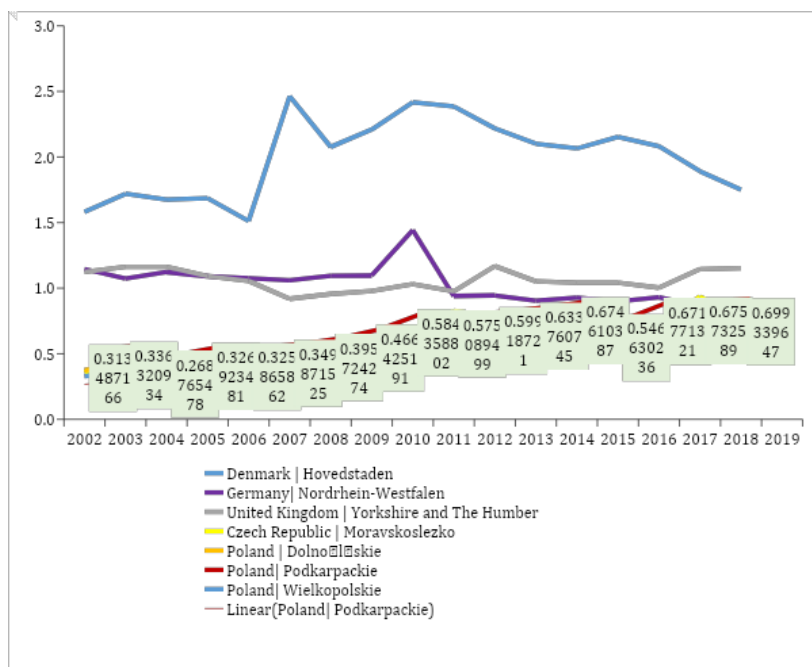


Figure 2. Regional synthetic innovation index in 28 EU countries (REUSII) for Podkarpackie against selected Polish and EU regions - average residual value index relative to EU28.
Source: Own research based on regional EIS indicators, European Regional Innovation Scoreboard (RIS 2017) and Eurostat.

The calculation of the REUSII index was possible for all 7 adopted regions, with a significant increase in the position of the Podkarpackie (from 0.31 to 0.70), although its starting position was not high. The highest position was taken by the Danish region (1.75), but, like most regions, it is characterized by a slight downward trend.

These observations were confirmed by the Regional Innovation Scoreboard 2019 - Relative performance to EU in '2011', where Podkarpackie gets a score of 61.0. The upward trend indicates that Podkarpackie strengthens its position against the background of Poland.

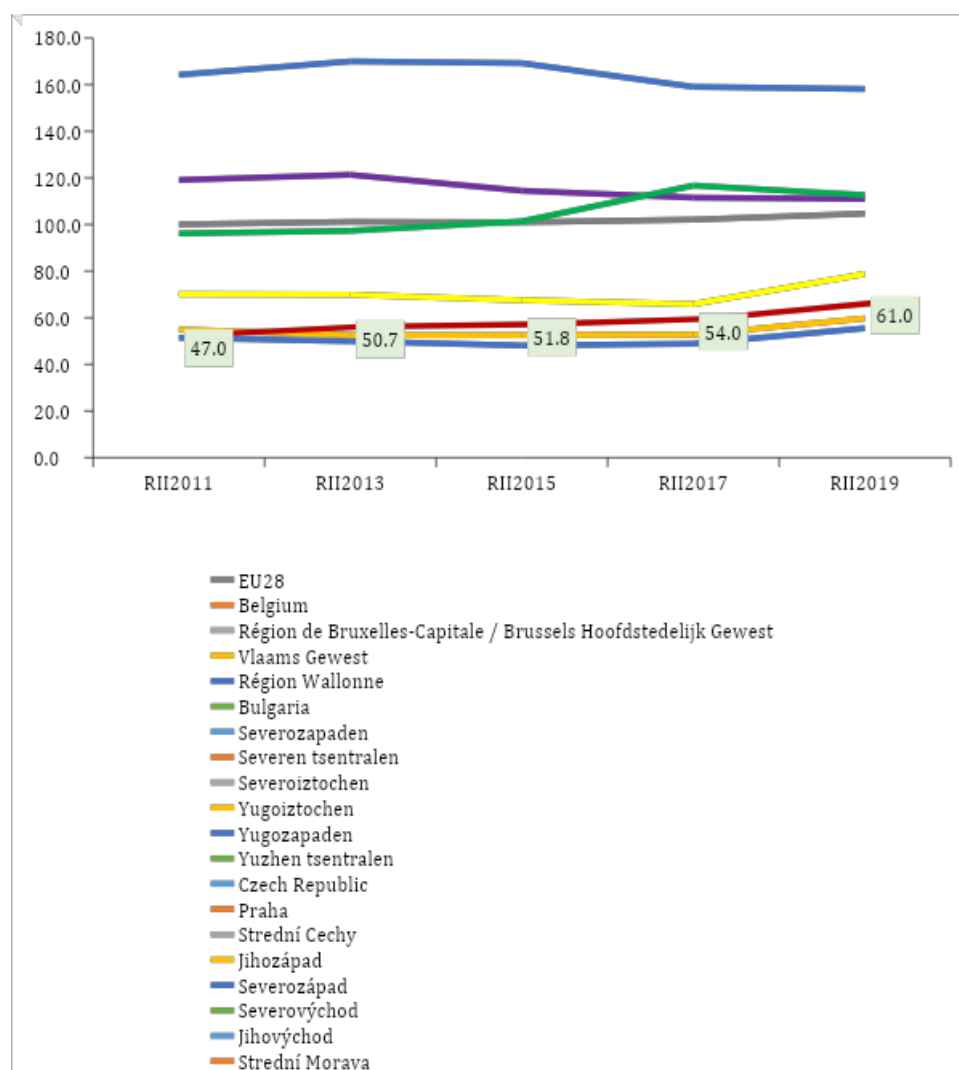


Figure 3. Regional Innovation Scoreboard 2019 - Relative performance to EU in "2011"

Source: Own research based on regional EIS indicators, European Regional Innovation Scoreboard (RIS 2019) and Eurostat.

The profiles of individual regions according to the 6 indicators that characterize them. (Population having completed tertiary education, Participation rate in education and training, R&D expenditure in the public sector, R&D expenditure in the business sector, EPO patents, Employment in medium-high/high-tech manufacturing+ knowledge-intensive services) are shown in Figure 4.

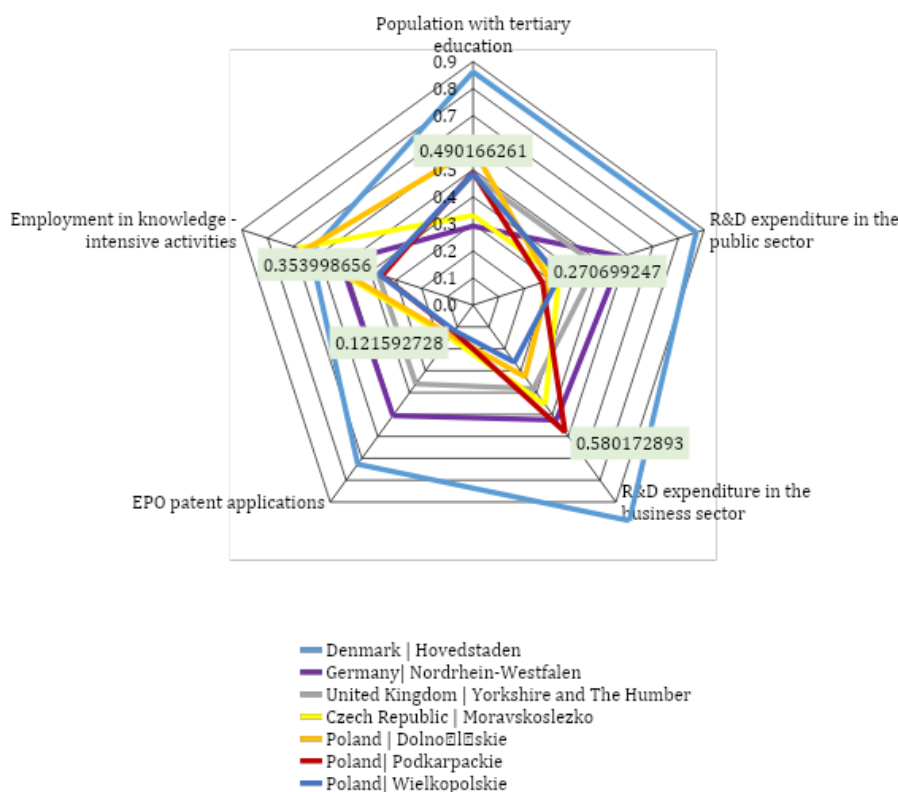


Figure 4. Selected regions: Innovation performance per dimension (according to the RIS normalized data)

Source: Own research based on regional EIS indicators, European Regional Innovation Scoreboard (RIS 2019) and Eurostat.

The above diagram shows that the regions of Poland and the Czech Republic are similar. Very different from other regions of Denmark, Germany and English. Hovedstaden is characterized by high levels of populations having completed tertiary education, large R&D expenditure in the public sector and in the business sector. The Nordrhein-Westfalen region is characterized by large private expenditure on R&D and high number of EPO patents. The Yorkshire region is specialized in high tech services and, above all, large R&D expenditure in the public sector.

Podkarpackie was the weakest among the selected regions of Poland and the EU in the case of two of the 6 characteristics influencing the level of regional innovation. Podkarpackie has the lowest EPO patent applications. The highest rate of R&D expenditure in the business sector was found in the Podkarpackie region. This is shown in Table 1. Podkarpackie is better than in Wielkopolskie only in R&D expenditure in the business sector. The Podkarpackie region has a greater advantage in R&D expenditure in the business sector than in Dolnośląskie (the highest in the regions of Poland and higher than in the Czech region).

Table 1

List of RIS 2019 indicators for Podkarpackie and selected regions of the EU and Poland

Region	Population with tertiary education	R&D expenditure in the public sector	R&D expenditure in the business sector	EPO patent applications	Employment in knowledge-intensive activities
Denmark Hovedstaden	0.86	0.87	0.99	0.73	0.63
Germany Nordrhein-Westfalen	0.29	0.58	0.53	0.51	0.51
United Kingdom Yorkshire and The Humber	0.48	0.48	0.38	0.36	0.37
Czech Republic Moravskoslezsko	0.33	0.34	0.45	0.15	0.68
Poland Dolnośląskie	0.58	0.30	0.33	0.14	0.66
Poland Podkarpackie	0.49	0.27	0.58	0.12	0.35
Poland Wielkopolskie	0.49	0.34	0.26	0.12	0.37

Source: Own research based on regional EIS indicators, European Regional Innovation Scoreboard (RIS 2019) and Eurostat.

Comparing Podkarpackie to Yorkshire and The Humber in the United Kingdom, we can see that it finances R&D works by private sources (58% of R&D expenditure comes from private sources in Podkarpackie vs. 38% in the case of the English region), whereas the English region finances these expenditures by public sources (48% of R&D expenditure comes from public sources in this region vs. 27% in Podkarpackie). In addition, the English region is better off in employment in the high-tech sectors in services and in the participation of adults aged 25-64 in education and training.

It is worth emphasizing that the Podkarpackie region has very good results (almost equal to the EU average) in terms of employment in technology and knowledge-intensive sectors (however, this result is worse than the Moravskoslezsko region in the Czech Republic), although in general the Polish regions are getting good results in this respect. The Podkarpackie has equally good results in EPO patent applications (35% of EU average). These are certainly the strengths of the region. In turn, the participation of adults aged 25-64 in education and training and public expenditure on R&D are weak points, which are very different from the EU average.

5. CONCLUSION

Competitiveness and innovativeness of management are important and the most desirable features, both in relation to enterprises, the regional economy and the entire national economy. Many indicators and macroeconomic data can be used to measure and evaluate competitiveness and innovativeness of the economy. Reports in this scope in relation to economies are developed, among others by the European Commission (EIS - European Regional Innovation Scoreboard), World Economic Forum (GCI - Global Competitiveness Index).

The paper presents the analysis of the Podkarpackie innovativeness from three points of view: factors conducive to innovation, firm activities and outputs of innovative activity. Podkarpackie region classified in terms of the level of innovativeness in 2018 as well as its changes in the years 2002-2018. The aim of the paper was to analyze the level of selected RIS indicators of the Podkarpackie against selected EU regions.

The study will make it possible to understand in which area Podkarpackie performs better and in which worse? Author conducted the analysis on the basis of the statistical data from Eurostat on the selected sights of innovativeness.

Podkarpackie is one of the poorest NUTS-2 regions of the European Union. One of the factors that contribute to the above is a low level of innovativeness in the matter of several conditioning factors. Particularly negative were indicators of innovativeness output, such as a relative number of submitted patents, or R&D expenditures in GDP, and as well as Life-long Learning. The improvement of those areas will be, in the highest degree involved to the position of the Podkarpackie in terms of innovativeness, and hence the economic development. However, macroeconomic indicators show that innovativeness level sharply increased during 2011-2014. It coincided with the increase in regional public funds for innovation. These funds were gathered within Regional Innovation System of the Podkarpackie Region. The institutional support system is an important driver of firms growth and their innovativeness. Lewandowska *et al.* (2019) described how the Regional Innovation System influences innovation-driven growth. According to them, the Regional Innovation System induces innovation but for very specific instruments. These instruments included especially – the tailor-made consulting and financial help from local, public and specialized organizations. The more general the instrument, the less attention enterprises paid to it. Thus, we recommend reduction of the budget for general Regional Innovation System activity, while directing the hereby saved funds to specialized more pin-pointed consultations. The public funds increase the probability of introducing innovations. The developing regions such as Podkarpackie are a specially fund-sensitive because companies have limited access to finance high-risk activities including innovations. Unfortunately some types of funding do not contribute to permanent improvement, but served only as demand factors. Thus, we think that this type of activity has a chance for success but if it starts with the initiative of enterprises, rather than public institutions.

Podkarpackie characterized, as well in the background of the country as in the EU, by some very innovative areas (aviation sector, IT sector – smart specializations). It is related to innovativeness of industry and relative number of people with higher education. An important regional factor having their impact on the innovation environment of the region and innovation potential is educated and flexible workforce employable in companies from the growing sectors being localized in the region. Those advantages should be used to stimulate innovativeness in the rest of the areas in the Podkarpackie.

The increase of the number of indicators and data, which will describe the innovation environment of the regions, could be recommended for further research of the innovation potential. Although the research data used in the paper is not able to fully assess the quality and complexity of the innovation potential of the selected regions, the research results are a valuable source of information for mapping the innovation potential of the regions and setting up innovation.

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