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**INNOVATION AND COMPETITIVENESS IN REGIONS OF THE SLOVAK REPUBLIC****Inovácie a konkurencieschopnosť v regiónoch Slovenskej republiky****JARMILA HUDÁKOVÁ****MILAN MAROŠ**

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**Annotation**

Innovations are the fundamental source of growth competitiveness of regional economy. The aim of the article is to identify the dependency between innovation and competitiveness of regions of Slovakia. The study of the link between innovation and competitiveness used descriptive analysis and correlation. The data of innovation for regions was extracted from the European Innovation Scoreboard using Regional Innovation Index (RII) 2017 on level NUTS II (Nomenclature of Units for Territorial Statistics). The data of competitiveness for regions was extracted from the Regional Competitiveness Index 2017 (RCI) also on level NUTS II. For testing the link between innovation and competitiveness we used correlation index. Bratislavský kraj is a Strong Innovator, Západné Slovensko is a Moderate Innovator, Stredné Slovensko is a Moderate Innovator, Východné Slovensko is a Moderate + Innovator. The region of Bratislavský kraj has the best results in both innovation and competitiveness. The region Východné Slovensko has the lowest competitiveness score. Paper shows that the correlation, between the Regional Competitiveness Index and the innovation performance, is very strong, the correlation coefficient being 0.954 for Slovak Republic, for Bratislavsky kraj is 0.906, for Západné Slovensko is 0.928, for Stredné Slovensko is 0.908 and Východné Slovensko has coefficient 0.815.

**Key words**

innovation, competitiveness, Regional Innovation Index, Regional Competitiveness Index, correlation, NUTS II

**Anotácia**

Inovácie sú základným zdrojom rastu konkurencieschopnosti ekonomiky regiónov. Cieľom článku bolo zistiť závislosť medzi inováciami a konkurencieschopnosťou. Štúdiu prepojenia medzi inováciami a konkurencieschopnosťou využíva opisnú analýzu a koreláciu. Údaje o inováciách pre regióny boli získané z European Innovation Scoreboard s použitím regionálneho inovačného indexu (RII) 2017 na úrovni NUTS II. Údaje o konkurencieschopnosti regiónov boli čerpané z indexu regionálnej konkurencieschopnosti 2017 (RCI) tiež na úrovni NUTS II. Na testovanie vzťahu medzi inováciami a konkurencieschopnosťou na úrovni NUTS II bol použitý korelačný koeficient. Bratislavský kraj je silný inovátor, západné a stredné Slovensko patria do skupiny mierny inovátor a východné Slovensko do skupiny mierny + inovátor. Bratislavský kraj má najlepšie výsledky v oboch ukazovateľoch. Východné Slovensko má najnižšie hodnotenie v konkurencieschopnosti. Korelácia medzi indexom regionálnej konkurencieschopnosti a inovačnou výkonnosťou je veľmi silná, korelačný koeficient na úrovni Slovenska je 0,954, Bratislavský kraj dosiahol 0,906, Západné Slovensko 0,928, Stredné Slovensko 0,908 a Východné Slovensko 0,815.

**Kľúčové slová**

inovácie, konkurencieschopnosť, regionálny inovačný index, regionálny index konkurencieschopnosti, korelácia, NUTS II

**JEL classification:** O31, O57

## 1. Introduction

Innovation is the driving force of regional development and contributes to the overall development and international competitiveness. The source of competitive advantage is in particular new and innovative products and services and innovative manufacturing processes. In a comprehensive notion, innovation is a purposeful, dynamic development process that results in a positive change aimed at improving the reproduction process and fulfilling meeting the needs of the consumer. In line with this understanding, innovation can relate to products, technologies, means of production, occupational and qualification structure of the workforce, organization of company. This can be both quantitative and qualitative changes, changes with positive and negative socio-economic consequences (Ivanová, Tomanová, 2014). Drucker (1993) is of the opinion that innovation is a function "New technologies" in the form of business management, the management of which is human activity in terms of commitment and managerial activity transforming inventions into innovation. Kotler (2007) says that innovation is defined such as a thought, service, product or technology, developed and offered to customers who perceive it as new or original. Statistical surveys on innovation have been going on in the European Union since 90s. These surveys allow a better understanding of the innovation process and analyse the effects of innovation on the economy. The scope of survey is gradually expanding. Initially, surveys addressed only product (technical) innovations in selected industries. Later, surveys were expanded and still expanding (Žitek, Klímová, 2011).

One of the important and proclaimed objectives of the European Union is competitiveness. Currently, under market economy conditions, it is perceived as one of the most important elements of development. Paradoxically, this concept is not clearly defined. As most authors agree, competitiveness is primarily a business issue. At a higher level, competitiveness becomes a non-transparent term. For example, the European Commission describes competitiveness as the ability to generate relatively high income and employment levels. Atkinson (2013) gives the following definition for competitiveness in context with innovation: "Competitiveness is the ability of a region to export more in value added term than it imports, while innovation is related to productivity, it is no synonymous". Competitiveness is defined by a set of institutions, policies and factors that determine the productivity level of a country, ensuring a sustainable level of welfare for its citizens. Increasing the competitiveness of the economies could be achieved through current European and national policies involving the allocation of a larger share of GDP for research and development (Albu, State, 2018). According to Porter (1994) national competitiveness examines the ability of national growth economy using a set of factors, policies, and institutions that determine the level of productivity of the state and thus its overall economic development. Workie (2006) argues that competitiveness economy is determined as a result of performance countries in the field of science and technology, individually innovative capacity that defined by the long-term the ability to create and commercialize new streams previously unrecognized solutions - innovations.

Boháčková and Svatošová (2012) point out that one view of the competitiveness of the region is that we consider region, that achieves the desired economic effect (GDP per capita) and the desirable social effect (rising employment) as a competitive one.

In the literature there is intense debate about the link between innovation and competitiveness. Ciocanel and Pavelescu (2015) assessed the link between innovation and competitiveness using an econometric panel model, measuring the impact of innovation on increasing competitiveness. The results showed that an improvement of the innovation performance by +5% leads to the increase of the national competitiveness +2.32 points. The economies that have or develop a pro-innovation culture can work better in the future despite unfavourable macro-conditions, while an anti-innovation culture prevents innovation and competitiveness, even if makers would improve macro-conditions (Petraakis, Kostis, Valsamis, 2015).

## 2. Aim and methodology

The aim of the article was to identify the dependency between innovation and competitiveness of regions of Slovakia. The study of the link between innovation and competitiveness was using descriptive analysis and correlation. The data of innovation for regions was extracted from the European Innovation Scoreboard using Regional Innovation Index 2017 on level NUTS II. The data of competitiveness for regions was extracted from the Regional Competitiveness Index 2017 also on level NUTS II. For testing the link between innovation and competitiveness on the level NUTS II was used correlation index.

The performance of EU national innovation systems is measured by the Summary Innovation Index. Based on results, the Member States fall into four performance groups: 1. Innovation leaders - includes Member States where performance is more than 20% above the EU average. 2. Strong innovators - includes Member States with a performance between 90% and 120% of the EU average. 3. Moderate innovators - includes Member States where performance is between 50% and 90% of the EU average. 4. Modest innovators - includes Member States that

show a performance level below 50% of the EU average. The Regional Innovation Index introduces three subgroups within each performance group to allow for more diversity at the regional level: the top one-third regions (+), the middle one-third regions, and the bottom one-third regions (-), creating the following 12 performance groups: Innovation Leaders +, Innovation Leaders, Innovation Leaders -, Strong + Innovators, Strong Innovators, Strong - Innovators, Moderate + Innovators, Moderate Innovators, Moderate - Innovators, Modest + Innovators, Modest Innovators, and Modest - Innovators.

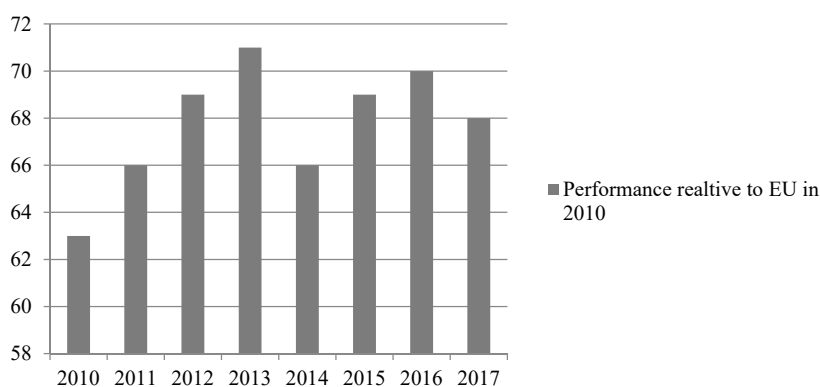
For measuring of competitiveness of regions we used the Regional Competitiveness Index (RCI). The RCI is based on the statistical NUTS 2 regions. The RCI is composed of 11 pillars that describe the different aspects of competitiveness. They are classified into three groups: Basic, Efficiency and Innovation. The Basic group includes five pillars: (1) Institutions; (2) Macroeconomic Stability; (3) Infrastructure; (4) Health; and (5) Basic Education. These represent the key basic drivers of all types of economies. As a regional economy develops and advances in its competitiveness, factors related to a more skilled labour force and a more efficient labour market come into play as part of the Efficiency group. This includes three pillars: (6) Higher Education, Training and Lifelong Learning; (7) Labour Market Efficiency; and (8) Market Size. At the most advanced stage of a regional economy's development, drivers of improvement are part of the Innovation group, which consists of three pillars: (9) Technological Readiness; (10) Business Sophistication; and (11) Innovation.

### 3. Results

#### 3.2 Regional Innovation Index

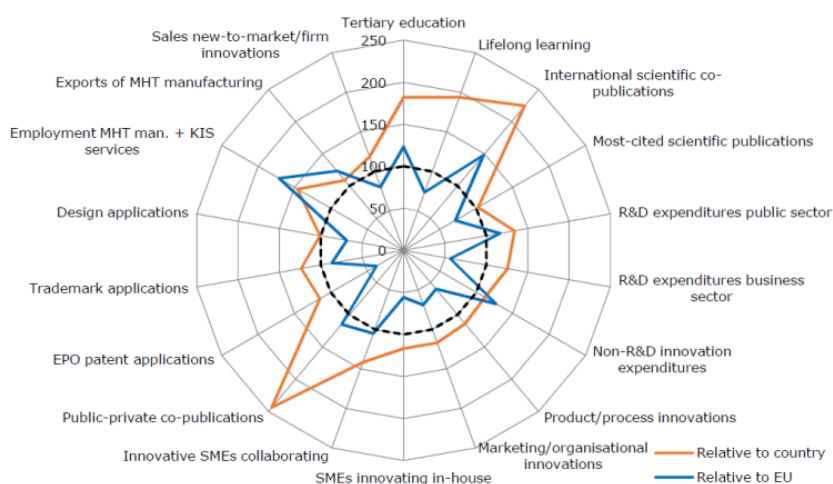
Slovak Republic also belongs to the group of moderate innovators. Summary innovation index is 67.8. Employment and sales are the strongest innovation dimensions. Finance and support and innovator are the weakest innovation dimensions. Over time, performance has declined relative to that of the EU in 2010 – Fig. 1.

**Fig. 1: Innovation index 2017 – Slovak Republic**



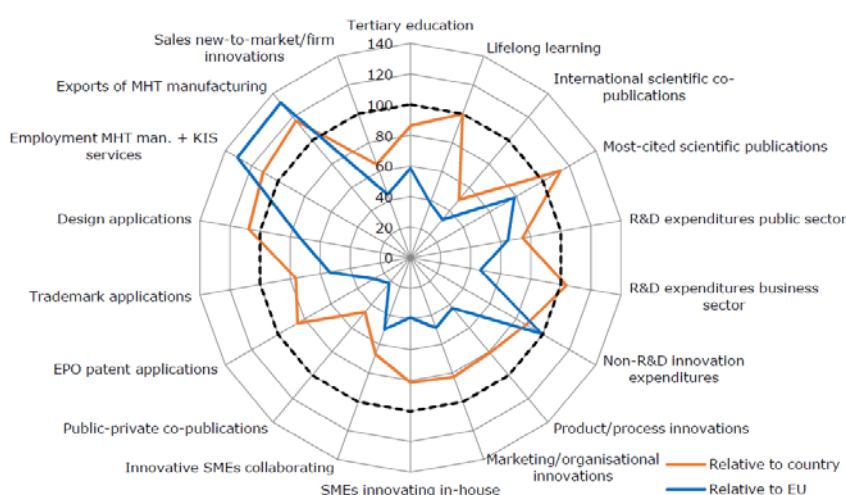
Source: European Innovation Scoreboard

By regions NUTS II, Bratislavský kraj is a Strong Innovator, and innovation performance has increased significantly over time. RII 2017 relative to SK (Slovakia) is 151.7. The radar graph (fig. 2) shows relative strengths compared to Slovakia (red line) and the EU (blue line), highlighting relative strengths (e.g. International scientific co-publications) and weaknesses (e.g. EPO patent applications).

**Fig. 2: Relative strengths of Bratislavský kraj**

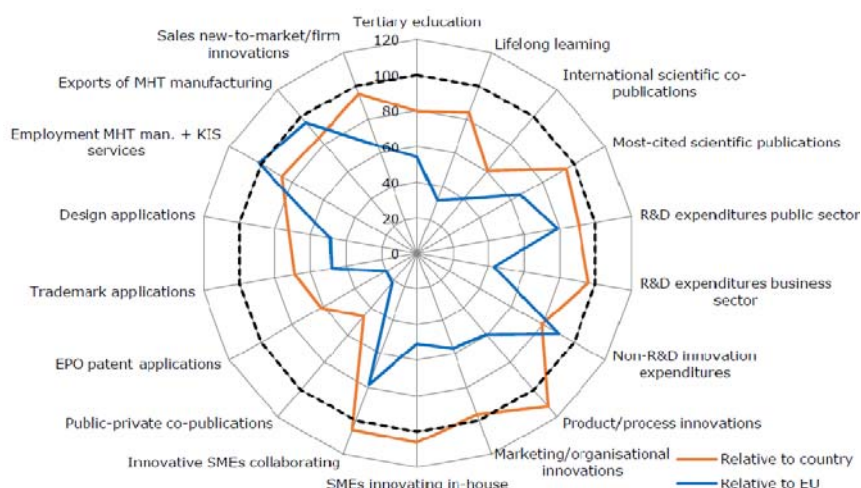
Source: *Regional Innovation Scoreboard 2017*

Západné Slovensko is a Moderate Innovator, and innovation performance has increased over time. RII 2017 relative to SK is 101.4. The radar graph<sup>3</sup> shows relative strengths compared to Slovakia (red line) and the EU (blue line), highlighting relative strengths (e.g. Employment in MHT manufacturing and KIS services) and weaknesses (e.g. Sales of new innovations).

**Fig. 3: Relative strengths of Západné Slovensko**

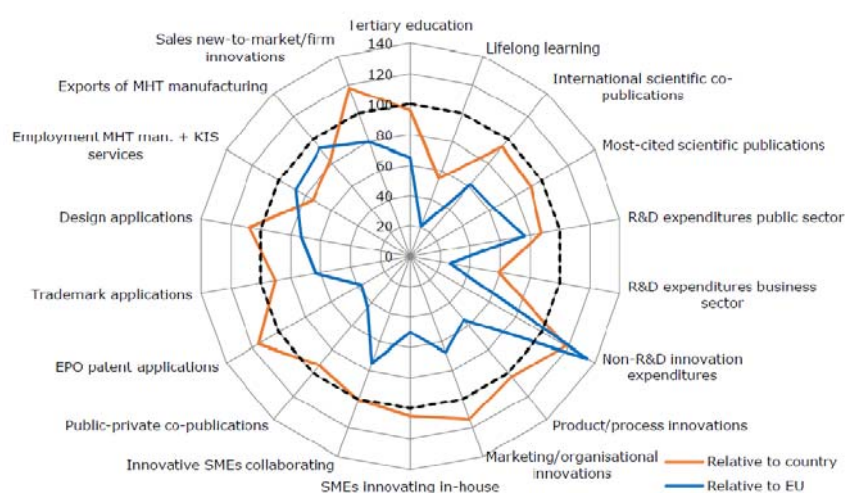
Source: *Regional Innovation Scoreboard 2017*

Stredné Slovensko is a Moderate Innovator, an innovation performance has remained stable over time. RII 2017 relative to SK is 96.3. The radar graph<sup>4</sup> shows relative strengths compared to Slovakia (red line) and the EU (blue line), highlighting relative strengths (e.g. Employment in MHT manufacturing and KIS services) and weaknesses (e.g. EPO patent applications).

**Fig. 4: Relative strengths of Stredné Slovensko**

Source: Regional Innovation Scoreboard 2017

Východné Slovensko is a Moderate + Innovator, and innovation performance has increased significantly over time. RII 2017 relative to SK is 104.8. The radar graph<sup>5</sup> shows relative strengths compared to Slovakia (red line) and the EU (blue line), highlighting relative strengths (e.g. Non-R&D innovation expenditures) and weaknesses (e.g. Lifelong learning).

**Fig. 5: Relative strengths of Východné Slovensko**

Source: Regional Innovation Scoreboard 2017

### 3.3 Regional Competitive Index

Table 1 shows Regional competitive index for regions NUTS II and score for sub-indexes.

**Tab. 1: RCI 2017**

Region	RCI	Basic dimension	Efficiency dimension	Innovation dimension
Bratislavský kraj	66.4	44.9	74.2	65.3
Západné Slovensko	33.8	36.8	51.7	29.1
Stredné Slovensko	29.7	31.7	47.1	32.2
Východné Slovensko	24.0	27.4	42.0	28.8

Source: RCI – scorecards

RCI and sub-indexes can range from 0 to 100. Bratislavský kraj has the best score in RCI and also in all sub-indexes. Západné Slovensko has second place in RCI, Basic dimension and Efficiency dimension, but in Innovation dimension is Stredné Slovensko better. Then Stredné Slovensko follows Západné Slovensko in all other values. Východné Slovensko has the weakest results in all indicators. Regions can use RCI scores to compare

themselves to any other regions in the EU or to the EU average. It can also be helpful to compare a region with regions at a similar level of economic development. For example, a less-developed region may have an overall low score but outperform regions with similar GDP per capita. Conversely, a highly developed region may have a high absolute score but still fall short of what is typical for comparably wealthy regions.

Region with similar level of economic development for Bratislavský kraj is, for example, Salzburg in Austria with RCI 85.3 and Hamburg in Germany with RCI 63.8. Bratislavský kraj has better score by 2.6 compared to Hamburg, but worse score compared to Salzburg by 18.9. Region with similar level of economic development for Západné Slovensko is Moravskoslezsko with RCI 43.6 and Jihozápad both in Czech republic with RCI 43.9. Západné Slovensko has a worse score than both of these regions by at least 9.8. Region with similar level of economic development for Stredné Slovensko is, for example, Severozápad in Czech republic with RCI 35.5 and Calabria with RCI 16.3. Stredné Slovensko has higher score by 13.4 compared to Calabria, but worse score compared to Severozápad by 3.8. Region with similar level of economic development for Východné Slovensko is Opolske with RCI 31.0 and Swietokryskie both in Poland with RCI 34.2. Východné Slovensko has a worse score than both of these regions by at least 7.0.

### 3.4 The relationship between innovation and competitiveness

We tested the link between innovation and competitiveness based on the Regional Innovation index and Regional Competitiveness index. Between the indicators that synthesize innovation and competitiveness is correlation coefficient being 0.954 for Slovak Republic, for Bratislavsky kraj is 0.906, for Západné Slovensko is 0.928, for Stredné Slovensko is 0.908 and Východné Slovensko has coefficient 0.815. This result means strong direct linear correlation. The existence of a linear correlation between variables does not necessarily mean and cause dependency. However, on the basis of the outcome, we assume that innovation increases the competitiveness of regions.

## 4. Conclusion

The growth and development of the innovative performance of the economy is largely determined by the implementation of a systematic and comprehensive innovation policy that affects the innovation performance and competitiveness of the whole economy. Bratislavský kraj is a Strong Innovator, Západné Slovensko is a Moderate Innovator, Stredné Slovensko is a Moderate Innovator, Východné Slovensko is a Moderate + Innovator. Each region has its strengths and weaknesses as shown in the graphs above. The region of Bratislavský kraj has the best results in both innovation and competitiveness. The region Východné Slovensko has the lowest competitiveness score.

Paper shows that the correlation, between the Regional Competitiveness Index and the Innovation performance, is very strong, the correlation coefficient being 0.954 for Slovak Republic, for Bratislavsky kraj is 0.906, for Západné Slovensko is 0.928, for Stredné Slovensko is 0,908 and Východné Slovensko has coefficient 0.815.

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