

INNOVATION PERFORMANCE AND INNOVATION POTENTIAL OF REGIONS AND ITS MEASUREMENT

Erika Ľapinová – Martin Varga – Beata Šarkanová

Abstract

The paper deals with intra-regional and the inter-regional disparities in Slovakia and Czech Republic. We make a comparison based on indicators of economic performance, innovation capacity, innovation potential and on indicators of income poverty. In particular, we focus on the relationship between these dimensions of the regional level and regional development.

Our paper emphasises wider social, spatial and cultural aspects of the issue and possibilities of the state and regional policies and strategies in this field. Geographically we localize our research into the Czech and Slovak regions (NUTS II).

The theoretical part of the paper summarizes the theory dealing with the development of regional innovation factors of innovation performance and the application of innovation in regional conditions.

In the analytical part we realize comparative analysis of national and inter-regional differences in innovation potential (using selected indicators of innovative assumptions so called "enablers"). For comparative analysis of the Czech Republic and Slovakia we use selected indicators at NUTS II level. A comparative analysis of innovation potential of Slovakia we process at NUTS III level.

Key words: innovation potential, inter-regional comparison, intra-regional comparison, differences

JEL Code: P25 Urban, Rural, and Regional Economics, O31 Innovation and Invention: Processes and Incentives

Introduction

Technological development, innovation and creative skills are a fundamental determinant of economic prosperity in a globalizing, knowledge-based economy. Research work on innovation systems testify that the key level of innovative abilities, the level of the region. For each country, which is characterized by different, often significantly diverging regional

economy rule, decisive, crucial factors in national prosperity are the relationships between economic actors, organizations and institutions at regional and local level, involving the horizontal and vertical relationships.

The issue of innovation is often associated with the business environment and to phase alone transfer of innovation into practice. Our intention is to highlight the much broader concept of innovation issues - particularly on a broad social and macroeconomic context - which form the criteria and conditions for promoting regional innovation. Economic success in today's competitive environment, however depends also on national policy, not only innovative, but broader public policy, and equally on the social qualities of the regions, on the creativity and talents of their citizens, and on support these regional factors.

In our contribution we want to pay particular attention to wider social, spatial and especially social - human, cultural aspects of the issue and the possibilities of the state and regional policies and strategies in this field. Geographically we localize our research into the Czech and Slovak regions (NUTS II and III).

1 Innovations in the theories of regional development and economic and political implications

Regional economies can be according Šipikal, Pisar and Uramová (2010) understood as the places of collective technological learning. Innovations are observed mainly in strongly concentrated regions in term of human capital or institutional density, using the advantage of agglomeration effects. Strong interaction between learning, social capital and agglomeration effects leads experts to paying more attention to the regional level of innovation, resulting in concepts such as industrial districts, innovative milieu and more recently regional innovation systems or learning regions. These concepts try to identify the precondition for economic growth of regions, basically based on innovation and learning. These concepts are not developed to complex theories, but identify some key issues related to innovation activities in the region. Despite some ambiguity in the theories, all concepts have shown the increasing importance of innovation governance on regional level.

Mechanisms of regional convergence and divergence are well described, although there several other factors exist such as national factor of regional dependence or border factor that work as obstacles of spatial spillovers. In a light of the recent theoretical research, regional growth depends according Hudec – Urbančíková (2010) on a number of external and internal qualitative attributes, formal and informal institutions, regional innovation system,

knowledge base, social capital, innovation governance, etc. The attributes can be summarised for both regions and subsequently will be defined problem areas, using Regional innovation systems indicators (Todtling, Trippel 2004, Cooke 2004, Asheim et al. 2007).

Despite a number of regional development concepts Blažek (2012) distinguishes two major directions:

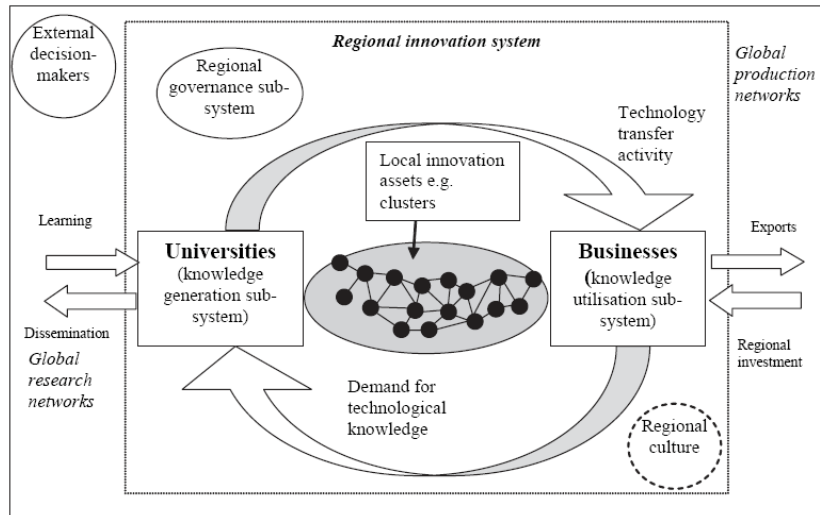
- institutional theories (theory of production districts, clusters theory, theory of learning regions, Triple Helix theory, theory of regional innovation systems). The first direction of the institutional approach considers as the main source of competitiveness a complex of regionally specific, mostly soft factors - the key importance is attributed to these factors and a horizontal link.
- theories laying emphasis on vertical links between companies (the theory of global commodity chain (GCC), the theory of global value chains (GVC), the theory of global production networks).

Modern institutional access to other concepts such as the new regional geography and cultural geography emphasize the importance of spatial aspects and the social environment which have influence on the actors of the innovation process and their actions. These include the theory of regional innovation systems (RIS) from the early 90s of the 20th century, which author is a British geographer P. Cooke. It is based on the production, recovery and absorbing of knowledge. The human factor is a key component of it. It was inspired by the theory of national innovation system of Freeman (1987) and Lundvall (1992).

The innovation system covers schools, universities, research institutions (education and science system), industrial enterprises (economic system), the politic-administrative and intermediary authorities (political system) as well as the formal and informal networks of the institutional actors (compare with “Triple-Helix” relationship of university–industry–government). As a “hybrid system” (Kuhlmann, 1999)¹ it represents a section of the society, through education, or through entrepreneurial innovation activities and their socio-economic effects. The innovation system has a decisive influence on the modernisation processes of a society. See also Blažek a Žížalová (2010), Čapková a kol. (2011), Hudec a Urbančíková (2010).

¹ According Kuhlmann (1999, 2001) “the innovation system of a society encompasses, according to a meanwhile widely accepted understanding, the “biotope” of all those institutions which are engaged in scientific research, the accumulation and diffusion of knowledge, which educate and train the working population, develop technology, produce innovative products and processes, and distribute them; to this belong the relevant regulative bodies (standards, norms, laws), as well as the state investments in appropriate infrastructures.

Fig. 1: An ideal-type Regional Innovation System



Source: Schrempp et al., 2013

The political function of RSI approach is the third important dimension - one can even say that RSI is both a theoretical concept as well as a policy objective (Schrempp et al., 2013). It is the policy level at which the national system exerts huge influence over the regional systems. One major example of the application of the third dimension of RSI approach can be found in the structural policy of the European Union.

One major contribution of the RSI concept to the innovation system debates is the idea that there is no single one-size-fits-all policy. Policy instruments should always be context-specific and need to be adapted to the regional circumstances. Policy intervention in the RSI context mostly targets system failures, trying to facilitate the effective functioning of complex interactions between the various actors in the regional system. Policies at the regional level may target the regional set-up at various points, for instance they may affect all actors of a region or just firms or even single persons. The measures implemented can help companies to overcome a shortage of competencies; they can introduce hard institutions such as laws, or tackle soft institutions such as the willingness to take risks. They may even intervene at the network level, helping to overcome lock-in effects (e.g. where two partners have been working with each other in stagnation to the exclusion of others), or helping to initiate more collaborative activities in order to assist companies in finding sources of complementary knowledge.

Criticisms of the RSI approach's focus on risk of normative thinking and the danger of overestimating the capabilities of regional innovation policies. When a normative view is

adopted, there is a danger that one may draw implications from stylised constructs, often drawn from empirical case studies, and try to reproduce them. This line of reasoning would ignore the importance of bottom-up processes, initial conditions and the context- and time-specific notion of regional systems. Policy-makers may be tempted by the RSI approach to act in regard of these specific features, expecting that they can act effectively independent of the context and overestimating the role of innovation for regional development (Schrempf et al., 2013).

2 Comparison of regional innovation efficiency based on selected indicators of innovation potential at NUTS level II and III

In the analytical part of the work we pay attention to the innovation potential of selected indicators of Slovak and Czech regions. We focus on the so-called innovation potential of the regions formed by the human factor (level of education and research potential represented by people with tertiary education by ISCED), on indicators of employment in R & D, including in particular the proportion of researchers. The second component is the financing of innovation, which compares indicators of expenditure on R and D. In both countries we can see significant inter-regional disparities, measured on the basis of the above indicators.

In the article we discuss the methodology for measuring innovation potential, assumptions and conditions for the development of innovations at national economic level and especially in regional scale (at NUTS II and NUTS III). For comparison of the socio-economic level of regions we follow the indicators of economic performance: GDP per capita in nominal Euro and in PPS and the risk of poverty. In the analytical part of the paper we use the method of comparative analysis for the purpose of comparing regional innovation potential of the regions. Based on its results we propose economic policy recommendations for improving the current situation.

Indicators used for the comparison of the innovation potential in our work include imputes of innovation. They relate knowledge investment as imputes to performance and economic output throughout the innovation cycle. The indicator “excellence in science and technology” takes into consideration the quality of scientific production as well as technological development. The innovation output indicator on the other hand covers technological innovations, skills in knowledge-intensive activities, the competitiveness of knowledge-intensive goods and services, and the innovativeness of fast-growing enterprises, focusing on innovation output. The indicator on knowledge-intensity of the economy focuses

on the economy's sectoral composition and specialisation and shows the evolution of the weight of knowledge-intensive sectors and products. The categories of innovation output indicators and knowledge-intensity indicators are out of our interest in this paper. They measure innovation performance and wider economic and social impacts and consequences of innovation at regional level.

Table 1 lists selected indicators of innovation capacity and innovation potential of regions: the research and development expenditures calculated per capita (first column) and as a percentage of GDP (second column), followed by the percentage of people with tertiary education by ISCED and / or employed in science and technology of the total economically active population (third column). The last two columns show the percentages of employees in research and development, particularly researchers as % of economically active population (columns 4 and 5).

Tab. 1: Selected indicators of innovation potential in Slovak and Czech regions (NUTS II level) in the year 2013

GEO/UNIT	Total intramural R&D expenditure Euro per inhabitant	Total intramural R&D expenditure in percentage of gross domestic product (GDP)	Persons with tertiary education (ISCED) and/or employed in science and technology (% of active population)	Total R&D personnel (% of active population)	of witch researchers represent
European Union (28 countries)	542	2,03	43,6	1,72	1,12
Euro area (19 countries)	620,2	2,11		1,84	1,14
Czech Republic	285	1,91	36,0	1,75	0,97
Prague	803,8	2,59	58,1	5,07	3,01
Central Bohemia	288,7	2,15	36,3	1,01	0,52
SouthWest	212,7	1,6	33,0	1,24	0,65
NorthWest	40,7	0,36	29,6	0,36	0,16
NorthEast	176,9	1,45	33,2	1,29	0,61
SouthEast	401,4	2,84	35,2	2,21	1,27
Central Moravia	159	1,32	28,7	1,26	0,68
Silesia	148,8	1,2	31,8	1,06	0,59
Slovakia	112,9	0,83	31,2	1,02	0,9
Bratislava Region	566,2	1,67	54,7	3,98	3,52
Western Slovakia	43,9	0,34	27,4	0,51	0,44
Middle Slovakia	70,5	0,65	29,3	0,67	0,58
Eastern Slovakia	54,8	0,59	27,0	0,67	0,6

Source: processed according data from the database Eurostat

According to the above data in the first column represent the average expenditure on research and development per capita in Slovakia 20% of EU 28 average expenditure. We compare this average with Czech Republic with more than doubled volume of expenditure also (national average of CZ is 50% of EU 28 average). These amounts of expenditure represent 0.83% of the Slovak Republic GDP and in the Czech Republic 1.91% of GDP. Another category of innovation potential indicators is category of human resources in science

and research. These are people with tertiary education by ISCED and / or employees in science and technology, and they are presented as a percentage of the active population. In Slovakia it is less than a third of the active population and in the Czech Republic it is 36%, (which is 71.5% respectively 82% of the EU 28 average value). The last two columns of the table 1 talk about the number of workers in research and development. Share of researchers in the total number of economically active population in the Czech Republic and in Slovakia are under the EU 28 average, again with a slight domination of Czech Republic.

Tab. 2: Selected indicators of economic performance and social situation in Slovak and Czech regions (NUTS II level) in the year 2013

GEO/UNIT	Gross domestic product (GDP) at current market prices by NUTS 2 regions						People at risk of poverty or social exclusion
	in Euro per inhabitant	in Euro per inhabitant as percentage of the EU average	Purchasing Power Standard per inhabitant	in Purchasing Power Standards per inhabitant as percentage of the EU average	in Million euro	in Million PPS (purchasing power standard)	
European Union (28 countries)	26 700	100	26 700	100	13 550 560	13 550 560	5,4%
Euro area (19 countries)	29 500	110	28 600	107	9 931 800	9 647 395	5,5%
Czech Republic	14 900	56	22 200	83	156 933	233 130	14,6%
Prague	31 100	116	46 200	173	38 689	57 473	10,2%
Central Bohemia	13 400	50	19 900	74	17 335	25 752	9,9%
SouthWest	13 300	50	19 800	74	16 091	23 904	11,5%
NorthWest	11 300	42	16 700	63	12 705	18 873	25,8%
NorthEast	12 200	46	18 100	68	18 362	27 277	13,8%
SouthEast	14 100	53	21 000	79	23 755	35 289	11,1%
Central Moravia	12 100	45	17 900	67	14 776	21 951	14,7%
Silesia	12 400	47	18 500	69	15 221	22 611	22,9%
Slovakia	13 600	51	20 200	76	73 835	109 525	19,8%
Bratislava Region	33 700	126	50 000	187	20 729	30 749	19,6%
Western Slovakia	12 800	48	19 000	71	23 560	34 949	17,7%
Middle Slovakia	10 800	40	16 000	60	14 523	21 543	20,0%
Eastern Slovakia	9 300	35	13 800	52	15 022	22 283	21,9%

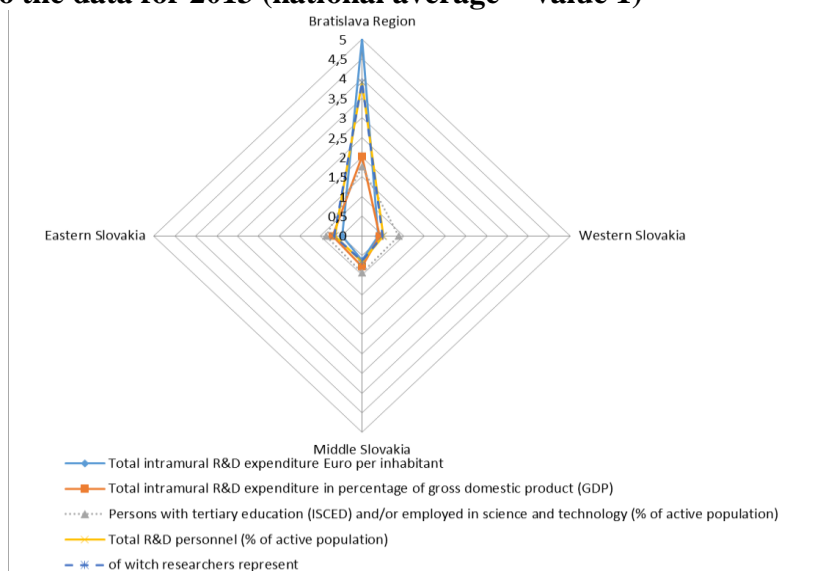
Source: processed according data from the database Eurostat

Table 2 summarizes the basic indicators of economic performance and social situation, in order to compare the above regions of the Czech Republic and Slovakia at NUTS II level. It is an indicator of gross domestic product per capita in Euro and in PPS. As an indicator of social status of the population we selected the proportion of the population at risk of poverty or social exclusion.

Bratislava and Prague regions show above-average values in comparison with the rest of the country. Even other regions are not homogeneous, neither in terms of economic performance, nor in terms of innovation potential and the differences can be observed between regions.

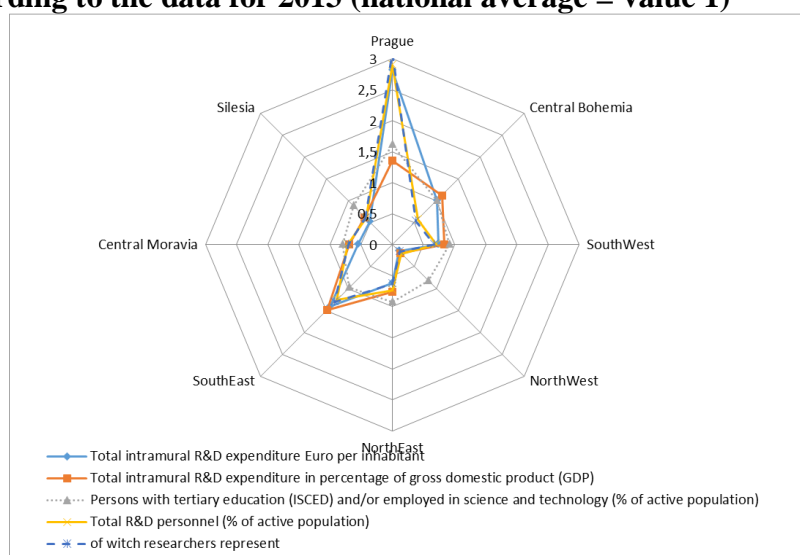
In Figures 2 and 3 we present further inter-comparison of the indicators showed above, in Table 1. Our goal is to detect discrepancies in innovative capacity of NUTS II regions Slovakia and the Czech Republic compared to the national average, which represent a value 1.

Fig. 2: Inter-regional differences in indicators of regional potential of Slovakia at NUTS II according to the data for 2013 (national average = value 1)



Source: processed according table 1 based on data from the Eurostat database

Fig. 3: Inter-regional differences in indicators of regional potential of Czech Republic at NUTS II according to the data for 2013 (national average = value 1)



Source: processed according table 1 based on data from the Eurostat database

Regional indicators for the Bratislava region compared to the rest of Slovakia and the region of Prague in comparison with the rest of the Czech Republic are several times higher. Bratislava region from the rest of Slovakia differs in spending on research and development

per capita 5 times, in the expenditures in % of regional GDP two times. R & D employment is almost 4 times higher as in the rest of Slovakia. The most significant negative deviations from the national average of the Slovak in all indicators has western Slovakia. Inter-regional disparities between rest regions in the country are less heterogeneous. The graphs show most significant regional disparities in the amount of expenditure on R & D per capita and in the share of employees of R and D and researchers as %-age of economically active population, while the spatially homogeneous is an indicator of population with tertiary education and / or employees in science and technology. Even more significant are the variations of these indicators in interregional comparison at NUTS III level, which we present in Table 3 and Figure 4.

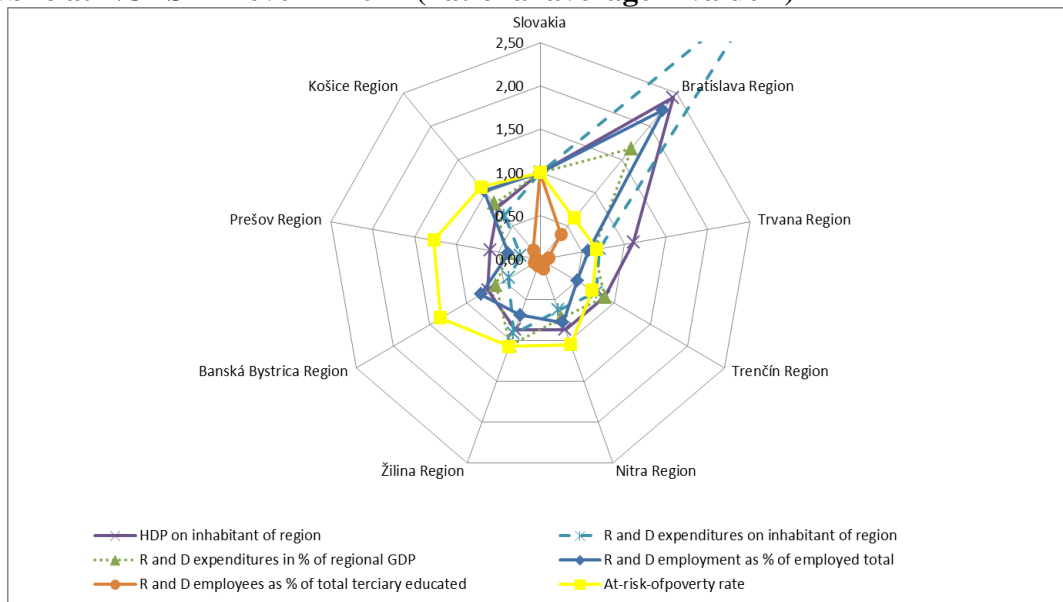
Tab. 3: Selected indicators of innovation potential in Slovak NUTS III regions in the years 2010 and 2014

	Year	Employees (average number)	Evidence number of employees	R and D employment as % of employed total	R and D expenditures in thousand Euro	R and D expenditures in % of regional GDP	HDP on inhabitant of region	R and D expenditures on inhabitant of region	Tertiary educated (ISCED 5A)	R and D employees as % of total tertiary educated	At-risk-ofpoverty rate
Slovakia	2010	2 151 930	28 128	1,31%	416 369	0,62%	12 463,03	76,66	71 092	39,57%	12,00%
	2014	2 204 646	28 825	1,31%	669 632	0,89%	13 944,44	123,58	61 108	47,17%	12,60%
Bratislava Region	2010	437 432	13 839	3,16%	208 160	1,10%	30 263,62	332,61	25 136	55,06%	5,10%
	2014	440 820	12 925	2,93%	311 169	1,48%	33 894,98	500,45	23 120	55,90%	7,80%
Trvana Region	2010	234 057	1 578	0,67%	27 996	0,36%	13 643,53	49,78	6 842	23,06%	6,70%
	2014	236 019	1 774	0,75%	48 742	0,56%	15 476,33	87,33	5 995	29,59%	8,50%
Trenčín Region	2010	227 263	1 535	0,68%	47 520	0,71%	11 101,50	79,33	3 962	38,74%	10,10%
	2014	226 626	1 489	0,66%	55 639	0,78%	12 130,51	94,01	3 123	47,68%	8,90%
Nitra Region	2010	253 782	1 865	0,73%	18 776	0,26%	10 214,23	26,63	8 510	21,92%	13,20%
	2014	255 535	2 602	1,02%	52 769	0,64%	12 026,97	76,95	7 115	36,57%	13,20%
Žilina Region	2010	253 642	2 482	0,98%	31 044	0,41%	10 787,83	44,48	6 401	38,78%	9,60%
	2014	290 256	2 612	0,90%	77 972	0,93%	12 079,35	112,93	5 263	49,63%	13,50%
Banská Bystrica Region	2010	221 676	2 018	0,91%	18 775	0,32%	9 105,39	28,76	6 675	30,23%	16,90%
	2014	217 045	2 287	1,05%	34 815	0,53%	9 962,11	53,06	4 843	47,22%	17,10%
Prešov Region	2010	240 242	1 090	0,45%	11 589	0,20%	7 140,10	14,33	4 922	22,15%	18,70%
	2014	250 745	1 261	0,50%	23 744	0,35%	8 364,18	28,98	3 554	35,48%	16,00%
Košice Region	2010	283 838	3 721	1,31%	52 508	0,68%	9 846,69	67,38	8 644	43,05%	12,70%
	2014	287 600	3 875	1,35%	64 783	0,75%	10 929,87	81,47	8 095	47,87%	13,70%

Source: processed according data from Regional Statistics Database of Statistical Office of the Slovak Republic

Bratislava Region exceeds the value of spending on research and development per capita Slovak average 4.34 times (in 2010), respectively 4.05 times in 2014. The most significant inter-regional differences were recorded in the amount of spending on R and D per capita. Among the regions with poorest innovations potential in the eastern and central Slovakia are regions Prešov and Banská Bystrica.

Fig. 4: Inter-regional differences in indicators of regional potential of the Slovak Republic at NUTS III level in 2014 (national average = value 1)



Source: processed according table 3, based on data from Regional Statistics Database of Statistical Office of the Slovak Republic

As regards the economic and political implications of mentioned theoretical approaches, it is clear that even in the economic and political, particularly in innovation policy is now mainly strengthened the importance of regional aspect (Šipikal, Pisár, Uramová, 2010). Implementation of innovative policies at regional level may show a different result in different types of regions. Degree of autonomy and political power of regions varies and depends on the structure of the national government. Regions with their own political system, decision-making and the ability to legitimately promote "regional interests" of regionalization can get much more than regions with a lower level of autonomy. Regional innovation policies is often hindered. Especially in regions with low innovation capacity is the lack of cooperation mechanisms that interconnect the supply and demand and with less suitable conditions for exploiting synergies. The aim of regional innovation policy is precisely overcome defragmentation of innovation system in the form of networks and clusters, with strong links that support the development of innovation, which is in regions lagging behind in many cases very difficult. At the same time the regional level is crucial in terms of innovation because for innovation and networking is of critical importance a spatial proximity.

Support for innovation is crucial for long-term strategic objectives of the EU and national countries too and it requires: 1. comprehensive system approach to developing the necessary pro-innovation environment, relevant to the development of innovation policy, the

specification an efficient use of their instruments, 2. coherence and consistency with other policies of the government and also building of effective institutional and legislative framework; 3. cross-cutting nature of innovation requires the cooperation of all stakeholders (stakeholders). The need for RIS strategy and cross-cutting approach to innovation requires increasing emphasis on the regional dimension of innovation policy (Šipikal, Pisár, Uramová, 2010).

Conclusion

The paper is devoted to the issue of innovation at regional level. Innovation we understand not only in narrow corporate sense, but in the broad economic, political and social context. In the theoretical part we pay attention to the innovation system and regional innovation systems. They present innovation issues in systematic way, as complexity of actors and relations between them, making focus on the distinction between the processes of innovation and application in regional practise. Very important part of these innovative systems is their institutional and political context. This systematic approach to the issue of innovation is recommended as the optimal to promote and increase regional innovation potential and regional innovation performance of Slovakia and its regions.

Based on existing studies on the issue of regional innovation and its differences in Slovakia and in our neighbouring country, we can say that large regional differences in innovation performance are directly related to the right degree of regionalization of innovation policy. Slovakia is in terms of innovation support one of the most centralized countries in Europe. On the other hand, in some countries it can be shown that decentralization alone is not enough to guarantee a high level of innovation potential and performance.

Experts point out broken horizontal links between RIS actors but also non-functional vertical links between national and regional innovation systems, which are essential for the initiative "bottom-up" in response to specific regional circumstances. We point out the crucial importance of non-codified knowledge and relationships between actors, particularly in the less developed regions and locally specific approach to the issue of innovation. On the basis of these findings about the current state of innovation in Slovakia we propose "RIS" approach in theoretical and economic-political level as the optimal solution for the existing problems and shortcomings of innovation potential and innovation performance of Slovakia.

In the analytical part of the work, using the tools of comparative analysis of the innovation potential of our two countries and their interregional and intraregional differences, we point out initial assumptions for starting process of support innovation potential and innovation performance. This process depends on the quality and quantity of human resources and on financing of R and D. They are necessary but not sufficient enablers of growth and development of the innovation capacity of Slovakia and Czech Republic at the national and regional levels.

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Contact

Erika Ľapinová

Matej Bel University, Faculty of Economics, Tajovského 10, 975 90 Banská Bystrica
erika.lapinova@umb.sk

Martin Varga

Matej Bel University, Faculty of Economics, Tajovského 10, 975 90 Banská Bystrica
martin.varga@umb.sk

Beata Šarkanová

Matej Bel University, Faculty of Economics, Tajovského 10, 975 90 Banská Bystrica
beata.sarkanova@umb.sk