Building of advanced innovation system: the story of the South Moravian Region

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Abstract

The current economic theory puts strong emphasis on innovation which has become a crucial factor for competitiveness of firms, countries as well as regions. This fact is also reflected in public policies. Countries of Central and Eastern Europe have gone through big changes in their political and economic regimes. Their starting point was not favourable at the end of the 20th century. Traditional branches (textile, food and heavy industry) prevailed in their sector structure, research infrastructure was outdated and the whole society was affected by many years of international isolation. Research tradition, availability of capital, skilled human resources, flexibility, and enlightenment of political representation have become the key preconditions of future success. The aim of the paper is to discuss preconditions and past development of the South Moravian Region (Czech Republic) for transformation into successful regional innovation systems. The Region is considered synonymous with a successful regional innovation system now. The attention is paid to its socio-economic features, research activity, elements of its innovation system and innovation policy. The analysis showed that the region represents a centre of research, development, education and innovation. The former symbol of textile and machinery industry has transformed into a cradle of ICT, biotechnology and medical research that has world class. Innovation policy plays an important role in improvement of innovation capability of the region and it is well-known for its pioneering implementation of various innovation tools.

Key words: Innovation system, region, knowledge base, innovation policy, research and development.

JEL Classification: O31, R11, R58

1 Introduction

Introducing and dissemination of innovations represents an important prerequisite for economic development and long-term competitiveness of regions. At a theoretical level, the territorial significance of innovation is dealt with by national and regional innovation systems (Cooke, Uranga and Etxebarria, 1997; Lundvall at al., 2002). We can define the innovation system as a group of players in the private and public spheres whose activities and interactions influence the development and diffusion of innovations in a particular territory. The basic idea of this approach is that innovations do not arise in isolated firms, but the innovation activity depends on interactions with other players (innovative companies, knowledge institutions, intermediaries, capital providers, etc.) and environment in which they operate (e.g. Fischer, 2001).

It is generally accepted that regions are the key level, at which innovation policy should be implemented. Regionalization of innovation policy is broadly discussed in scientific literature (e.g. Fritsch and Stephan, 2005). Individual regions differ considerably in their ability to use innovation as a source of their development. At the same time, geographical (spatial) proximity

facilitates the creation, acquisition, collection and use of knowledge thanks to the existence of both formal and informal relations and networks linking the participants involved in the innovation processes (Boschma, 2005). Geographical proximity also strengthens other types of proximity (e.g. cognitive, organizational, social). For these reasons, innovation policy should be tailored to specific needs and characteristics of specific regions and it is not suitable to design a universal innovation policy for all regions (e.g. Prokop and Stejskal, 2017).

2 Aim and methodology

It is a well-known fact that during the period of transition after the fall of communism, regions in Central Europe encountered a range of processes and forces that have reshaped their structure and functions (Hlaváček, Raška and Balej, 2016). The aim of the paper is to discuss preconditions and past development of the South Moravian Region for transformation into successful regional innovation system. This region is perceived as a successful innovation leader in Central Europe and its ambition is to join the leaders in the European and world context. We believe that analysis of its development and innovation policy can be inspiring for other regions in Central Europe.

Our research is influenced by a large strand of literature dealing with innovation system concepts. The concept of innovation systems serves as an analytical framework for analysis of innovation performance of regions and countries. This tool can also be used for design and adjustment of innovation policy. This concept emphasizes that each region has its own unique features, history, and prerequisites for the innovation development. The main attention is paid to elements of the South Moravian innovation system in our paper. For this purpose, we use stakeholder analysis.

3 Regional innovation system and innovation policy

The broader concept of innovation systems encompasses all components and aspects of the economic structure and the institutional arrangement affecting learning, as well as exploration and discoveries. A regional innovation system consists of two basic subsystems (Autio, 1998; Tödtling and Trippl, 2005):
- knowledge generation subsystem (supply side) and
- knowledge application & exploitation subsystem (demand side).
- Because there are some barriers between the two subsystems, specialized organizations for their linking are set up:
- intermediary organizations.

Both of the main subsystems are mutually influenced by each other and they are connected with other players in global, national and other regional innovation systems. The first subsystem involves universities, research institutes, and other organizations generating new knowledge. The second one involves innovative companies, their suppliers, customers, and competitors. In fact we cannot clearly define the border between these two subsystems, because they are overlapped. It means that enterprises can generate new knowledge and research organizations can apply new knowledge into practice. Innovative companies can be classified into several groups. We distinguish among five groups in our research: multinational companies, traditional domestic companies, well-established domestic companies, gazelles, and spin-off firms.

The main tasks of intermediary organizations are to create linkages between the two main subsystems and to eliminate barriers between them. For example, innovation centres, innovation agencies, technology transfer centres, and development agencies belong to this

group of innovation players (Edler and Yeow, 2016). These organizations often provide public aid to innovative companies (Mynarzová and Štverková, 2015).

Successful regional innovation systems have several common features. Scientific literature often emphasizes economic activity, research activity and infrastructure, and political consciousness (Skokan, 2005; Technopolicy Network, 2007). Political consciousness and regional innovation policy are very important in less developed regions, because they can reinforce the economic transformation (Košta and Flaška, 2015). Innovation policy can be defined as a set of measures of public organizations that influence innovation processes in a certain territory. The main objective of this policy is to create a favourable innovation environment and enhance innovation performance. Innovation policy can be viewed from two perspectives – a top-down innovation policy links directly with national interests and adopts a more macro, inter-regional perspective; a bottom-up innovation policy tries to accommodate national conditions into their policy frameworks (Howells, 2005). At the regional level, the planned steps of policy makers are defined in regional innovation strategies (Žítek and Klímová, 2015).

4 Development of innovations in the South Moravian Region
This section deals with the development of regional innovation system in the South Moravian Region in the Czech Republic. It also analyses way of the regional innovation policy implementation.

4.1 Socio-economic characteristics
The South Moravian Region (SMR) lies in the southeast of the Czech Republic (CR) on the borders with Slovakia and Austria. It consists of seven districts and 673 municipalities. Its capital city is Brno, the second biggest city in the Czech Republic. The region has approximately 1.2 million inhabitants (11.1% of the Czech population) and 380 thousand of them live in Brno. The second biggest city of the region is Znojmo (34 thousand inhabitants). We can find quite big differences between Brno and the remaining territory. Brno is considered to be a university city with a high level of research activity. Economic activities are concentrated in Brno too and this city is also well-known due to its trade fairs. The northern part of the region has mostly an industrial character, whereas the southern part has mostly an agricultural and viticultural character. A high share of population in the region is employed in service sector, which is generally significant for developed regions. Employment rate in services was 61.4% in 2015, which is above the Czech average (59.0%) (CSO, 2016). Gross domestic product per capita (Table 1) is slightly below the Czech average. However, the national average is distorted by an extreme value of GDP in Prague (178% of EU28 average and 204% of CR average).

Tab. 1: Gross domestic product in the South Moravian Region (in 2015)

GDP per capita in CZK (EUR)	Share in GDP of the CR (%)	Rank among 14 Czech regions	Share in CR average (CR = 100%)	Share in EU average (EU28 = 100%)
424,994 (15,580)	11.0	2	98.4	85.8

Source: CSO (2016)

The SMR has an advantageous geographical position near several European capitals (Table 2). The two most important Czech motorways (D1 and D2) intersect there. Its disadvantages are a missing motorway to Vienna and a low number of flights from the Brno Airport.

Tab. 2: Distance between Brno and selected European capitals (km)

	Bratislava	Vienna	Prague	Budapest	Ljubljana	Zagreb	Berlin	Warsaw
Brno	130	130	200	330	500	500	550	550

Source: authors' own processing

Economic development in the region was affected by the transformation of the economy from a centrally planned to a market economy. Economic transformation induces industrial restructuring and development of new industries (Rehák, Hudec and Buček, 2013). Mechanical engineering and textile industry were the most important and traditional sectors in the South Moravian Region before 1989. However, both industries faced economic decline after the Velvet Revolution. Mechanical engineering lost some important markets (Eastern Europe and Near East, in particular) and the employment rate went down. But we can observe its recovery, growth of its revenues and interest of foreign investors in it after 2000 (e.g. Chládek, 2010). Textile industry did not manage economic changes and Asian competition, therefore many big factories have been definitely closed. This sector is not in the foreground of industrial and innovation policy any more, but future prospects may be expected in the area of new textile materials and technologies.

Nowadays, mechanical engineering, electric engineering, information technologies, and life sciences are the anchor industries of the SMR and the regional innovation policy pays close attention to them. Mechanical and electric engineering have a long and strong tradition in the region and they are represented by big Czech as well as multinational companies. Brno is the world leader in the area of electron microscopes. Several producers of them are located and carry out their research there (e.g. Thermo Fisher Scientific, TESCAN, Delong Instruments). This specialization arises from the long tradition established before 1989. On the other hand, information technologies and life sciences are perceived as new high-tech sectors with promising prospects. Multinational big IT companies are attracted to the region due to the presence of highly skilled workers and quality education. Informatics is taught at two faculties in Brno (Masaryk University and Brno University of Technology). We can also find many successful Czech companies (well-established, start-ups and spin-offs) in the region.

4.2 Research and development as a source of innovation

Research and development (R&D) is one of the most important sources of innovation (Kraftová, Miháliková, 2011; Barge-Gil, A., López, A., 2014), because R&D creates new knowledge and enables companies to create radical innovations with high value added. The South Moravian Region has a high level of research activity and all fields of science and technology are represented in the region. Table 3 shows gross expenditures on research and development (GERD) as a share in gross domestic product. We can see that this region (CZ064) has the highest share of R&D expenditures in the Czech Republic (3.55%). It is caused by the presence of public universities and research institutes to some extent. The region is also successful in public tenders for grants and gets high support from the European Structural and Investment Funds. Nevertheless, it is necessary to state that the position of Prague (2.97 %) is negatively influenced by limited access to the European funds.

It is generally accepted that the private sector finances a large proportion of R&D expenditures in top-performing countries (Crespi et al., 2016). We can also assume that private expenditures on R&D are transformed into innovations and are put on the market in a relatively short time. Therefore, we focused our attention on business expenditures on R&D (BERD). Fig. 1 illustrates the development of share of BERD in GDP in the top five Czech regions. It is apparent that the South Moravian Regions was slightly below average in 2005, but its business expenditures have grown during the last ten years and they have reached the highest values in

the Czech Republic. It is quite interesting that its business expenditures are higher than in Prague (CZ010), where many multinational and domestic companies have their headquarters. It indicates that the South Moravian Region has good prerequisites for development of new innovations.

Tab. 3: Share of GERD in GDP in the Czech regions (%)

Year	CZ010	CZ020	CZ031	CZ032	CZ041	CZ042	CZ051	CZ052	CZ053	CZ063	CZ064	CZ071	CZ072	CZ080	CZ
2005	1.99	1.38	0.89	0.68	0.10	0.28	0.98	0.60	1.25	0.52	**1.45**	0.88	1.07	0.65	1.17
2015	2.97	1.89	1.16	1.98	0.23	0.40	1.71	0.95	1.47	0.85	**3.55**	1.38	1.14	1.19	1.95
Change	48.9	36.8	30.3	189.0	130.6	44.6	75.6	57.8	17.8	63.2	**144.2**	56.5	6.4	83.6	66.3

Source: authors' own calculation based on CSO (2017a, 2017b)

Fig. 1: Share of BERD in GDP in the top five Czech regions (%)
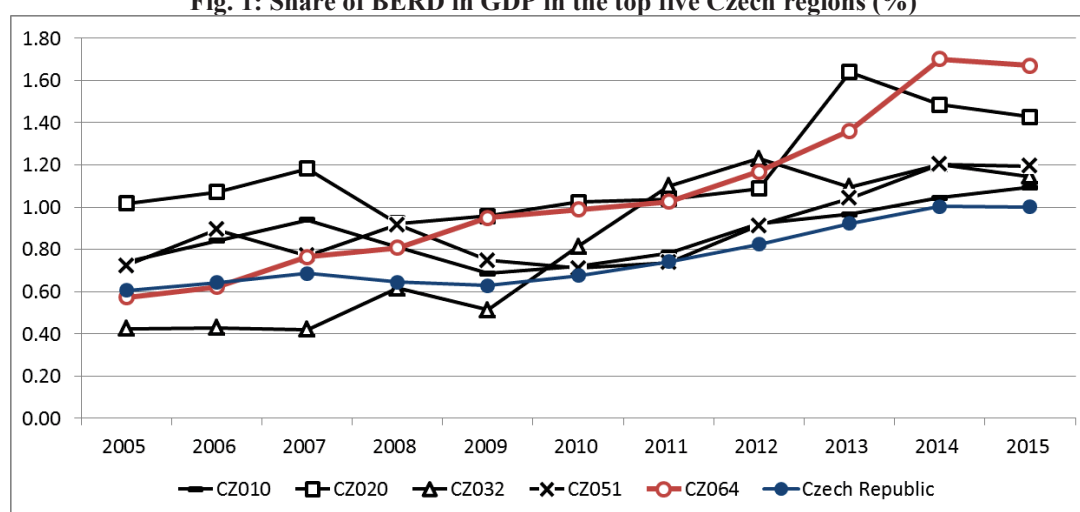
Note: CZ010 – Prague, CZ020 – Central Bohemian Region, CZ032 – Pilsen Region, CZ051 – Liberec Region, CZ064 – South Moravian Region
Source: authors' own calculation based on CSO (2017a, 2017b)

We can also find many public and private entities engaged in research and development in the region. Their brief summary is presented in section 2.3. The main weakness of the research system in the South Moravian Region, likewise the entire Czech Republic, is low cooperation between public research and private companies.

4.3 Elements of regional innovation system

As mentioned above, a regional innovation system consists of the knowledge generation subsystem and the knowledge application & exploitation subsystem. Communication and cooperation between them can be assisted by intermediary organizations.

Knowledge generation subsystem
Universities are among the entities that are parts of regional innovation systems. They carry out not only educational activities, which are perceived as their primary function, but also research activities. In other words, universities significantly contribute to presence of highly qualified labour force and they bring new knowledge and technologies (Vaceková and Soukopová, 2015). In comparison with developed European countries, the role of universities in the R&D sector in post-communist countries is different and relatively weaker. This is connected with the different organizational forms of basic and applied research in these countries before transformationin 1989 (Gál and Ptáček, 2011).There are five public

universities and one state university in the South Moravian Region. More detailed information about them is showed in Table 4. The most important of them is the Masaryk University (focused especially on natural sciences) and Brno University of Technology (specialized in engineering and technology). Both universities have large research infrastructure, are well equipped with research facilities and have technology transfer centres that are very active in licensing and spin-offs establishment. Weaknesses of the universities are quite a low international research cooperation in comparison with universities in the most developed countries and limited number of study programmes in the English language.

Tab. 4: Public and state universities in the South Moravian Region

	Number of faculties	Number of students (in 2016)	Fields of science and technology*
Masaryk University	9	31,700	natural (incl. software), medical and health, social, humanities and the arts
Brno University of Technology	8	20,000	engineering and technology, natural (software), social (economics), humanities (fine arts)
Mendel University in Brno	5	9,200	agricultural, natural, social
University of Veterinary and Pharmaceutical Sciences Brno	3	2,900	medical (pharmacy), agricultural (veterinary science)
University of Defence	2	1,500	engineering and technology, social (economics)
Janáček Academy of Music and Performing Arts in Brno	2	700	humanities (arts)

* Classification according to OECD (2015)
Source: authors' own processing based on universities websites and MEYS (2017a)

Besides the universities, R&D is carried out by public research institutes. The main founder of them is the Czech Academy of Sciences. The Academy has established more than 50 research institutes, most of them have their residences in Prague and the Central Bohemian Region. Table 5 shows the number of institutes that have residence addresses in the South Moravian Region, all of them are located in Brno. Several other institutes have established their branches in this region.

Tab. 5: Number of public research institutes in the South Moravian Region

Founder	Main field of science and technology*				
	natural	engineering and technology	agricultural	social	humanities
Czech Academy of Sciences	5	1		1	1
Ministry		1	1		
South Moravian Region					1

* Classification according to OECD (2015)
Source: authors' own processing based on MEYS (2017b)

Knowledge application & exploitation subsystem

The launching of innovations depends on the firm's capacities (research activity, human resources, financial background), primarily (Páger, 2014). Table 6 provides the examples of innovative companies located in the South Moravian Region. We pay attention to businesses that operate especially in the four above-mentioned anchor industries. The multinational companies usually focus on information technologies and mechanical engineering. Whereas engineering companies are often settled in Brno and northern districts of the South Moravian Region, IT firms are nearly always located in Brno. Many multinational companies have placed their centres of strategic services to the region (e.g. IBM, AT&T, Acer, Lufthansa). More than 10 world-leading companies carried out their research activities in the region in 2014, e.g.

Honeywell, ABB, Thermo Fisher Scientific (JMK, 2014). For instance, Honeywell has a global development centre in Brno whose extensive industrial research is aimed at aircraft technologies, which should be put in practice in 5-10 years. Traditional Czech companies are domestic companies that were established before 1989 and so they have a tradition of many decades. These firms usually focus on mechanical engineering. Well-established companies are domestic companies founded after the Velvet Revolution and older than ten years. They usually operate in IT technologies, electric engineering and life sciences and have a stable position in domestic as well as foreign markets. Some of them belong to the world leaders in their sphere of interest, e.g. TESCAN in electron microscopes and YSoft in effective print solutions. Gazelles are represented by quite young high-tech companies (younger than 10 years) with high growth rate of employment or revenues (e.g. Bos and Stam, 2013). The best known is Kiwi (formerly Skypicker) that provides flight booking. Kiwi was established five years ago, has about 900 employees now and expected revenues in 2017 are 1 billion EUR. Spin-off firms are companies that were established by separation from university of research institute. In the South Moravian Region, they usually arise at the Masaryk University and Brno University of Technology and focus on information technologies and life sciences. The universities usually do not have any ownership interest in spin-offs, but they are linked with them through some agreement (e.g. licence agreement). With respect to the companies' research activities, we can say that the number of business research workplaces is increasing. In 2015 over 400 companies had their research workplaces in the SMR, while in 2005 about 230 companies carried out research there (CSO, 2017b). The share of enterprises with technological innovation is shown in table 7. We can see that this region exceeds the national average in all observed periods.

Tab. 6: Examples of innovative enterprises in the South Moravian Region

Type of business	Examples of business
Multinational companies	IBM, Red Hat, AT&T, Acer, Honeywell, Thermo Fisher Scientific (formerly FEI), Siemens, Daikin, Tyco Electronics, Alstom Power, ABB, Lufthansa, Lohmann & Rauscher
Traditional Czech companies	Zetor, Královopolská, Královopolská RIA, ČKD Blansko, TOS Kuřim, Šmeral Brno, Bioveta, Hartman-Rico
Well-established Czech companies	TESCAN Orsay Holding, ALTA, UNIS, YSoft, Webnode, BioVendor Group, Evektor, AVG Technologies
Gazelles	Kiwi (formerly Skypicker), GINA Software
Spin-offs	Enantis, FlowMon Networks, CaverSoft, Celebrio Sofware, Nano Fusion, RehiveTech, NenoVision

Note: Traditional and well-established companies are companies that were established in the Czech Republic (Czechoslovakia), but some of them could be sold to a foreign investor later.
Source: authors' own processing

Tab. 7: Enterprises with technological innovation (as a percentage of all enterprises)

Period	2004-06	2006-08	2008-10	2010-12	2012-14
SMR	31.5	33.0	37.0	36.3	37.7
CR	28.1	31.6	34.8	35.6	35.7

Source: CSO (2017c)

Intermediary organizations

Intermediary organizations can be established by a regional or national authority. They can have their own legal personality (independent entities) or they can be established as a part of an organization (e.g. department). We primarily concentrate on those that were established by regional authorities, because the national organizations are very similar in all regions. South Moravian Innovation Centre (JIC) has a unique position with respect to its wide range of services, achieved results and excellent reputation. JIC supports businesses of all sizes, connects the business and the academic spheres and creates a favourable environment for innovative

companies. JIC employs about 60 people. The second special organization is South Moravian Centre for International Mobility (JCMM) that is aimed at the development of talents and attraction of talented students and scientists to the South Moravian Region. We should also name Regional Development Agency South Moravia which focuses on attracting foreign investors to the region. Within this activity it has to closely cooperate with other organizations, particularly JIC, because investors are interested in favourable innovation environment of the region. We should also mention centres for technology transfer that have been established by universities. In particular, centres at Masaryk University, Brno University of Technology and Mendel University carry out many activities. Brno Observatory and Planetarium and Moravian Science Centre Brno deal with popularization of R&D and education in science and technical fields.

4.4 Regional innovation policy

In the Czech Republic, political responsibility for regional innovation policy lies with the regional board and council, executive competences are divided between the council and the regional authority. Individual regions can transfer a part of the competences to specialized institutions that concentrate qualified human resources with knowledge required for an efficient functioning of the system. We can say that representatives of the South Moravian Regions are aware of the importance of innovations for economic, social and environmental development, therefore they put strong emphasis on innovation policy and support for innovations. This region is an example of a region that has placed a substantial part of competences into the sphere of activity of the South Moravian Innovation Centre (JIC), a specialized institution co-established by the South Moravian Region (as the self-government territorial unit), the City of Brno and four universities in 2003. JIC is closely connected with preparation and creation of the Regional Innovation Strategy (RIS) and it is responsible for the management and implementation of the strategy. Another institution that has been entrusted with some competencies within the innovation system is the South Moravian Centre for International Mobility (JCMM), which was established by the South Moravian Region and four universities in 2005. This Centre is responsible for some projects of regional innovation strategy concerning development of human resources.

The first Regional innovation strategy of the South Moravian Region was approved in 2002 and it was the first innovation strategy in the Czech Republic at all (the first National Innovation Strategy was approved in 2004). The main task of the first strategy (Table 8) was to establish an organization that would be responsible for innovation enterprise development. Several possibilities have been considered and it was finally decided to found a new autonomous specialized organization (South Moravian Innovation Centre). Main functions and objectives of these strategies are presented in table 8. As innovation environment and performance have changed, so the priorities of the strategies have changed too. We called these changes "from spaces to smart services". While ten years ago the main attention was paid to infrastructure and tangible property, today the emphasis is put on intangible things such as first-rate consultancy and mentoring, internationalization, networking and quality research.

Tab. 8: Regional innovation strategies in the South Moravian Region

Version	Period	Main functions and objectives
1	2002–2004	Establishment of the South Moravian Innovation Centre
2	2005–2008	Spaces and finances for small and medium-sized enterprises, linking of innovation actors, technology transfer
3	2009–2013	Technology transfer, services for small and medium-sized enterprises, human resources, internationalization
4	2014–2020	Research and Innovation Strategy for Smart Specialization (RIS3) Governance favourable to innovations, excellence in research, competitive innovation businesses, European top-class education, attractive region

Source: authors' own processing based on regional innovation strategies

In the last fifteen years a large innovation and research infrastructure has been built in the South Moravian Region. Originally, efforts were concentrated to building incubators and science parks, later excellence research infrastructure was developed too. Incubators and science parks are usually established by the South Moravian Regions and operated by JIC. One business incubator is located in Znojmo and all remaining ones are placed in Brno. The demand for incubator services exceeds the supply considerably, therefore only the most innovative young companies can obtain the public support. The research infrastructure is mostly constituted by universities in cooperation with other actors and is located near university campuses. Overview of the most important research centres is shown in Table 9, the CEITEC, CzechGlobe and ICRC are expected to be the European centres of excellence (in accordance with grant guidelines). These facilities are financed from national and European resources. In other words, these measures are initiated from the bottom-up perspective, but their financing has top-down perspective.

Tab. 9: Research infrastructure in the South Moravian Region

Research centre (research field)	Main founders
CEITEC – Central European Institute of Technology (life sciences, advanced materials and technologies)	Masaryk University, Brno University of Technology
CzechGlobe (issues of environmental sciences, the problem of global climate change)	Global Change Research Institute CAS
FNUSA-ICRC (research of cardiovascular and neurological diseases)	St. Anne's University Hospital Brno
11 regional research centres established by universities and public research institutes: AdMaS, AdmireVet, ALISI, CMV, CEPLANT, CVVOZE, CETOCOEN, NETME, RECAMO, SIX, Transport R&D Centre	

Source: authors' own processing

In the end of this paper we would like to present several proofs that innovation policy has a high priority in the Region through introducing several innovation tools and measures. These advanced tools inspired by foreign experience were applied in the South Moravian Regions for the first time in the Czech Republic and afterwards some of them spread to other regions and the national level. Their examples are: microloans (2005), innovation vouchers (2009), SoMoPro – support for arrival of scientists from abroad (2010), regional seed fund (2015), creative vouchers (2016) and FabLab - fabrication laboratory (2017). These measures are not as expensive as the innovation and research infrastructure, therefore they can usually be financed from public regional resources.

5 Conclusion

Regional innovation policy plays an essential role in regional innovation systems. Each region has its own history, socio-economic features, strengths and weaknesses. For this reason it is not possible to create a universal innovation policy, but the policy has to be tailored to real needs of the given region. If we want to have a systematic and conceptual political approach, we need

to define clear rules and tools. These things are usually stated in the regional innovation strategy that should arise from the specific regional prerequisites whose progress is monitored continuously. At the same time, we agree with the opinion that innovation strategy brings significant progress in regions where the ability to produce new knowledge is accompanied by professional and enthusiastic approach of innovation agencies and political support (Blažek et al., 2012).

The paper has shown that the SMR is successful in innovation development and has an outstanding position among Czech regions. We suppose that the region has good prerequisites to be a European innovation leader in future. We can find several factors of the South Moravian success. First of them is the tradition of research, tertiary education and industrial production. We should also mention the high level of research activity, increasing expenditures on R&D, presence of a wide range of research fields and highly qualified labour force. In the region we can find many innovative domestic companies, establishment of spin-offs is stimulated and the region is also attractive for foreign companies. Political awareness of innovation importance is on a high level across all dominant political parties and the region tries to build its image of an innovative region. On the other hand, we can also find many deficiencies in the innovation system. First of them is strong concentration of innovation and research activities in Brno, which causes polarity between Brno and the remaining territory and an idle innovation capacity. The innovation policy is dependent on support from the European Union as the national and regional resources are not sufficient. Weak cooperation between research and the business sphere and the absence of functioning clusters can represent a barrier for future development. Additionally, the future development can be influenced by unsolved problems with transport accessibility (e.g. fast connection to Vienna).

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