Different tools have been used in recent years to increase the overall general innovation potential of universities and their collaboration with non-academic environments. The opening up of the funding system, its rising compatibility with more developed EU countries, and the general process called the "Europeanisation" of the innovation policy in Central and Eastern Europe are among them (Suurna and Kattel 2010). There have also been relatively high expectations based on the role of EU structural funds in the upgrading of R&D infrastructure. Universities and other research institutions should be more relevant partners not only in the field of basic research but also in collaboration with the business sector. Many new EU member states allocated a substantial part of their structural funds in the last programming period, 2007 – 2013, to increase the competitiveness of their research institutions (not only universities, but also other HEIs and research institutions) to approach the level of more developed EU member states. There was a general consensus that convergence between the old and new EU member states is possible only through substantial investment into innovation infrastructure, of which universities are an integral part.

Of course, EU structural funds do not always play only a positive role and they do not always bring the expected results. If the existing innovation infrastructure is not prepared for this highly competitive environment, if there is not demand from the side of businesses located in the region or country, the results could be doubtful. In this article the extent to which the innovation infrastructure has been successfully upgraded through EU structural funds will be described and partly evaluated through the example of an Operational Programmes called "Science and Research for Innovation"(VaVPI) and "Education for Competitiveness" (OPVK) in the Czech Republic. First, the third role of universities in general and then in the post-communist context will be described. Furthermore, the limitations and specific features that universities in post-communist countries have in comparison to their counterparts in western countries will be discussed. Then the article will focus on the role of the "Europeanisation" of innovation policy in the post-communist context and which role for EU structural funds was expected by the new EU member states. The role of the EU structural funds spent to upgrade the innovation infrastructure will be presented through examples of empirical material from the Czech Republic. The results will focus on geographical, sectoral, and branch aspects. The main research questions will focus on answering such problems as the extent to which the creation of this infrastructure contributes to the strengthening of fundamental research at universities and in regions and the extent to which applied research has also profited from it. Another important question is which barriers to collaboration between universities and the business sector are there? Is it because of a lack of demand from the side of local companies or is there a mismatch between the branch structure of the region and the research at universities? Which kind of collaboration is there between universities and the business sector? Insofar as all these projects have been finished only recently (many of them in 2015), the evaluation of their overall impact must be very careful, especially if the impact could be expected from the long-term perspective only.

THEORETICAL PART

There is a lot of literature focusing on the rising third role of universities worldwide. Specific issues of journals have been published. But what is mostly discussed is the situation in the more developed market economies of Western Europe, North

America and East Asia. Less attention has been paid till recently to this issue in the context of post-communist countries (Adamsone-Fiskovica et al. 2009, Krčmářová 2009, 2010 and 2011, Suurna and Kattel 2010 and Lengyel et al. 2015). In the broader context of innovation policy in post-communist countries the long-term research activities of Slavo Radosevic should be mentioned (for example, Radosevic and Lepori 2009 and Radosevic 2011). For decision makers and practical policy the importance of policy guidelines and documents on the European or global level (European Commission, OECD etc.) should be highlighted. They influenced the architecture of R&D infrastructure building and the setting of priority schemes in the 2007 – 2013 programming period of the EU.

THE CHANGING ROLE OF UNIVERSITIES IN CONTEMPORARY SOCIETY: THE ROLE OF THE "THIRD MISSION"

As stated by Göransson et al. (2009, p. 83), there are progressively increasing expectations about the role of universities in society: "The two time-honoured tasks of universities are teaching and research, which have long provided society with specific skills and new knowledge and ideas. Expectations have increased exponentially and demands are originating from a much wider range of stakeholders. Universities are now given progressively more important roles in economic expansion, social development, better forms of political organization and governance, plus providing education for more students, and developing and transferring technology to industry. The capacity of universities to respond is insufficient, in both the developed and developing worlds. New models to guide the evolution of universities include the triple helix, the creation of entrepreneurial or specialized universities, large-scale excellence-driven environments or the concept of developmental universities." They also write about the rather vague understanding of the "third mission".

In the strategic materials of the European Union and OECD it is stressed that HEIs compose the keystones of regional development strategy in the EU and OECD. This role of collaboration between HEIs and regions only started at the end of the 20th century and is connected with the implementation of the Lisbon strategy and the growing role of a knowledge-based economy in achieving this strategy (Arbo and Benneworth 2007, EC 2003, 2005 and 2006, OECD 2007 and Krčmářová 2010). The role of HEIs as creators and intermediators of innovations and knowledge is rising. It has contributed to the collaboration with, especially, higher value-added branches and fast-developing technical disciplines. Besides economic importance, the role of universities as social and cultural centres is also stressed (Krčmářová 2010). The role of universities is seen as very important in the networked transmission of innovations not only in developed but also in developing countries (Hübelová et al. 2016). On the basis of OECD documents Krčmářová (2010) argues that higher education institutions are pushed to increase commercialisation and collaborate with the business sector because of shrinking finances from the public budget. According to OECD experts, HEIs are currently those that best fulfil the economic role. So, as understood by OECD, the third role of universities (or HEIs) is mostly to serve regional actors in business and industry and to help to create an entrepreneurial milieu, to bring innovations, and to contribute to the cohesion of the region and also to its sustainable development.

This understanding of the third role of universities is in contrast to the approach of the UN and UNESCO, which see the third role of universities predominantly in the critical assessment of the causes and consequences of current global problems (Krčmářová 2010).

THE THIRD MISSION OF UNIVERSITIES IN THE CONTEXT OF POST-COMMUNIST COUNTRIES AND ITS IMPLICATION FOR THEIR ROLE IN INNOVATION POTENTIAL

The situation of universities and their mission in post-communist countries is specific and different in many ways in comparison to their Western European counterparts. Thanks to the different roles of universities in CEE countries under communism it is only since the early 1990s that efforts have been undertaken to integrate the research and teaching functions and to strengthen their "second mission" and at the same time to raise the quality of the "first mission" (Adamsone-Fiskovica et al. 2009, Radosevic and Lepori 2009 and Radosevic 2011). Universities have to respond to the changing requirements of the labour market too. Moreover, while in many countries the discussion about the "third mission" started in the 1990s, the coexistence of two traditional missions has been disputed (Adamsone-Fiskovica et al. 2009). This was due to the fact that in most CEE countries there was a sharp separation between the teaching and research roles. The educational role was almost solely within the competence of HEIs, while research functions were mostly performed by the research institutes of Academies of Science. So it is obvious that the development of links between universities and the business sector is a relatively new phenomenon. This is due to many reasons; in addition to the above-mentioned factor there is also the fact that the business sector only started to develop in the 1990s. One of the most important factors mentioned in connection with the example of Latvia (but relevant for most CEE countries) is the so-called "horizontal brain drain", the drain of scientific and engineering staff from universities during the transformation period in the 1990s, as well as the marked predominance of students in the social sciences and humanities (Adamsone-Fiskovica et al. 2009).

In recent years the building of university-business links has been prioritised by governments as one important factor in building a knowledge-based economy, but it faces many structural problems. As mentioned above, this effort has been highlighted in many strategic documents on the national and EU level. There are also economic reasons for establishing and strengthening these links as the public budgets for education in HEIs is shrinking. There are some important obstacles to universities collaborating more actively with business sectors in the CEE (Adamsone-Fiskovica et al. 2009), such as the lack of researchers, an underdeveloped policy for the protection of property rights, and a lack of entrepreneurial spirit, as well as scant responsiveness to the needs of the business sector. Additionally, the existing staff is overloaded with its other "two missions" (teaching and research). So the public policy has to focus on overcoming these limitations and in this matter the "Europeanisation" of innovation policy and changes in the R&D funding system can help substantially (Radosevic and Lepori 2009, Suurna and Kattel, 2010 and Radosevic 2011).

BUSINESS-UNIVERSITY RESEARCH LINKS IN THE POST-COMMUNIST CONTEXT: CHANGES IN PUBLIC RESEARCH FUNDING IN CEE COUNTRIES

In the first stages of transformation the overall economic development was characterised by a decline in economic development and a sharp decline in relative funding for R&D in relation to GDP. On the other hand, there are also clear limitations on the business sector side. There is generally very little interest in proactive innovative activities and a rather limited demand for university services in the enterprise sector. Many companies carry out research commissioned by foreign companies, or are subsidiaries thereof, as a result of which R&D activities are often undertaken in parent companies abroad (Adamsone-Fiskovica et al. 2009).

The reason for this situation is based on the overall path-dependent development of relations between R&D institutes and the enterprise sector that already began in the 1990s. Transition shock led to the rapid marginalisation of the R&D sector and a collapse in the industrial demand for R&D (Radosevic 1998 and Suurna and Kattel 2010). With the collapse of the institute system, the links between academia and industry became, as Radosevic (1998, p. 90) suspected, the weakest link in the CEE R&D system. Hand in hand with the implementation of the Washington consensus in many CEE countries, there were no other R&D policy initiatives in the 1990s (Suurna and Kattel 2010, p. 650).

The second half of the 1990s was characterised by the gradual stabilisation of the funding systems and by the implementation of European policy into the national innovation and funding systems (Lepori et al. 2009 and Radosevic and Lepori 2009). After 2000 this led to the stabilisation of the funding system and after the accession of the EU-10 into the EU in 2004 EU funds started to play a more and more important role. However, substantial differences among the EU-10 countries in terms of the share of GERD/GDP were still present.

This process went on hand in hand with substantial changes in the funding system. New funding instruments and bodies were introduced and there was a clear trend towards project funding (project funding increased its share of the costs of institutional funding). The second stage — establishing independent agencies to fund R&D — started in the late 1990s and became the dominant trend in the mid-2000s with EU accession (the decentralisation of the decision-making system, the externalisation of the R&D management into agencies, the gradual increase of competition-based funding of R&D, the diversity and flexibility of funding sources, and the promotion of excellent R&D performers; Radosevic and Lepori 2009, pp. 661-662)

With regard to the impact of the EU on the innovation policy in CEE countries, some authors stress the "transformative power" of the EU, which is connected to the candidate countries' ability and power to influence the content of the rules imported (Grabbe 2006 in Suurna and Kattel 2010). The "top-down" and "bottom-up" dimensions in the concept of Europeanisation are also often discussed. Because of time pressure (there were only six years for the implementation and harmonisation of the legal infrastructure) it is mentioned that the adoption of the legal infrastructure was executed without much attention to the local context. This often led, at least at the beginning of EU membership, to the ad hoc allocations of pre-accession funding (Suurna and Kattel 2010).

While the harmonisation period before EU accession was very important both for the implementation of the legal infrastructure and also for industry, the key change in innovation policy occurred with the implementation of EU structural funds in 2004. In most CEE countries EU accession triggered a significant political change and brought the innovation policy onto the agenda very strongly. Suurna and Kattel (2010, p. 653) formulate similarities which were common in all CEE countries:

– the normative policy documents on innovation policy were formulated very recently and to a great extent as a result of EU pressure,

– innovation policy plans were often short-term, and

– the existing policy mix strongly reflected the priorities and objectives as defined in the EU programmes for R&D and innovation.

Emerging CEE innovation policies tended to concentrate on high-technology sectors, on commercialising university research, technology parks for start-ups (Radosevic 2002, p. 355, Radosevic and Reid 2006, p. 297 in Suurna and Kattel 2010) and similar initiatives emphasising science and technology (S&T) components in innovation policies reflecting in general the predominance of the "linear model" thinking in the framework programmes and in the budget for structural funds (Tunzelmann and Nassehi 2004, p. 481 in Suurna and Kattel 2010).

Authors analysing the impact of innovation policies implemented through EU structural funds are quite sceptical and critical about their overall impact on the innovation infrastructure (at least in the first years of the implementation of EU structural funds). Radosevic 2002, Lacasa 2008 and Tunzelmann and Nassehi 2004 in Suurna and Kattel 2010 state that the transfer of EU policies emphasising high technology and networking (such as S&T parks, clustering, centres of excellence, academy-industry links, etc.) did not respond to the local problems in the CEE and did not resolve the main constraint, namely the lack of collective action. Nor did it take into account the weak state of domestic actors, especially if compared to foreign firms investing comparatively more in R&D and innovation. As a result, the emphasis was on building new institutions, which did not respond to specific local problems, and secondly, did not actually support ways of overcoming and going beyond them.

Lacasa (2008, p. 371) criticises the considerable gap between the performance in the development of the knowledge base and its economic usefulness. Secondly, the development led by the technological progress derived from western countries was oriented to respond to supply-side developments and not according to local needs or demand, together with limited attention to local "absorptive capacity" (Tunzelmann and Nassehi 2004 in Suurna and Kattel 2010). Next, FDI spillovers were often restricted to vertical linkages, and horizontal spillovers were absent or negative (Radosevic 2006, p. 47), and the reliance on FDI actually supported the concentration of hi-tech manufacturing in the CEE on the low-value-added segment (Radosevic and Reid 2006, Radosevic 2006 in Suurna and Kattel 2010).

Suurna and Kattel (2010, p. 655) sum up the impact of EU structural funds as of 2010 with the following statement: "while with the introduction of structural funds and through the strong influence of the EC, CEE innovation policies have significantly changed since the mid-2000s, there are also serious problems that emerged with this trend or are still emerging. The emerging innovation policies tend to be based on a rather linear understanding of innovation (from lab to market) whereas

most CEE countries are specialized in low-end production activities virtually devoid of any research and with low demand for high skills. Indeed, one can argue that CEE emerging innovation policies copy the "European Paradox" thinking from the older member States."

Is this still the main weakness of the implementation of European structural funds in innovation policy? It will be analysed further through the example of the programming period from 2007 – 2013 in the Czech Republic and its impact on innovation infrastructure, with the focus on universities as the keystones of innovation infrastructure.

METHODS AND DATA

The main method used in the article is an analysis of a wide range of secondary data on the development of science and research in the Czech Republic. This data can be divided into two groups. The first consists of data from the annual analysis of the Czech Statistical Office in the area of science and research, which maps out long-term trends in this field. The data published by the Czech Statistical Office relates to the years 2005 – 2015, which covers a substantial part of the period since of the Czech Republic accession to the European Union in May 2004. For the purposes of the article we used data on the regional and sectoral structure of science and research. We analysed the science and research budgets in higher education expenditure on research and development institutions (HERD) in the regional context at the NUTS 3 level (regions). Considering the focus of the article, we also examined sources of funding for science and research at higher education institutions, which are divided into public and business sector sources, and, within this classification, also to internal sources from the Czech Republic and sources from abroad. At the regional level we analysed the dynamics of gross expenditure on research and development (GERD), and then in more detail, as well as the South Moravian region, which represents the most dynamic region in the Czech Republic both within GERD and HERD.

The second group of data contains information about projects that were implemented within the framework of two Operational Programmes in 2007 – 2013. These were the Education for Competitiveness Operational Programme and the Research and Development for Innovation Operational Programme, in which universities were an important group of grant recipients, which resulted in a significant development of R&D infrastructure at Czech universities. Data taken from the tabular overview of projects presented on the websites of the Operational Programmes (OPVK 2016 and OPVAVPI 2016) were analysed according to the categories of beneficiaries (universities, institutes of the Czech Academy of Sciences, and others), the amounts of grants allocated, and the location of projects (NUTS II and NUTS III). The latter attribute was deliberately monitored only in projects implemented under the Operational Programme Research and Development for Innovation, as this was a crucial programme for financing the R&D infrastructure of universities, the main objective of which should be the competitiveness of Czech science internationally.

Partial results derived from the analysis became the basis for the synthesis of knowledge about the historical development and direction of research and development in the Czech Republic, both at a general level and more specifically at Czech universities. This synthesis is also the starting point for potential research in an area which has so far received scant attention in the Czech Republic.

SUPPORT FOR SCIENCE AND RESEARCH IN THE CZECH REPUBLIC IN REGIONAL AND SECTORAL CONTEXTS WITH A FOCUS ON THE ROLE OF HIGHER EDUCATION INSTITUTIONS (HEIS) AND EU STRUCTURAL FUNDS

Support for science and research is proving to be crucial for the transition of the national and regional economies of the post-communist countries from production with low added value (often mere assembly plants of foreign multinational companies) to production with higher added value, which includes their own research and development. The aim of this chapter is to introduce funding for science and research in the Czech Republic in the European and regional contexts and focus on the sources of funding for R&D at universities.

Gross expenditure on R&D (GERD) in the Czech Republic increased over the first ten years (since joining the EU) from 1.17% in 2005 to 1.95% of GDP in 2015. The maximum of 1.97% was achieved in 2014 (CSO 2016).

Regarding the position of the Czech Republic in the EU, thanks to this growth, the Czech Republic approached the EU average, which in 2012-2014 was between 1.9% and 2.0% of GDP and among the post-communist countries the Czech Republic ranked in second place behind Slovenia, where in 2014 GERD was 2.4% of GDP (CSO 2015). An important role in the growth dynamics of GERD was played by the increase in the higher education sector (HERD). While in 2005 the share of HERD in GERD was 18.1%, in 2012 it was already 27.2% and in 2015 25.4% (CSO, 2016). Among the post-communist countries, the highest share of HERD in GERD is in Estonia and Lithuania (in recent years, between 40% and 50%). We can state that the increase in GERD, particularly in the last programming period of the EU in the Czech Republic, was due to higher HERD, while for the other components (BERD and GOVERD) in recent years their share was the same (BERD), or even decreased (GOVERD), as can be seen from Tab. 1.

Tab. 1. Shares of R&D expenditures by sectors in the Czech Republic in 2005 – 2015 (in %)

R&D Sectors	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Business (BERD)	58.2	58.6	57.7	57.6	55.3	56.7	54.4	52.8	53.3	55.2	54.3
Government (GOVERD)	22.8	22.2	23.3	23.5	24.2	22.7	20.7	19.2	19.1	19.0	20.4
University (HERD)	18.6	18.7	18.6	18.5	20.0	20.0	24.4	27.5	27.2	25.4	24.9
Non-profit	0.5	0.5	0.4	0.4	0.5	0.6	0.6	0.5	0.3	0.4	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Czech Statistical Office (2016).

The aim of this article is to focus on the role of EU structural funds in the financing of GERD and especially HERD. If we look at the overall dynamics of the use of funding for GERD from all foreign public funds, we can clearly see high growth dynamics at the time of the launching of operational programmes within the Research and Development for Innovation (VaVPI) Operational Programme and partly also the Education for Competitiveness (OPVK) Operational Programme. In

2011 – 2015, the share of foreign public funds in GERD was about one sixth and accounted for 0.3% of GDP on science and research funding in the Czech Republic, which is a very significant share.

If we focus on the sources of funding for HERD, the importance and especially the dynamics of the increase in funding from foreign public sources, i.e. from EU structural funds, is unambiguous. In the crucial period of 2011 – 2015, when the above-mentioned operational programmes were implemented, especially the VaVPI, half of them went to HERD and EU structural funds were one of the most important sources of HERD funding (see Tab. 2). In this period, the share of structural funds in HERD funding increased to more than 1/3, while until 2009 it had never exceed 5%.

Tab. 2. HERD by sector financing (in %)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Business (BERD)	0.8	0.7	0.7	0.6	1.0	1.1	1.0	0.8	2.0	2.4	4.0
Government (GOVERD)	0.1	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.2
University (HERD)	92.0	90.7	91.7	91.0	90.6	86.8	71.6	58.6	59.4	61.8	61.7
Non-profit	2.6	4.1	4.4	4.2	4.2	8.3	23.8	37.4	36.9	33.4	31.3
Total	4.5	4.2	3.2	4.1	4.1	3.8	3.6	3.2	1.6	2.3	2.8
Business (BERD)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Czech Statistical Office (2016).

On the other hand, it is obvious that the share of the business sector in HERD is beginning to increase gradually, which would mean a gradual diversification of HERD sources and the beginning of the expected implementation of the third role of universities in economics. It is difficult to predict whether this is a beginning of a long-term and growing trend or not, when in 2015 those resources amounted to only 4.2% of HERD.

GERD/HERD REGIONAL DYNAMICS

Regarding the regional distribution of GERD and research activities in general, we observe their strong territorial concentration in metropolitan regions. This is doubly true for the post-communist countries, where it is very difficult to find any major concentration of R&D outside these regions. This is also emphasised by Lengyel et al. (2015) in their study aimed at creating patents in the countries of Central and Eastern Europe. The authors also emphasise the necessity for a university and its resources to exceed a certain critical size to be able to establish a more effective R&D interconnection between universities and businesses. In this context, the concord between the needs of local businesses or foreign companies and the R&D background of universities in the region is also very important (e.g. Gál and Ptáček 2011).

In terms of quantitative evaluation, firstly, it is useful to look at the regional distribution of GERD or HERD in the Czech Republic. We have data up to the NUTS III level (regions) since 2002, which is a sufficient level of detail to identify

these poles of concentration. In this respect, it is not surprising that the capital, Prague, and the Central Bohemian region have a dominant position on a long-term basis. At the beginning of the period for which we have data (2002), these two regions had a dominant position in the Czech Republic and greatly exceeded the national GERD average in comparison to regional GDP. After 2009, however, the increase in the dynamics of GERD in the South Moravian region was much faster and this region took over the leading role. Currently, it is the sole region where GERD exceeds 3% of regional GDP.

Tab. 3. Regional GERD by regions of the Czech Republic in 2002, 2007, 2012 and 2014

Region (NUTS III)	GERD as a percentage of regional GDP	GERD as a percentage of regional GDP	GERD as a percentage of regional GDP	GERD as a percentage of regional GDP
	2002	2007	2012	2014
Prague	1.74	2.70	2.67	2.86
Central Bohemia	2.94	2.76	1.45	2.01
South Bohemia	0.62	0.94	1.30	1.14
Pilsen	0.68	0.78	2.30	2.15
Karlovy Vary	0.13	0.11	0.26	0.18
Ústí nad Labem	0.29	0.30	0.46	0.48
Liberec	0.85	1.09	2.29	1.89
Hradec Králové	0.55	0.79	0.92	1.04
Pardubice	0.99	1.36	1.86	1.61
Vysočina	0.40	0.36	0.59	0.68
South Moravia	1.25	1.58	3.63	3.66
Olomouc	0.73	0.92	1.96	1.69
Zlín	1.04	1.03	1.22	1.29
Moravian Silesia	0.60	0.77	1.17	1.26
Czech Republic	**1.20**	**1.54**	**1.88**	**2.00**

Source: Czech Statistical Office (2015), Czech Statistical Office (2016), Kadeřábková (2009).

THE ROLE OF EU STRUCTURAL FUNDS AND UNIVERSITIES IN STRENGTHENING THE R&D BASE – THE EXAMPLE OF THE SOUTH MORAVIA REGION

As already mentioned, especially in the last five years, the role of universities in the financing of GERD has increased. Their share rose as a result of the growth in financing from the state budget, and especially thanks to the growth of the share of funds won from the EU operational programmes. The South Moravian region, which thanks to its wide range of universities, was able to make use of this opportunity, has a special position in this development as the City of Prague was to some extent ruled out of the possibility of drawing from EU structural funds (except for a few projects in the Central Bohemian Region). Below, Fig. 2 shows the substantial increase in the share of structural funds (public funds from abroad) in the financing

of GERD in the South Moravian region. From 2011 to 2015 the share of public foreign sources was up to 30%, while in the previous period it was only 2 – 3%.

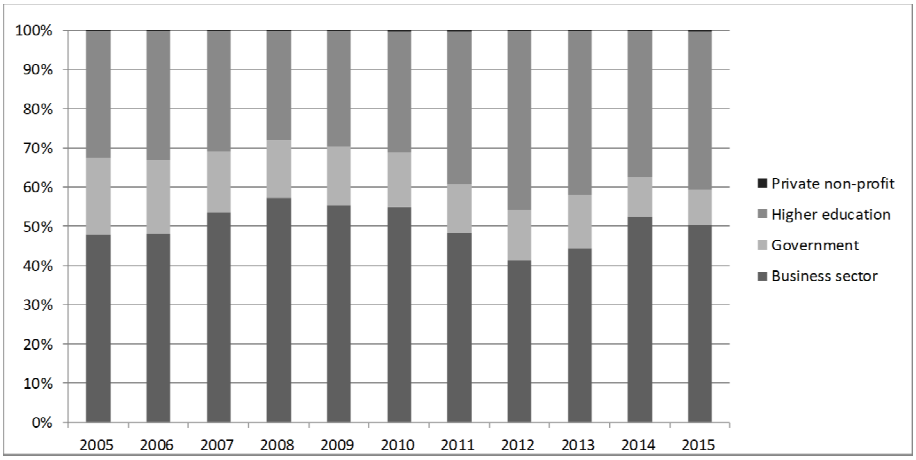

Fig. 1. GERD in the South Moravian Region by source of funding (2005 – 2015)
Source: Czech Statistical Office (2016).

Figure 1 also shows a significant strengthening of the share of the higher education sector in GERD. In the last five years, this share was about 40% and, together with businesses, it was a dominant sector in terms of its financing in the South Moravian region.

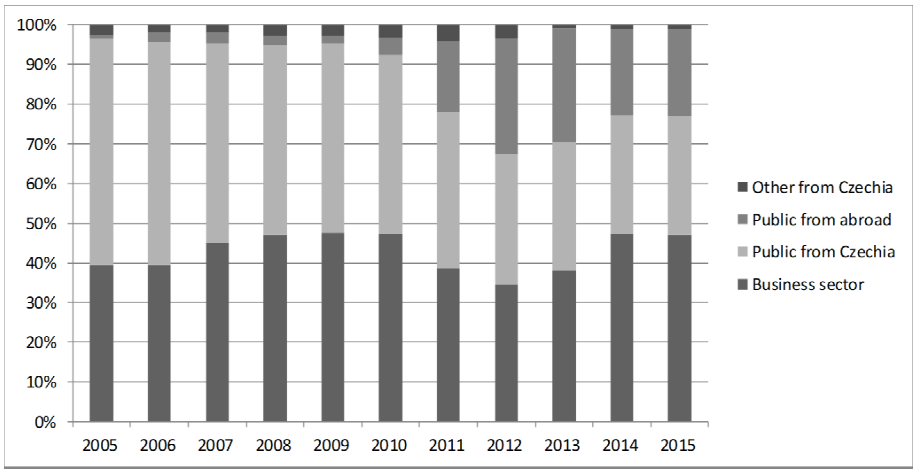

Fig. 2. GERD in the South Moravian Region by sector of implementation (2005 – 2015)
Source: Czech Statistical Office (2016).

ANALYSIS OF EXPENDITURE ON R&D AT UNIVERSITIES AND RESEARCH INSTITUTIONS WITHIN THE EU OPERATIONAL PROGRAMMES

The previous analysis of GERD and BERD shows the differentiated development of R&D expenditures in both the private and public sectors at the regional level. There is an obvious concentration of these expenditures in regions with higher economic performance and the presence of universities and other academic institutions. Therefore the dominance of the South Moravian Region and the City of Prague, the two strongest regions in the country on a long-term basis, both economically and in terms of R&D, is not surprising.

In the next step, we present the analysis based on the evaluation of projects of the two Operational Programmes that explicitly served the promotion of science and education at universities in the previous programming period from 2007 to 2013. The first was the Education for Competitiveness Operational Programme, aiming at a wider spectrum of educational institutions in the country, where universities represented only one of several areas that were supported. In the Research and Development for Innovation Operational Programme, financial resources were allocated to support science and research at universities, scientific institutions of the Czech Academy of Science, and other scientific institutions, including private ones. It is important that the target areas of support in both operational programmes were the economically and socially less developed regions of the country, which means that the projects could be implemented throughout the entire territory of the republic, excluding the NUTS II Prague cohesion region, which significantly exceeds the economic indicators of other parts of the country, and thus does not meet the criteria for receiving EU funds under the Convergence objective.

EDUCATION FOR COMPETITIVENESS OPERATIONAL PROGRAMME (OPVK)

In the last programming period, 2007 – 2013, this operational programme focused on the development of human resources through education in all its forms, with an emphasis on a comprehensive system of lifelong learning, creating a suitable environment for research, development, and innovation activities and stimulating cooperation between the participating subjects. The main objective of the programme was to support the development of educational society to strengthen the competitiveness of the Czech Republic through the modernisation of its systems of initial, tertiary, and further education, as well as improving conditions in research and development.

The total amount designated for the financing of projects under this operational programme amounted to 53.8 billion CZK (€2,084.5 mil.). In terms of structure 85% of this amount was EU resources (ESF); the remaining 15% of the total allocation was national resources from the state budget. As a result, the projects were solved without co-financing, which was very attractive for potential applicants (all types of schools, municipalities, counties, NGOs, and employers).

As already mentioned, a partial goal of the programme was innovation in higher education, having the character of modernisation for education and research and development, especially at universities. Within the Tertiary Education, Research, and Development axis, there was a considerable number of projects, implemented especially by public universities, but also some private tertiary education institu-

tions practically throughout the whole territory of the Czech Republic (see Tab. 4). Regarding the above-mentioned fact that Prague was excluded from the territory that was supported, it should be added that Prague universities and other educational and scientific institutions could apply for grants for projects, but only in areas outside the City of Prague. A similar rule applied for the Research and Development for Innovation Operational Programme (see below).

In total, there were over a thousand projects (1067) within the priority axis (Tab. 4), totalling 17.5 billion CZK (on average 16.4 mil. CZK per project).

Tab. 4. Structure of the education for competitiveness operational programme by completed projects (as of 1. 8. 2016)

Priority axis/area of support	Number of projects	Funds allocated (in mil. CZK)	Reimbursed (in mil. CZK)	Average per project (in mil. CZK)
1. Initial education	12,528	25,572.5	20,625.9	1.6
2. Tertiary education, R&D	1,067	19,981.6	17,527.1	16.4
Higher vocational education	*56*	*215.8*	*200.7*	*3.6*
Higher education	*497*	*7,506.9*	*6,759.2*	*13.6*
Human resources in R&D	*338*	*8,824.3*	*7,696.8*	*22.8*
Partnerships and networks	*176*	*3,434.5*	*2,870.3*	*16.3*
3. Further education	1,147	5,101.4	4,464.8	3.9
4. System framework of Lifelong learning	36	4,011.9	3,409.1	94.7
5. Technical assistance (convergence)	104	2,193.6	1,753.3	16.9
Total	14,882	56,860.9	47,780.1	3.2

Source: OPVK (2016), Authors' own calculations and processing.

The most successful applicants were Palacký University in Olomouc, Masaryk University in Brno, and Brno University of Technology, which drew 45% of the funds paid out within this priority axis. Each of these universities implemented more than a hundred projects within this priority axis with a total value in excess of eight billion crowns (8,089.5 billion CZK). The other most successful universities were VSB – Technical University of Ostrava, Mendel University in Brno, the University of West Bohemia in Pilsen and the University of Pardubice.

RESEARCH AND DEVELOPMENT FOR INNOVATION OPERATIONAL PROGRAMME (VAVPI)

This operational programme focused on strengthening the research, development, and innovation potential of the Czech Republic, mainly through universities, research institutions, and their cooperation with the private sector. Projects should promote the development of the equipment of the research centres with modern

technology, building new research facilities, and increasing the capacity of tertiary education (OPVAVPI 2016).

The programme should significantly strengthen the position of universities and scientific institutions in all NUTS II regions (outside the City of Prague). The major explanation for this decision of the Government of the Czech Republic can be found on p. 12 of the programme: "Support for R&D in the Czech Republic suffers from several serious problems which will in the near future need to be responded to appropriately. R&D supported from public funds generally covers almost all scientific disciplines. Under the global competition in the production of R&D results, it is necessary for a state of a smaller size, like the Czech Republic, to concentrate its investments into a limited number of centres with critical size and of top quality. Unfortunately, the system of support for R&D in the Czech Republic is characterised by high fragmentation. For a smaller-sized country, this fact represents a significant systemic constraint that leads to the diffusion of resources and obstacles to the founding of top and extremely well-equipped centres in selected strategic areas." In this programme, it is also stated that: "The results of R&D produced by Czech researchers do not reach satisfactory quality in international comparison. Though the capacity of the Czech Republic in the field of basic research is rapidly growing, this potential has not been fully utilised for the growth of competitiveness. Although the overall competitiveness of the Czech Republic in the production of internationally recognised results is rather below average, there are many fields in which the Czech Republic reaches above-average results and, in some cases, results that are significantly above average. This suggests that in the Czech Republic we can identify research centres or individual teams of experts that show results that are fully competitive in international comparison. At the same time, however, these professionals often lack adequate material conditions to work in and their teams are affected by the exodus of young people abroad." (see OPVAVPI 2016, pp. 12 – 14).

The skeleton of the programme was the construction and further development of eight European centres of excellence and forty regional R&D centres. These research centres cover the network of major universities in the country where there are scientific disciplines with R&D potential on an international scale. In addition, scientific institutions of the Academy of Science and other R&D institutions also participated in this programme. The programme was also joined by some of the Prague universities (e.g. Charles University) and institutions of the Czech Academy of Sciences that, because of the conditions of the programme, implemented their projects mostly in the hinterland of Prague (NUTS II Central Bohemia or Central Bohemia Region). For a detailed description of the situation, see Figs. 3 and 4.

The European Centres of Excellence Operational Programme focused on the establishment of research centres with modern and often unique infrastructures that would contribute to the production of relevant R&D results, including results applicable in practice (patents, contract research). Another priority of the programme was to build strategic partnerships with prestigious research institutes in the Czech Republic and abroad, with the objective being to increase the integration of the Czech R&D teams into leading international research organisations and European research infrastructures. Finally, the programme should contribute to the development of human resources in research through doctoral programmes and attracting skilled researchers from the Czech Republic and abroad to the regions. Whether

these programme goals were successfully implemented is not the subject of this analysis. We aim to introduce the size of projects that led to the building of a network of research centres at Czech universities and other research institutions.

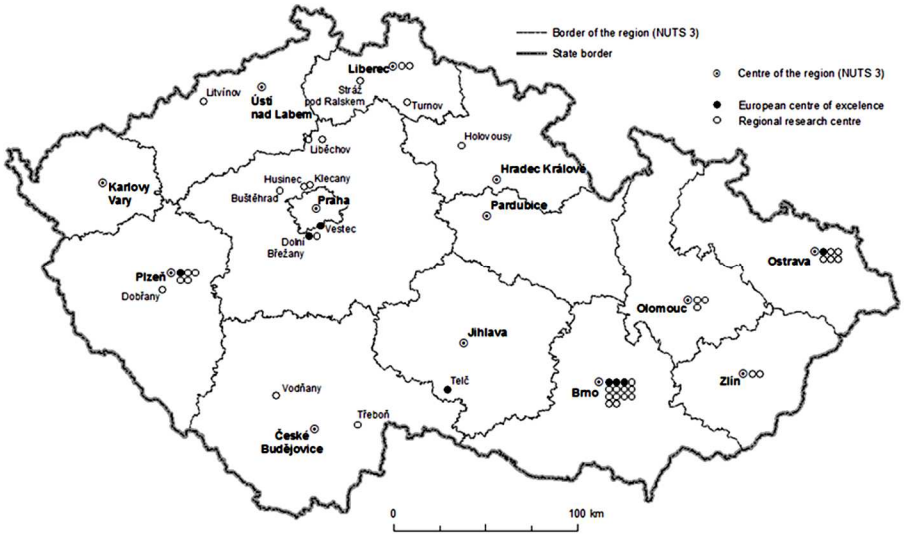

Fig. 3. European centres of excellence and regional research centres funded by the Research and development for innovation operational programme (2007 – 2013) by municipalities

Source: OPVK (2016), Authors' own calculations and processing.

As shown in Fig. 3, the European centres of excellence were built at six places in the Czech Republic: Brno (3), Ostrava, Pilsen, Telč, Dolní Břežany and Vestec. Universities participated in the development of this form of research centre "only" in three cases; the other centres were established by scientific institutes (mainly the Czech Academy of Sciences). The total subsidy for the development of R&D infrastructure extended 18 billion CZK, which is about the same amount as the entire support for tertiary education within OPVK. Because of the requirement for there to be active cooperation of the regional centres with (regional) economic entities, projects in industrial research, technologies and agriculture prevail (Kursová 2014).

The largest research centres (with a total subsidy amounting to over 5 billion CZK) include the CEITEC (Central European Institute of Technology in Brno) and ELI (Extreme Light Infrastructure in Dolní Břežany) projects implemented by the Institute of Physics of the Czech Academy of Sciences. The former deals with research and development in the field of life sciences and advanced materials and technology and functions in cooperation with six Brno universities and research institutions (Masaryk University, Brno University of Technology, Mendel University, Veterinary and Pharmaceutical University, Research Institute of Veterinary Medicine and Institute of Physics of Materials of the Czech Academy of Sciences). The second research centre is a laser centre built for Czech and international interdisciplinary research.

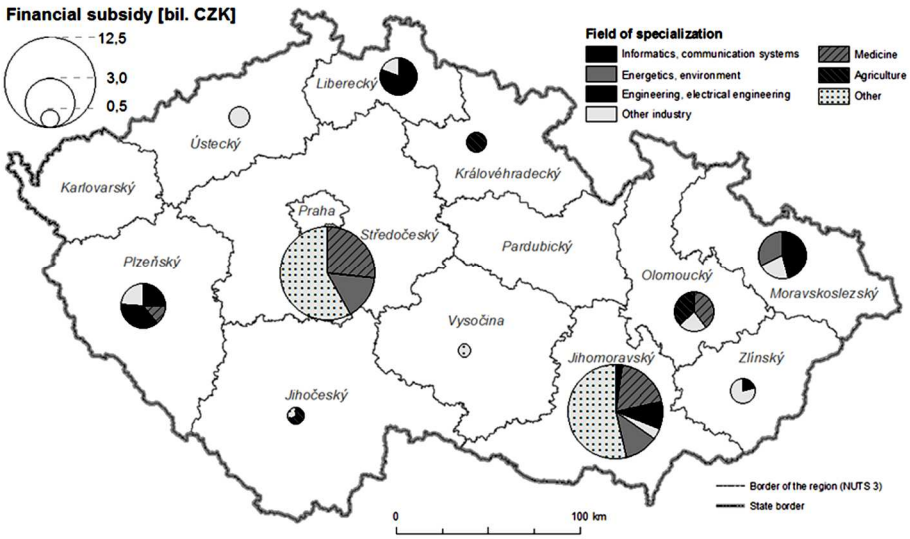

Fig. 4. European centres of excellence and regional research centres funded by the Research and development for innovation operational programme (2007 – 2013) by branch structure, regions and financial subsidy

Source: OPVK (2016), Authors' own calculations and processing.

Within the network of regional research centres, 25 of them were built at Czech public universities and 15 centres were established by research institutes, particularly by the institute of the Czech Academy of Sciences, as well as private research institutions and institutes primarily focused on medical research (Masaryk Oncology Institute in Brno and National Institute of Mental Health in Klecany near Prague). If we focus solely on universities, then Brno universities with a total of seven research centre projects clearly dominate. In Ostrava, the VSB – Technical University has established five research centres. In Pilsen, three research centres were established in cooperation with the University of West Bohemia and one by Charles University, which has one of its medical faculties in Pilsen. Not only Charles University, but also the Czech Technical University, was forced, because of the rules of the operating programme, to place its research projects outside the capital city. This, of course, also applied to research institutes based in Prague. As a result, the regional research centres were established by 12 public universities, including two in Prague (Charles University and the Czech Technical University). Other public universities in the Czech Republic, for example the Silesian University or the University of Hradec Králové, did not participate in the implementation of projects for regional research centres (probably because of their lower scientific performance, which was one of the evaluation criteria).

In the course of the implementation of the operational programme, individual calls were put up, the purpose of which was to promote the development of R&D infrastructure at already implemented research centres and universities in general. This enabled the investment of additional financial resources to strengthen R&D at

Czech universities and research institutes (including private ones). Except for one call, which was specifically focused on supporting projects of universities in Prague (apparently with a view to increasing regional imbalances in the field of the R&D infrastructure of the Czech Republic), the projects implemented in this Operational Programme were located in all the cohesion regions and almost all the regions of the Czech Republic (except Karlovy Vary and Hradec Králové).

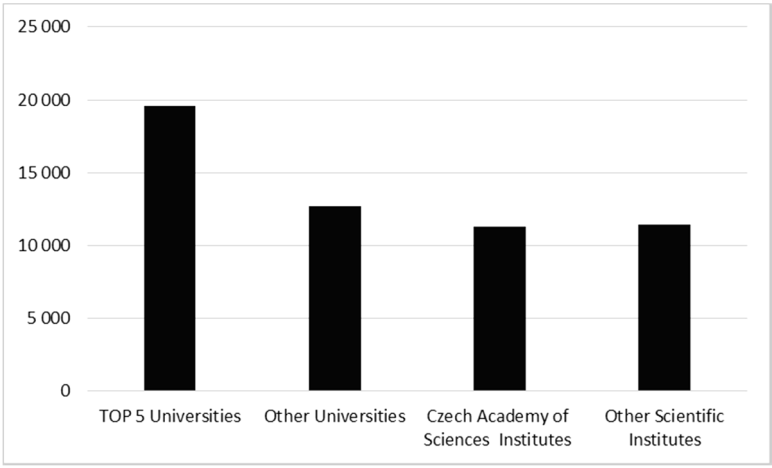

Fig. 5. Structure of projects in the Development for Innovation Operational Programme according to categories of recipients of subsidies (CZK mil.)

Source: OPVAVPI (2016), Authors' own calculations and processing.

Fig. 5 shows that the largest part of the subsidies provided under the respective operational programme was received by a group of five Czech public universities collectively labelled the "Top five universities". These universities are (in order, from the most successful applicants): Technical University (Brno), VSB-TU (Ostrava), Palacky University (Olomouc), Masaryk University (Brno) and Charles University (Prague). While the universities in Olomouc, Brno, and Prague (Charles University) set up projects to promote science, the other two universities focused on building technically-oriented R&D infrastructure. On aggregate, the first five universities received state support amounting to almost 20 billion CZK (19.60), which was more than a third (35.6%) of the total subsidy (54.96 billion CZK) provided to support R&D in the Czech Republic in this Operational Programme. Together with other Czech universities, especially regional ones, their share increased to 58.7%.

Although the Research and Development for Innovations Operational Programme was also successfully entered by other R&D institutions in the Czech Republic, the position of universities in the system of science and research in the Czech Republic, as well as the international arena, was significantly strengthened. In compliance with the specifications of the Operational Programme, the major part of the support was directed to several universities that started a new stage in the development of international research. In recent years, the whole R&D sector has undergone dramatic modernisation; in addition to the construction of new buildings, the grants were also used for the purchase of unique laboratory equipment and

wage funds for professional staff (including scientists and researchers from abroad). Many of these 48 research centres, which are dominated by universities, are still in the early days of their operation. It is therefore too early to assess their contribution to Czech science and application practice.

DISCUSSION

Within the OPVK and VaVPI Operational Programmes, about 103.3 billion CZK (€3.82 billion according to the current exchange rate) was spent on the promotion of science, research, and education with EU funds in the Czech Republic in the period 2007 – 2013. This represents a substantial portion of the total amount of EU structural funds won in this period by the Czech Republic (about 14.3% of the total amount allocated). Universities drew nearly a half of this amount (47.3%, i.e. 48.9 billion CZK). The greater part was obtained within the VaVPi Operational Programme (about 2/3 of the amount); the rest was then drawn from the OPVK. In connection with the drawing of EU cohesion funds, questions about the effectiveness of their use are asked very often and of course, their effect on reducing disparities both within the country and between individual EU member states has been questioned. In relation to the modernisation of R&D infrastructure at universities and the development of capacity for competitiveness in the field of R&D, doubters often stated that the EU structural funds only cover a prolonged deficit in the financing of universities which has accumulated over a long period not only in the Czech Republic but also in other post-communist countries (e.g. Gál and Ptáček 2017). Therefore, strictly speaking, these funds represent a kind of short-term rehabilitation of a long-underfunded system. In the future, we can expect a risk to the sustainability of these projects (or R&D infrastructure developed within these projects) in connection with the reduced drawing of money from EU structural funds and it will be necessary to seek national resources and increase the share of businesses.

The projects that were implemented represent a sort of "window of opportunity" for the above-mentioned universities and other R&D institutions to get onto the same level as in Western Europe in terms of the quality of the infrastructure used. Even the experts who prepared the VaVPI Operational Programme and monitor its implementation know that not all of the projects being supported will be successful and in the long term they will hardly meet their expected purpose, i.e. a closer link between R&D at universities and the business sector, which should be associated with self-financing and financial sustainability (JIC 2016).

It is supposed that a similar situation also exists in developed Western Europe. It can be hard to find any cases where all the money spent on R&D support infrastructure has been fully utilised. R&D is often not possible without the help of the public sector and there are only some sectors in which we can expect close links with the business sector (Kadlec and Blažek 2015). Additionally, in the environment of post-communist countries, these conditions are even more limited and more difficult (for the reasons described in theoretical part).

Nevertheless, we can expect and, albeit with a certain degree of uncertainty, estimate the types of projects and regions with a relatively successful and sustainable long-term potential for an increase in the value of money invested in the system. Generally, it depends largely on a number of factors whose effects are often mutually reinforcing:

– it can be assumed that the synergetic effect with greater involvement of the business sector can be expected in metropolitan rather than in non-metropolitan regions. In the Czech Republic, this definition applies to the metropolitan regions of Prague, Brno, and Ostrava (Stryjakiewicz 2010 and Ženka and Slach 2016);

– it can be assumed that the projects which will be successful and sustainable in the long term will be those whose specialisation (and also the specialisation of the respective universities) is consistent with the sectoral focus and innovative potential of companies operating in the region. Here, the offer from the universities and their R&D centres will naturally comply with the demand within the region (Gál and Ptáček 2011, 2017). It may not be just the interest from local companies, but, in the case of multinational companies, the spill-over effect in the R&D area works to a significantly lesser extent (Radosevic 2004, 2011). In addition, multinational companies usually accept and participate in R&D only if it is really excellent;

– it turns out that a higher rate of success in the transfer of innovation outside universities occurs in regions where the supportive institutional infrastructure works properly and aligns the often divergent demands and expectations of key actors in the area, i.e. the business and public sectors (government, local government) and the possible potential of universities. In regions where such support infrastructure works on a long-term basis and relatively successfully, the interests of all these actors dovetail and the R&D infrastructure is used and operated more efficiently in general, i.e. also at universities (JIC 2016);

– in addition to the factors described above, it is also appropriate to highlight the discrepancy between the expectations of the public sector and objectively possible reality in terms of the utilisation of the R&D potential of universities. It is true that in the regions where the university is often the most important scientific-research institution, these expectations are often unrealistic (Gál and Ptáček 2017).

On the basis of these assumptions, we can expect future strengthening in those regions and those universities where the above-mentioned factors will work synergetically. In this context, we can mention Brno and South Moravia or, under certain circumstances, also other regions where projects that are supported have a chance of succeeding. Their success is based partly to factors that may be influenced by the proactive approach of representatives of universities, public institutions, and the business sector, while on the other hand there are objectively existing factors which are very difficult to overcome and perhaps only in the long term (Göransson et al. 2009).

CONCLUSION

The article is based on available data on the development of science and research in the Czech Republic after its accession to the European Union. It is too early to evaluate, particularly in the case of projects supported by the VaVPI Operational Programme, whether the success of the application of the results of Czech science and research institutions have been massively supported by public (European) grants in real practice. At Czech universities and other research institutions, there is considerable scientific potential, which is represented by dozens of new research centres, whose ambitions are to establish deeper links between them and practice. Some of the studies that deal with this topic (e.g. Rychlík 2016) mention in particular the publication of articles in the Web of Science and quotes referring to these articles. They are also among the main monitoring indicators of projects, but in terms of the target condition of the programme, they are certainly not

everything. On the other hand, it is not entirely clear whether the research centres will continue to exist in future when they "run out" of funds from public sources and contract research is not sufficient (Štampach 2015). There are many questions to which the answers are unknown at present. Therefore, the authors intend to continue working on the topic in order to further analyse the impacts of the newly developed R&D infrastructure on businesses in practice.

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Pavel P t á č e k, Zdeněk S z c z y r b a

ROLE UNIVERZIT PŘI POSÍLENÍ INOVAČNÍHO POTENCIÁLU A VĚDECKO-VÝZKUMNÉ INFRASTRUKTURY V ČESKÉ REPUBLICE: PŘÍPADOVÁ STUDIE STRUKTURÁLNÍCH FONDŮ EU

Článek se zaměřuje na třetí roli univerzit, a to zejména při posilování jejich spolupráce s podnikatelským sektorem a zvyšování potenciálu jejich vědecko-výzkumné infrastruktury. Jedním z důležitých nástrojů pro posílení tohoto potenciálu byly v programovacím období 2007 – 2013 strukturální fondy EU, z nichž bylo v Česku přibližně 14 % alokováno a vyčerpáno v rámci dvou operačních programů – OPVK a VaVPI. Univerzity využily přibližně polovinu tohoto rozpočtu, především na posílení vědecko-výzkumné infrastruktury ve formě budování center excelence a regionálních výzkumných center. Vzniklo osm center excellence, z nichž se univerzity podílely na třech a v případě regionálních výzkumných centrech se university podílely na 25 projektech. Pokud jde o jejich geografické rozložení, projevuje se zde princip koncentrace, kdy pět univerzit získalo podstatnou část alokovaných prostředků (35,6 %). Vybudovaná infrastruktura představuje potenciál pro posílení spolupráce s podnikatelským sektorem, i když dosavadní nastavení indikátorů úspěšnosti projektů spíše podporovalo jejich potenciál v základním výzkumu. Do budoucna lze předpokládat, že projekty naplňující třetí roli univerzit budou tam, kde funguje podpůrná institucionální infrastruktura, v metropolitních oblastech a tam, kde již fungují vazby mezi podniky a univerzitami.