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Public Support for Higher Education Institutions from EU Structural Funds and its Evaluation: Case Study of Slovakia

Peter Pisár[1], Martin Varga[2]

Abstract

The European Union gives universities an important place to participate in research and development in the country. The basic research and teaching process of higher education institutions is gradually becoming more and more scientific, and the importance of science and research is growing. The growing importance of R&D for universities also increases the importance of public support in this area. Slovakia was eligible for support from the structural funds by joining the EU. In the period 2007–2013, universities have had the highest increase in science and research spending due to the use of these resources. However, it is a question of the extent to which this form of public support has contributed to the field of research and development of higher education institutions and whether there has been a real increase in their research and development activities. We examine the effectiveness of the support granted to public universities from the European Union Structural Funds on the basis of measurable indicators of granted projects and the impact of outputs on their scientific research potential in the regions of Slovakia. The results of the analysis highlighted the high level of public support for university infrastructure projects at the expense of support with a focus on intellectual property creation and patents. The discussion is focused on whether the funds allocated in this way were effective in relation to the objectives of the Operational Program Research and Development 2007–2013 and thus contributed to an increase of scientific and research potential at higher education institutions in the regions in Slovakia.

Keywords:
Higher Education, Public support, Structural funds, Research and Development

1 Associate Professor, Faculty of Economics, Matej Bel University in Banska Bystrica, Slovak Republic.

2 PhD student, Faculty of Economics, Matej Bel University in Banska Bystrica, Slovak Republic.

1. Introduction

Research and development is the output of a number of innovation actors in the individual regions of the EU Member States – the sector of universities, the private sector, the non-profit sector and the public sector (European Commission 2016). The university sector has its inherent role in R&D and represents a significant place in innovative systems within the concept of the Triple Helix Model (Etkowitz 2008; Etkowitz and Leydesdorff 2000). The need for the innovation and promotion of science and research is also recognized by the European Union through its institutions and particular public policy support programs. These include strategic guidelines and documents specifically aimed at supporting science and research, in order to mobilize financial investment from innovative actors.

Due to a higher impact of the university sector, there are several possibilities for funding research and development in the European Union. This is largely funded from the state budget and government agencies. Public higher education institutions in Slovakia were eligible for R&D support and were able to use the Structural Funds of the European Union. This support should ensure the improvement of the science and research infrastructure. In view of the significant increase in the impact of these interventions, it is necessary to examine how this public support promoted the growth of R&D in the 2007–2013 programming period and whether these resources were effectively used. The effectiveness of the aid granted is primarily sought by the European Commission.

The aim of the article is to examine the effectiveness of the support provided to public higher education institutions from the European Union Structural Funds for the 2007–2013 programming period on the basis of measurable R&D project indicators and to verify whether the allocated funds have had an impact on enhancing the scientific and research potential of universities in the regions in Slovakia. For the purpose of achieving the main goal of the article, a sample was selected. The range consists of public higher education institutions and their activities in the regions in Slovakia. The research methodology is based on a combination of deduction methods, induction, comparisons, synthesis and practical studies of supported projects of universities that have received support from the European Union's Structural Funds. The mapping of public support from the Structural Funds is based on secondary data and methods of deduction and induction. The basic resources needed to process the necessary data are mainly at the level of strategic documents and drawing lists published by the Structural Funds implementing agencies, European Commission documents, the National Strategic Reference Framework and contracts for financial support to public higher education institutions. In particular, the systematization of indicators is based on the approved programming documents (National Strategic Reference Framework 2007–2013, The Concepts of Financial Management for Structural Operations 2007–2013 and Operational Program Research & Development 2007–2013), which were at the time focused on program-

ming, management and implementation of structural operations for the 2007–2013 programming period.

2. Literature overview

Higher education institutions provide the business sector a basis for research and development, which is then transformed into an economy in the form of innovation. The significant impact of the R&D needs in recent years has seen the emergence of other important roles of universities. Due to the significant impact of new knowledge on economic development, several authors (Erber 2010; Uyarra 2010; Maťátková and Stejskal 2011; Dan 2012) attribute an important place to universities in the innovation systems of regions and countries. Rogers (1986) defines the research and development of universities as a key activity for long-term growth as well as its basic direction. Varga (1998) identifies the impact of university knowledge and research on the growth of regional innovation.

The authors Christensen and Eyring (2011) illustrate how higher education must also respond to the growing impact of science and research and analyze the necessary change from traditionally-oriented educational institutions to scientific-educational institutions. While the European Commission (2011) defines universities as centers of knowledge and education, the OECD (2014) identifies an important role for higher education institutions in moving the frontier of knowledge forward by generating new knowledge. Trippl et al. (2012) note an increasing need for universities to engage in regional activities, particularly in terms of producing new knowledge and subsequently collaborating on research with other innovative actors. "The key role of universities is science, research and development. The implementation of both basic and applied research and the intensified engagement of universities in regional innovation systems contribute to the economic growth and competitiveness of the region. Basic research dominates in universities in Slovakia, while applied research dominates in companies and research institutes. It is the result of a different motivation in the realization of fundamental research, whose potential economic benefits are difficult to estimate, and are hardly empowered" (Ali Taha and Tej 2009, 9). Uyarra (2010) understands universities as a partner of small and medium-sized enterprises in securing production innovation processes, but their important role of universities is attributed by the authors (Trippl et al. 2012) in connection with local institutions and the overall dissemination of knowledge in the regions.

Universities should be involved in creating innovation in the regions as producers of new knowledge. The output of the university's knowledge should flow from the various interactions between several disciplines and ultimately influence the current problems (Gibbons et al. 1994). Higher education research should be applicable at the same time and address the socio-economic disadvantages of the

regions (Nowotny et al. 2001). Varga (1998) claims, that applicable research is any process of transferring information, knowledge, and innovation itself from universities to the private sector. Higher education institutions are defined in developed countries as primary institutions involved in the development of applied research (OECD 2014). Based on the analyzed data, we can state that universities are one of the key elements of innovation systems in individual regions and contribute to the growth of innovation performance and the economic and social development of the country. Applied and fundamental research of universities bring positive externalities to society, which implies that governments should be involved in their funding (Romer 2012).

Funding is also defined as an institution or a project which may enhance competition in the area of the reallocation of funds (Auranen and Nieminen 2010; OECD 2014). In recent years, however, we can also define a significant increase in funding for research and development at universities. The national state plays an important role in supporting R&D through the use of several options, such as maintaining a suitable R&D environment, investing in research, and public support for R&D itself. A major source of project-oriented support is the Cohesion Policy of the European Union. Its primary objective is, in particular, to support the development of more backward regions in order to exploit the local potential for their development. It is one of the key beneficiaries of support to universities. Public higher education institutions were eligible beneficiaries of the Operational Program Research and Development and the Operational Program Education. The Operational Program R&D followed the Community Strategic Guidelines aiming to improve knowledge and innovation for the growth of the Community by increasing investment in research and technological development and facilitating innovation by linking the scientific sphere to the application of R&D results.

Olejniczak (2011) created an evaluation of the ERDF support and a group of authors evaluated the support granted to small and medium-size enterprises (Bernini and Pellegrini 2011). The findings of the authors who examined the impact of public support on research and development of individual innovation actors abroad are also valuable. These include some published studies by German authors (Czarnitzki and Licht 2006; Czarnitzki et al. 2007; Hussinger 2008; Aerts and Schmidt 2008), but we also find analyses of public support for innovation from Spain (Lucena and Afcha 2014) or a comparison of public policies on public support in the UK and France (Freitas and Tunzelmann 2008), measuring for Absorption of EU Cohesion Policy (Mike and Balás 2016). In Slovakia the issue was processed by Šipikal and Nemethova (2017), Szitásiová et al. (2014) and publications by authors Šipikal et al. (2017). Batterbury (2006) identifies three main reasons for the evaluation in his study: responsibility, planning and quality. Basle (2006) is a follow-up to the study and complements the primary objective of assessing the output and quality of the processes as well as their effectiveness, efficiency and impact. In addition to assessing the effectiveness of public support, other public sector views can be seen

in the terms of public sector organizations, as well. For example, published performance studies in EU countrys of different types of public organizations are known – at the level of state/central governmental organizations (Dobrolyubova 2017; Pisár and Šipikal 2017; Virtanen and Vakkuri 2016; Hammerschmid and Löffler 2015), performance management of municipal/regional self-governments regions (Plaček 2017; Špalková et al. 2016) and others.

3. Theoretical-conceptual framework

Based on this theoretical framework, the universities are among the main actors in creating new knowledge, and more public support should be given to the research and development system of those universities. In the article we define the outputs and outlines of supported projects from Structural Funds for the 2007–2013 period. The content of the article is based on the stated scientific aim. The aim of the article is to examine the effectiveness of the support provided to public higher education institutions from the European Union Structural Funds for the 2007–2013 programming period on the basis of measurable R&D project indicators and to verify whether the allocated funds have had an impact on enhancing the scientific and research potential of universities in the regions in Slovakia. Based on this article and the acquired knowledge of the studied subject, we define the research question as follows: Has public support from the EU Structural Funds been used effectively to develop the scientific and research potential of supported universities?

The research methodology was based on a combination of deduction methods, induction, comparisons, synthesis and practical studies of supported projects of some universities that have received support from the EU Structural Funds to demonstrate the effectiveness of using this support. Within the effectiveness of the support provided to public higher education institutions, we focused on the analysis of achieved measurable indicators of Operational Program Research & Development 2007–2013. Due to the broad orientation of the operational program indicators we have analyzed the level of the priority axes. Systematization and breakdown of indicators is based on the approved program documents (NSRF – National Strategic Reference Framework 2007–2013, The Concepts of Financial Management for Structural Operations 2007–2013 and Operational Program Research & Development 2007–2013), which were at that time focused on programming, management and implementation of structural operations for the program period 2007–2013.

4. Evaluation of the effectiveness of EU Structural Funds support

The European Commission is funding research and development in individual regions and countries through its Structural Funds, an example of which is Slovakia.

As part of public spending, the state budget and structural funds are the basic instruments for funding research and development of public higher education institutions. In the last two decades, more attention has been devoted to examining the effectiveness of drawing on these resources, which stems from the principles of the operation of EU support.

4.1 Financing higher education institutions in Slovakia

The main source of funding for public and state higher education institutions is subsidies from the state budget, which are provided under the chapter of the Ministry of Education under the so-called grant contract. The contract contains data on the amount of funds provided, the time, the method of provision and the purpose of the use (Higher Education Act No. 131/2002). Established by Section 89 par. 2 of the Act the financial support consists of the state budget for public higher education from the following four grants providing subsidies for the implementation of accredited study programs, research, development or artistic activity, the development of a college, and social support for students.

Subsidy for research, development or artistic activity is provided under Section 89 par. 5 of the Act. In accordance with Section 16 of Act no. 172/2005 Coll. on the organization of state support for research and development and on the amendment of Act no. 575/2001 Coll. on the organization of government activity and the organization of the central state administration, as amended, state support for research and development at public higher education institutions is provided in an institutional form and purpose form (providing funding for research and development projects through the Research and Development Agency).

The funding system has long prevailed in the quantitative principle of allocating grants according to the number of students. At present, the quality of results in science and research at a supported university is also taken into account (Šebová 2009). At present, an increasing proportion of funding is linked to defined performance indicators of universities through grant sources. It is either proportionally linked to the achievement of indicators by individual universities or distributed directly to specific projects through competition. In the first case, this may be funding based on backward measurement of outputs. Such a scenario has been applied to Slovak universities since 2002. The reason was the new Higher Education Act no. 131/2002, which changed universities from state budget organizations to public higher education institutions (with the exception of the Police Academy, the Academy of the Armed Forces and the Slovak Medical University, which remained state budget organizations). This also changed the Slovak funding system for universities. Its positive point is that it introduces performance parameters into funding and forces universities to compete (Devínsky 2015).

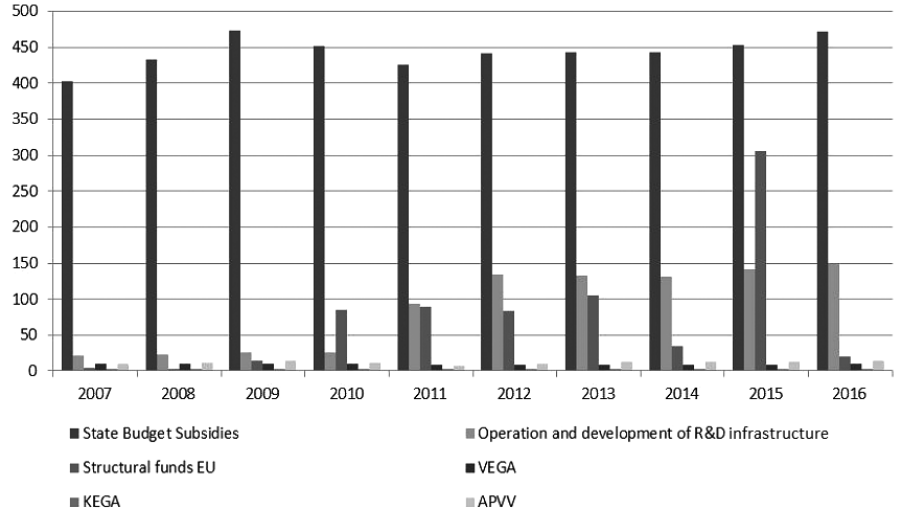
The arrangements for the breakdown of individual grants are different. In particular, two procedures are used: a performance-based breakdown in education

and a performance-based breakdown of research. In addition, the system uses basic grant-based procedures, an index approach based on the breakdown of the previous year, a breakdown based on the quality of the projects, a breakdown based on the individual requirements of higher education institutions, a breakdown based on statutory claims and a breakdown based on some other performance indicators (Mederly 2009).

The second form is mostly project-oriented challenges and government schemes available to all universities and other research entities. In Slovakia these include the VEGA, KEGA, or APVV schemes. Using funding through government schemes allows the identification of the main priorities for R&D to be addressed (OECD 2014). Research funding priorities and strategies are key aspects which influence knowledge creation in the country. However, funding sources for research at universities may be different and can be defined as internal and external sources of funding. Internal resources are government resources and university assets, while external resources are mostly made up of public support agencies, domestic or foreign grants, or support from the EU Structural Funds (Šipikal and Nemethova 2017).

Graph 1

Public support granted for the scientific and research activities of public higher education institutions (mil. EUR)



Source: Self-processed

For the purpose of a comprehensive analysis of public support provided to public higher education institutions in Slovakia, we identify the importance of the

different forms of their multi-source financing. Graph 1 summarizes the amount of cumulative annual support for public higher education institutions over the period 2007–2016.

As part of public support to public higher education institutions, we can see a significant increase in funding for research, development and arts activities in 2011. Operating and R&D infrastructure spending grew in total from 21 to 25 million EUR between 2007 and 2010. Therefore, there is the presumption that the growth of public support from the Structural Funds has also led to an increase in these R&D expenditures from the state budget. The increase can also be attributed to the need for co-financing of supported projects from the EU Structural Funds. The total volume of operation and development of R&D infrastructure expenditures for science and research increased by more than 126 million EUR in the reference period 2007–2016. According to the data from Graph 1, we can state the development of drawing of the European Union Structural Funds, which benefited public universities in Slovakia in the period 2007–2016. Even on the basis of chart data, we can see a significant increase in R&D funding from the Structural Funds. These form a separate group in the financing system, and their financing was linked to the co-financing of the state budget and the final recipient of the aid granted.

4.2 Financing Higher Education Institutions from Operational Program R&D 2007–2013

Public higher education institutions were eligible beneficiaries of the Operational Program Research and Development 2007–2013. This program had several priority axes, depending on the focus of the investment, its specificity, as well as the territorial allocation in the regions. Within the framework of this Operational Program, 250 projects of public universities were approved in total. The cumulative numbers of contracted projects depending on the inclusion of projects in individual priority axes can be seen in Table 1.

Table 1

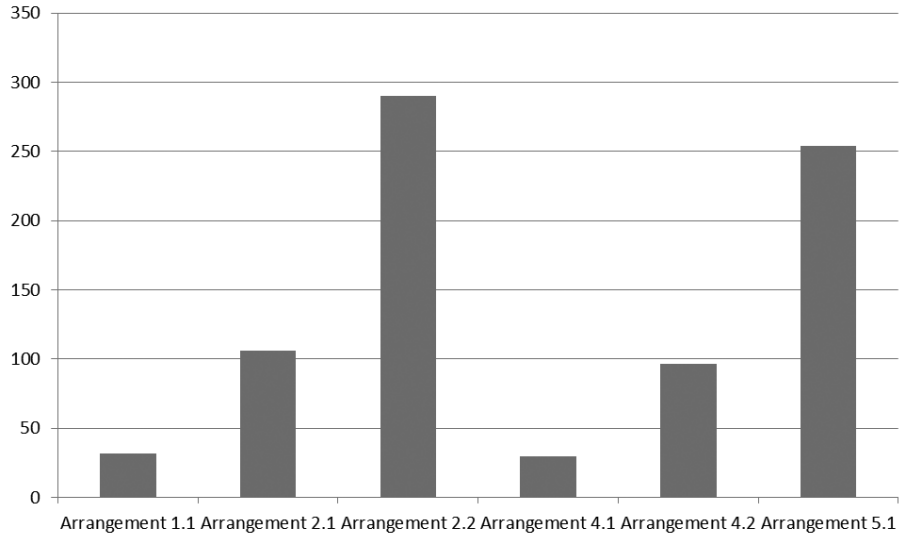
Number of Operational Program Research and Development 2007–2013 contracts contracted by public higher education institutions

Priority axes	Number of projects
1. R&D infrastructure	14
2. Support of research and development	125
4. Support of research and development in the region of Bratislava	37
5. Higher Education Infrastructure	74
Total OP R&D	**250**

Source: Self-processed, based on NSRF data 2007–2013

The largest number of supported projects is found in Priority Axis 2: Support for research and development, whose main objective was to focus on creating functional links between research and development workplaces in the Slovak Republic and abroad that have the potential to achieve top performance and to contribute to the development of the region where they are located. A very significant area of research and development support for universities was the area of R&D infrastructure, and a high volume of financial allocations was also granted under Priority Axis 5: Higher Education Infrastructure. The cumulative absolute values (EUR) of the supported projects under the individual priority axes of the Operational Program Research and Development 2007–2013 are illustrated by Graph 2.

Graph 2
Allocation of public support in the priority axes of Operational Program Research and Development 2007–2013 (mil. EUR)



Source: Self-processed, based on NSRF data 2007–2013

This fact is due to the strategic priority of the NSRF SR "Knowledge Economy", which is defined by the four specific priorities (NSRF 2007): Promoting the competitiveness of enterprises and services, in particular through innovation; infrastructure of universities; research and development and company computerization.

The largest number of projects was approved for the activity of Priority Axis 2: Support for Research and Development. The emphasis was therefore placed on achieving the priority axis objective, which is to make the R&D support system more effective so as to contribute to an increase of economic competitiveness, high-

tech small and medium-sized enterprises and create new jobs while reducing regional disparities. In particular, projects aimed at enhancing the quality of research centers and promoting excellence in research, focusing on areas of strategic importance for the further development of the economy and society as well as increasing the level of cooperation between R&D institutions and social and economic practices through the transfer of knowledge and technology.

The results and impacts of public allocation of funds can be seen in the measurable indicators of supported projects and their priority axes. The following subsection defines the benefits of the Structural Funds concerning the indicators of the projects of public higher education institutions.

4.3 Implementation of the planned measurable indicators of the Operational Program Research and Development 2007–2013

The system and its breakdown of indicators is based on the approved programming documents (NSRF 2007–2013, Concepts of Financial Management of Structural Operations 2007–2013 and Operational Program Research and Development 2007–2013), which were at that time focused on programming, management and implementation of structural operations for the 2007–2013 programming period.

To compare the indicators of the supported projects, the cumulative values of the achieved levels of higher education institutions were identified. Measurable indicators are result-oriented and impact-oriented and depend on the classification of the respective operational program and their values and are presented in the numbers. Their breakdown is based on the approved specific documents for programming, management and implementation of structural operations in the 2007–2013 programming period. Depending on the focus of the priority axes, we have divided the surveyed indicators according to their focus and ranking and quantified the cumulative contribution to the higher education institution.

The data of the selected results and impact indicators at the project level were summarized in Table 2. Both the evaluation documents of the European Commission and the Evaluation reports of the individual operational programs identify the levels of achieved measurable indicators only at the cumulative levels of the operational programs or priority axes. Next, we define the main areas of focus of measurable indicators of the supported projects.

Table 2
Areas of focus and identification of measurable indicators of the Operational Program Research and Development 2007–2013

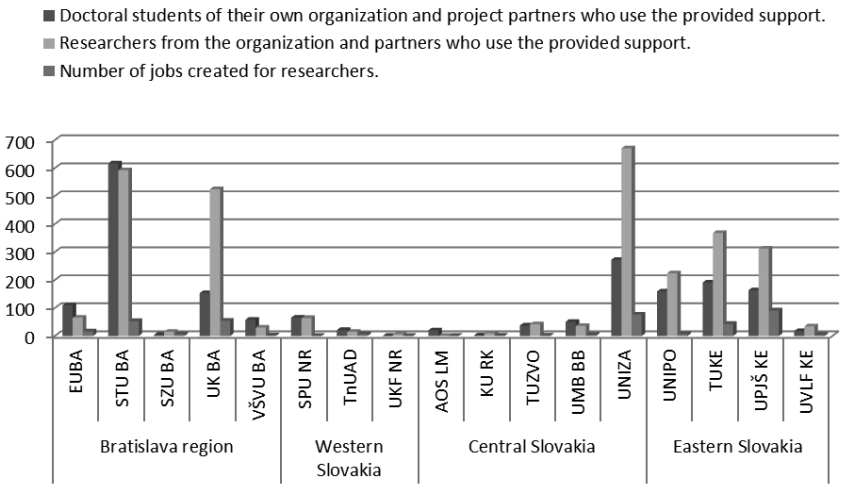
Field of focus of indicators	Identification of measurable indicators
1. Human Resources	a. Doctoral students of their own organization and project partners who use the provided support, b. Researchers from the organization and partners who use the provided support, c. Number of jobs created for researchers.
2. Publishing Performance	a. Number of publications in current journals, b. Number of publications in non-current journals, c. Number of scientific works published in reviewed scientific journals, d. Number of scientific works published in non-reviewed scientific journals and collections, e. Number of professional book publications.
3. Protection of Intellectual Property	a. Number of patents granted by the USPTO, b. Number of EPO patent applications, c. Number of other forms of patent protection.
4. Infrastructure of Higher Education Institutions	a. Number of machines, apparatus and equipment acquired, b. Number of learning with established or upgraded ICT networks, c. Number of renovated buildings and facilities, d. Number of newly built buildings and facilities.

Source: Self-processed, based on NSRF data 2007–2013

Firstly, we analyze the measurable indicators achieved in the field of human resources. The values of the achieved numbers in individual categories are identified in Graph 3. Based on the data, we monitor the positions of several universities in individual regions of Slovakia in the area of human resource creation. Outside the Bratislava Region, the best achieved values in the 2007–2013 programming period can be found in Eastern Slovakia. The results of the measurable indicators of Central Slovakia also reached high values in the monitored period of the programming period, but we can identify a significant difference in the generation of human resources indicators and the significant impact of Žilina University when comparing the individual beneficiaries. Other beneficiaries have very low values of measurable indicators. The Region of Western Slovakia has achieved the cumulative lowest results in the analyzed indicators, which also results in a lower level of public support from the EU Structural funds compared to other beneficiaries.

Graph 3

The values of reported measurable indicators of the Operational Program Research and Development 2007–2013 at the level of human resources



Source: Self-processed, based on NSRF data 2007–2013

Concerning the public support provided, we identify the total contribution of the Structural Funds at the level of human resources and creation of jobs for the researchers (Table 3) and we compare the achieved values of the created functional positions with the overall state at the public universities in the monitored period 2009–2016.

Table 3

Contribution of the Structural Funds of the European Union to the creation of researchers' positions in higher education institutions

Examined variable	Number of research staff of public higher education institutions
Total for public higher education institutions (average 2009–2016)	1,603
Contribution of the EU Structural funds	358
Percentage contribution of EU Structural funds	22.34 %

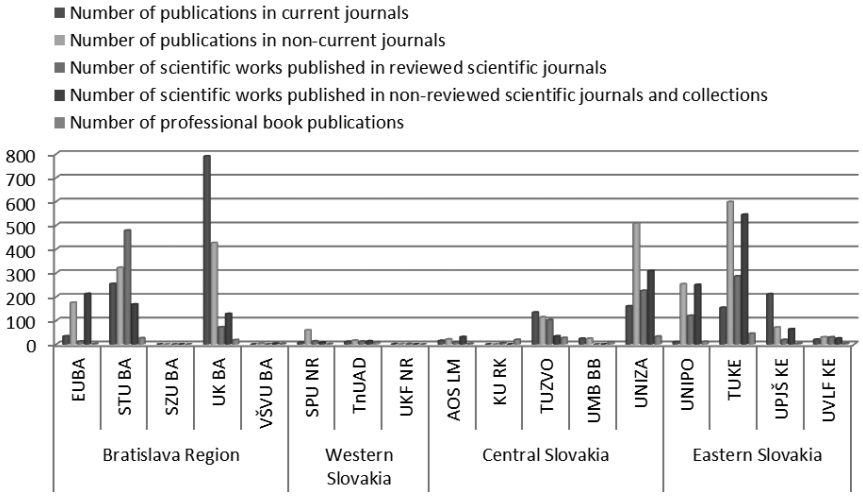
Source: Self-processed

Based on the results of Table 3, we can see a significant impact in over 22 % of the cases on the job creation of research staff supported by public higher education institutions thanks to public support from the EU Structural Funds.

The second group of measurable indicators is scientific publications. The values of the achieved number of publications in each category are identified in Graph 4.

Graph 4

The values of reported measurable indicators of the Operational Program Research and Development 2007–2013 in the publication performance of the beneficiaries



Source: Self-processed, based on NSRF data 2007–2013

In the case of human resources indicators, we note a significant difference between the regions of Bratislava compared to other regions concerning publishing activities. Low publication values can be seen in Western Slovakia. On the contrary, the highest impact can be seen in Eastern Slovakia. The publishing performance of Central Slovakia is significantly influenced by the University of Žilina as a result of the public support provided. However, we also notice a significant contribution at the Technical University in Zvolen. When comparing the published outputs with the overall state of publications for the analyzed public higher education institutions, we can note the very low contribution of EU funds (Table 4).

Table 4
Contribution of the Structural Funds of the European Union to the growth of publishing performance of universities

	Professional book publications	Publications in periodicals	Scientific works published in the reviewed scientific periodicals
Total (number)	10,849	19,732	172,349
Contribution of the Structural Funds EU (number)	212	1,825	1,385
Contribution of the Structural Funds EU (%)	1.95 %	9.25 %	0.80 %

Source: Self-processed

It is also questionable how effective the publishing performance was, based on the creation of researchers' positions in higher education institutions. We note a 22.34 % contribution of EU Structural funds to the creation of those positions, but the contribution of the Structural Funds to the growth of publishing performance achieved a much lower percentage. The created research positions did not lead to the same creation and growth of publishing performance of universities.

The highest shortcoming in achieved measurable indicators of the regions is the issue of protection of rights in the form of patents. The values of the achieved indicators are illustrated in the Table 5.

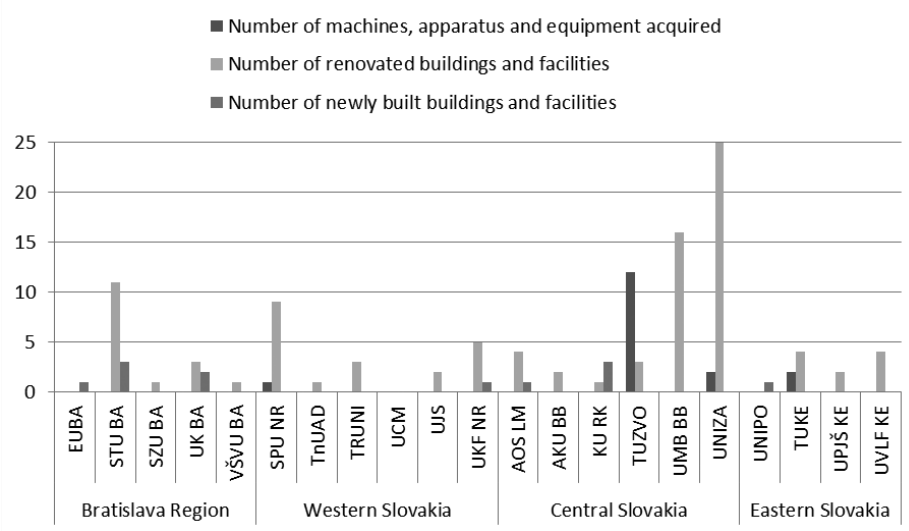
Based on the values of Table 5, we can see significantly low patent values, especially in the field of EPO patent applications. In most universities, the patent values were zero, and higher values were achieved in technical universities. Patents are generally at the lowest levels in relation to the support provided.

Table 5
The values of reported measurable indicators of the Operational Program Research and Development 2007–2013 in the field of patents

NUTS 2	Beneficiaries of the support	Number of Patents granted by USPTO	Number of patent applications for EPO	Number of other form of patent protection
Bratislava region	EUBA	0	0	0
	STU BA	0	4	26
	SZU BA	0	0	0
	UK BA	0	0	3
	VŠVU BA	0	0	0
	TOTAL	**0**	**4**	**29**
Western Slovakia	SPU NR	0	0	0
	TnUAD	0	0	0
	UKF NR	0	0	0
	TOTAL	**0**	**0**	**0**
Central Slovakia	AOS LM	0	0	0
	KU RK	0	0	1
	TUZVO	0	0	5
	UMB BB	0	0	0
	UNIZA	0	2	10
	TOTAL	**0**	**2**	**16**
Eastern Slovakia	UNIPO	0	0	3
	TUKE	35	1	17
	UPJŠ KE	0	0	6
	UVLF KE	0	0	0
	TOTAL	**35**	**1**	**26**

Source: Self-processed, based on NSRF data 2007–2013

Graph 5
The values of reported measurable indicators of the Operational Program Research and Development 2007–2013 in the field of Infrastructure



Source: Self-processed, based on NSRF data 2007–2013

The last set of indicators under the Operational Program Research and Development 2007–2013 deal with infrastructure. Support for university infrastructure and R&D equipment was mainly focused on the technical and construction infrastructure of individual beneficiaries. Based on the previous Chart 5, we can see a significant use of public support for higher education institutions for the reconstruction of buildings and facilities, or even new buildings and facilities. Most notable is the allocation of funds to the University of Žilina and Matej Bel University in Central Slovakia. Improving the infrastructure through the purchase of new machinery and equipment can be seen in the Technical University in Zvolen and Košice.

4.4 Discussion

There are several open issues to discuss. The first problem area is the extent to which the infrastructure of universities influenced the growth of research and development at these schools. The results of the analysis have highlighted the high orientation of supported Structural Funds projects. In particular large investment projects, such as the development of university infrastructure and research and development infrastructure at public higher education institutions were supported at the expense of intellectual property and patents projects. More than 33 % of the total EU Structural Fund support from the Operational Program

Research and Development was provided in Priority Axis 5: Higher Education Infrastructure to improve the quality of education through investment in physical infrastructure for the purposes of the learning process. The fulfillment of the objective was implemented under one measure 5.1 Building the infrastructure of the higher education institutions and modernizing their internal equipment in order to improve the conditions of the educational process. The question here is whether the allocated funds thus led to an increase in the scientific and research potential at higher education institutions in the regions of Slovakia. This situation is illustrated by two case studies of good and bad practice of specific supported projects under Priority Axis 5: Higher Education Infrastructure.

The second problem is the focus and correctness of setting up the Operational Program Research and Development 2007–2013 in relation to its objective. In view of the focus of the Operational Program Research and Development 2007–2013, it is unjustifiable to include the discussed measure 5.1 and its priority axis. The inclusion of this priority axis in this operational program itself can be considered inappropriate as these activities should be supported by other operational programs. In this case, reallocation could take place under other priority axes, and higher support should be given to outputs in the area of research and development. This Operational Program should build on the Community Strategic Guidelines, which aim to improve knowledge and innovation for the growth of the Community by increasing investment in research and technological development and facilitating innovation by linking the scientific sphere with the application of research and development results to practice. Investing in the R&D material infrastructure should serve as a prerequisite for growth in the research activity of higher education institutions in the coming years, but the scientific and research contribution of the physical infrastructure of universities continues to be questioned. We also note a 22.34 % contribution of EU Structural funds to the creation of positions, but the contribution of the Structural Funds to the growth of publishing performance achieved a much lower percentage. That resulted in lower performance of the created positions and lower effectiveness of those public resources. It can also be the result of bad focus and setting up of the Operational Program Research and Development 2007–2013.

The third problem is the effectiveness of setting the evaluation policies at the level of the operational program. The findings of the ex-ante evaluation reports of Operational Program Research and Innovation 2014–2020 in the part of setting measurable indicators showed that the indicators of Priority Axis 5: Higher Education Infrastructure as well as the inclusion of this priority axis within the Operational Program Research and Development 2007–2013 were not properly set, resulting in shortcomings in the measurable indicators from the 2007–2013 programming period. On the other hand the programming documents define the justification of infrastructure support due to the necessary investment need for high-tech equipment, which should later re-orient the supported grant schemes to support the output of the R&D and innovation system.

4.5 Case study on the allocation of public support to higher education institutions from the EU Structural funds

In order to better define the impacts of the support provided from the Structural Funds, we analyze selected case studies of good and bad practices under Priority Axis 5: Higher Education Infrastructure. As an example of the specific allocation of public support from the EU structural funds, we include supported projects at Žilina University (UNIZA) and the University of Konštantín Filozof in Nitra (UKF NR).

Table 6
General information of the UNIZA supported project

University	Žilinská univerzita v Žiline
Project	Complex modernization of UNIZA
Volume of granted public support	5,117,838 EUR

Source: Self-processed, based on NSRF data 2007–2013

Concerning the supported project, the main objective was to increase the quality of the teaching process by investing in the reconstruction of the material infrastructure and the modernization of information and communication technologies. Specific objectives for the project were also defined:

1. Improving the conditions and quality of the teaching process by modernizing ICT at the premises of the University of Žilina.
2. Improving the quality, efficiency and attractiveness of education by modernizing the teaching space of individual faculties of the university.

The main activity of the project consisted of several sub-activities that contributed to the fulfillment of the stated objective of the project, namely:

- Modernization of electrical installations,
- Enlargement and upgrading of ICT networks,
- Provision of internal equipment for lecture rooms and teaching staff and its faculties,
- Purchase and installation of video conference system (VCS),
- Modernization of social facilities at the Faculty of Mechanical Engineering,
- Reconstruction and modernization of FRI – building A,
- Reconstruction and modernization of teaching laboratories.

The added value of the main activity was determined as a result of the increase in the satisfaction of the UNIZA students as well as in the quality of the teaching process. This project should also help to strengthen the competitiveness of the UNI-

ZA in the spectrum of universities. The implementation of the supported project defined the basic impact in two areas, namely:

1. direct impact on all participants in the teaching process,
2. indirect regional impact, which can be characterized, for example, through a higher quality of lifelong learning.

Table 7
Values of reported measurable indicators of the supported UNIZA project

Indicator name	Achieved value
Number of organizations with upgraded indoor equipment	1
Number of learning with established or upgraded ICT networks following the implemented project	115
Number of renovated buildings and facilities	3
The amount of funds spent on the reconstruction of buildings and facilities	2,414,823 EUR
The amount of funds spent on the modernization of internal equipment	2,703,015 EUR

Source: Self-processed, based on NSRF data 2007–2013

Based on the amount of the support provided, we can state a high amount of funds spent on modernization and reconstruction. However, it should also be noted that a total of 911,828 EUR was spent on the modernization of electrical infrastructure, representing almost 18 % of the total amount provided. However, within the framework of the supported project, we can define the support of the infrastructure in relation to the research activities of the higher education institution. The support of the project is mainly in the field of teaching laboratories, a conference system, or the modernization of ICT networks, which should lead to the future growth of research and development at the given university.

A second practical example of supported projects under this Priority Axis 5: Higher Education Infrastructure is the UKF NR. The basic information on the example of a supported project is identified in Table 8 below.

Table 8
General information about the supported project UKF NR

University	University of Konštantín Filozof v Nitre
Project	Infrastructure development focusing on ICT – a condition for education in the 3rd millennium
Volume of granted public support	5,117,838 EUR

Source: Self-processed, based on NSRF data 2007–2013

The main objective of the project was to improve the conditions of the educational process at the UKF NR through the modernization of the infrastructure with an emphasis on the use of ICT. The specific objectives of the supported project have also been defined, namely:

1. Upgrading the learning areas with an emphasis on introducing new and expanding existing ICT forms in the learning process.
2. Expansion and reconstruction of educational facilities at the UKF NR.

The main activity of the project consisted of several sub-activities that contributed to the fulfillment of the stated objective of the project, namely:

- Enhancement and enhancement of data network security at the UKF NR,
- Replacement of outdated PCs within Incoming Common Spaces,
- Creating an integrated information system,
- Establishment of a library information system and automated evaluation system,
- Creation of ICT background for internal PhD students and young scientists,
- Upgrading, completion and reconstruction of the Central European Studies Faculty,
- Modernization of the infrastructure through reconstruction of lifts in dormitories of UKF NR,
- Modernization of the pool's technological equipment,
- Upgrading the infrastructure in the form of window exchanges.

On the basis of the sub-activities, we can say that several activities have had no impact on research and development at the supported university. Besides the fact that the activities did not have an immediate effect on the growth of research and development, we can state that from the point of view of supported project sub-activities, it is very questionable whether the environment for the growth of R&D and its outcomes in the future is improved by this support. Under the 2007–2013 programming period, under the R&D infrastructure of the R&D Operational Program, which should be predominantly set up to support the R&D area, they have been supporting activities to upgrade lifts, upgrade the pool, or modernize the infrastructure and the changing of windows. These indicators and supported activities have had no R&D and have no impact on innovation. Such activities should be supported by other operational programs, such as environmental programs or technical assistance. The overall contribution in the form of the indicators of the supported project is identified in Table 9.

Concerning the results and the focus of the main and side activities of this supported project, we can state that the supported project did not affect the output-based research and development of the college and had a minimal impact on the growth potential of R&D on the entry side.

Table 9
The values of reported measurable indicators of the supported UKF NR project

Indicator name	Achieved value
Number of organizations with upgraded indoor equipment	1
Number of classrooms with established or upgraded ICT networks	208
Number of renovated buildings and facilities	2
Total amount of funds spent on a supported project	5,599,092 EUR

Source: Self-processed, based on NSRF data 2007–2013

5. Conclusion

Based on the analysis of public support from the Structural Funds of the European Union in the program period 2007–2013, the beneficiaries of which were public higher education institutions, we have reached a number of conclusions and recommendations. These resources were one of the main sources of R&D funding for public higher education institutions. For the 2007–2013 programming period, several priority axes have been created under the Operational Program Research and Development to use this support from the European Union Structural Funds for public higher education institutions. However, the overall allocation of resources from the Structural Funds as well as the individual priority axes were based on the ex-ante analysis of the 2007–2013 programming period, where one of the main focuses of the priority axes and the operational program was the development of the infrastructure of the universities. As we have defined in the article, high levels of public support have been allocated to infrastructure under the Operational Program Research and Development 2007–2013. Public R&D support should be one of the basic prerequisites for the growth of the potential of R&D.

The documents of the 2007–2013 programming period have highlighted the importance of investing in the initial phase of research and development at public higher education institutions by investing not only in R&D equipment, but also in overall infrastructure for improving the quality of education through material infrastructure. However, as we have seen in the examples of supported projects under Priority Axis 5: Higher Education Infrastructure, the supported subactivities of the projects are not related to research and development. These activities should be supported by other operational programs, such as the Operational Program for Environmental Improvement or Technical Assistance. Allocation of these funds to window replacement or modernization of the pool's technological equipment does not have an immediate or future impact on innovation performance, and therefore there is no justification for supporting this activity in the Operational Program Research and Development.

More emphasis is needed in support of patenting and protection of rights in the development of effective innovation policies of the state and regions. Despite the focus of the research and development program on patent creation, we can state that the support received a very low number of patents for the monitored beneficiaries, and for most of the eligible beneficiaries of the higher education sector, this value was zero. In light of the conclusions of the ex-ante evaluation report on Operational Program Research and Innovation 2014–2020 and the lessons learned from the 2007–2013 programming period, more focus should be on linking the operational program and its objectives and setting the focus of the priority axes and measures themselves, depending on the needs of public innovation policies, research and development and the focus of smart specialization.

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