ISSN 2392-1641

Economics and Business Review

Volume 2 (16) Number 2 2016

CONTENTS

ARTICLES

BOOK REVIEWS

Poznań University of Economics and Business Press

Paper based publication

ISSN 2392-1641

POZNAŃ UNIVERSITY OF ECONOMICS AND BUSINESS PRESS
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Printed and bound in Poland by:
Poznań University of Economics and Business Print Shop

Circulation: 300 copies

Economics and Business Review, Vol. 2 (16), No. 2, 2016: 39–53
DOI: 10.18559/ebr.2016.2.3

Structural barriers to research and development activities in emerging markets: the case of Poland, the Czech Republic, Slovakia and Hungary[1]

***Anna Odrobina*[2]**

Abstract: The paper discusses the structural barriers to R&D in Poland, the Czech Republic, Slovakia and Hungary, emerging markets striving to build economies based on innovation and knowledge. In reality research and development in the above countries suffer from some structural faults including: deficiency in R&D investments, ineffective structure based on government funding and insufficient engagement of business in financing and implementation of R&D.

Keywords: R&D structure, business R&D deficits, Visegrad Countries, foreign affiliates in R&D, R&D financing.

JEL codes: F23, M21, O30, O57.

Introduction

Presently in every country R&D is considered one of the keys to building an economy based on knowledge as the level of its innovation can determine a country's position in a global economy characterized by intensive technological progress. Even though Poland, the Czech Republic, Slovakia and Hungary have been members of the European Union for over a decade they are still ranked among emerging markets. All of these countries have developed in a similar way, are situated in the same geographical region and are in a similar geopolitical situation. The four countries used to be leaders of political change in Central-Eastern Europe which in 1991 brought about the creation of the Visegrad Group (V4) – an informal organization of mutual assistance

[1] Article received 11 December 2015, accepted 16 May 2016. The publication was financed from funds allocated to the Faculty of Economics and International Relations at the Cracow University of Economics within the framework of the grants for the maintenance of research capacity.

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[MSZ RP 2015; Visegrad Group 2015]. At present they are attempting to build economies based on knowledge and catch up with more developed countries [Visegrad.info 2010]. In this context research and development activity is of fundamental importance, as focus on innovation is viewed as a chance to develop and modernize their economies, which can be further enlarged based on technological progress.

Scientific literature contains some research analyzing R&D in the Visegrad Countries at various levels. Some of them present R&D evolution and compare it with other countries [Piekut and Pacian 2013; Podwysocka 2015; Balcerzak and Pietrzak 2016]. The others show that R&D in V4 is not sufficient to meet the Europe 2020 strategy [Bočková 2013; Balcerzak 2015; Káposzta and Nagy 2015] or is not effective in increasing innovativeness and competitiveness [Gardocka-Jałowiec 2012; Golejewska 2013; Piekut 2013; Bartha and Gubik 2014; Daszkiewicz and Olczyk 2014; Golejewska 2014; Krajewski 2014; Hudec and Procházková 2015; Sierotowicz 2015]. The other authors concentrate on analysing R&D policy and its effects [Owczarczuk 2013; Huňady, Orviská, and Šarkanová 2014]. Some of the studies perform the analysis at the enterprise level [Buckley and Hashai 2014; Hölzl and Janger 2014; Huňady, Orviská, and Šarkanová 2014; Kilar 2014; Tomaszewski 2014].

The following paper is aimed at the identification of problematic areas within R&D in Poland, the Czech Republic, Slovakia and Hungary and determining common deficits in R&D. The paper presents a comparative analysis of the research and development activities in the countries discussed against leading world benchmarks. The paper focuses first of all on the structure of R&D initiatives already implemented since it seems that on the one hand, structural problems in research and development constitute a significant barrier (which hinders the improvement of these economies in terms of innovation and limits the effectiveness of expenditures on R&D) and on the other, they are a manifestation of the faulty and ineffective R&D systems functioning in the countries discussed. The paper is divided into three sections. Section 1 covers the problem of global expenditure on R&D in the analyzed countries compared to global leaders. The second section is devoted to a comparative analysis of the R&D structure in terms of financing and realization. The third section discusses the question of business involvement in R&D, including foreign R&D subsidiaries in the Visegrad Group. The paper is closed with a conclusion.

1. Evolution of expenditure on R&D

The elementary problem for Poland, Czech Republic, Slovakia and Hungary is lack of a global expenditure on R&D (GERD) which keeps them constantly trailing Europe and the world's leading countries. According to Gokhberg [2012: 153–172] and Meske [2004: 185–258], R&D in post-socialist countries

is still under the influence of complicated political, social, economic and institutional considerations from the period of transformation, however changes to the system of R&D are more and more visible, shifting from political and institutional solutions towards economic effectiveness.

In the years from 2000 through 2013 all four countries continued to increase their expenditure on R&D: in 2013 in Poland they amounted to 7.9 bn USD, in the Czech Republic to 5.8 bn USD, in Hungary to 3.2 bn USD and in Slovakia to 1.2 bn USD (Figure 1). All these countries noted more than a three-fold increase in R&D implementation compared to the year 2000 (Figure 1).

Despite the highest nominal R&D expenditure recorded in Poland, considering the size of the economy the Czech Republic presents itself best (although even here the years 2007–2010 witnessed stagnation) and as early as 2007 its R&D expenditure equalled those recorded in Poland. Undoubtedly the stagnation in 2007–10 is a result of the global financial crisis. The better situation of the Czech Republic is also reflected by the ratio of R&D per capita: 553 USD in 2013 (an increase from approximately 182 USD in 2000). Hungary invested around 328 USD per capita in R&D in 2013 which meant a three-and-a-half-fold increase compared to 2000 (96 USD). In Slovakia the ratio amounted to around 220 USD in 2013, up from 71 USD in 2000. Poland fared the worst as it only increased expenditures per capita from 68 USD (in 2000) to 206 USD in 2013. It should be noted that R&D funding rates per capita in all four countries are below the EU 28 average (673 USD in 2013) and OECD average (895 USD in 2013), whereas the highest ratios worldwide were recorded in Sweden (1474 USD in 2013) and the USA (1444 USD in 2013) [OECD 2015a].

It is commonly believed that a country should spend around 3% of its GDP on research and development in order to maintain its position in the global

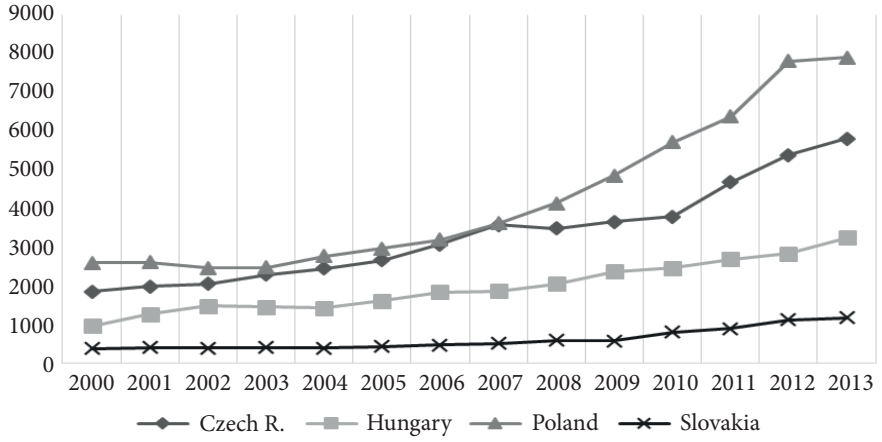


Figure 1. GERD (millions USD PPP)
Source: Own analysis based on: [OECD 2015a]

economy and keep up with technological progress. We should add that only a few countries around the world are able to meet this level and within the European Union itself only Finland, Sweden and Denmark have succeeded in doing so[3] [OECD 2015a]. An analysis of R&D expenditure against GDP makes it clear that Poland and Slovakia did not make any marked progress in the period of 2000–2013 (Figure 2). In 2000 both countries devoted 0.64% of their GDP to research and development, in 2013 in Poland the figure equalled 0.87%, and in Slovakia – 0.83% of GNP. By far the best amongst the four countries discussed is the Czech Republic with 1.12% in 2000 and 1.92% in 2013 whilst the ratio clearly increased since 2010. Hungary, on the other hand, consistently kept increasing its share of R&D of GDP from 0.79% in 2000 to 1.41% in 2013 (Figure 2).

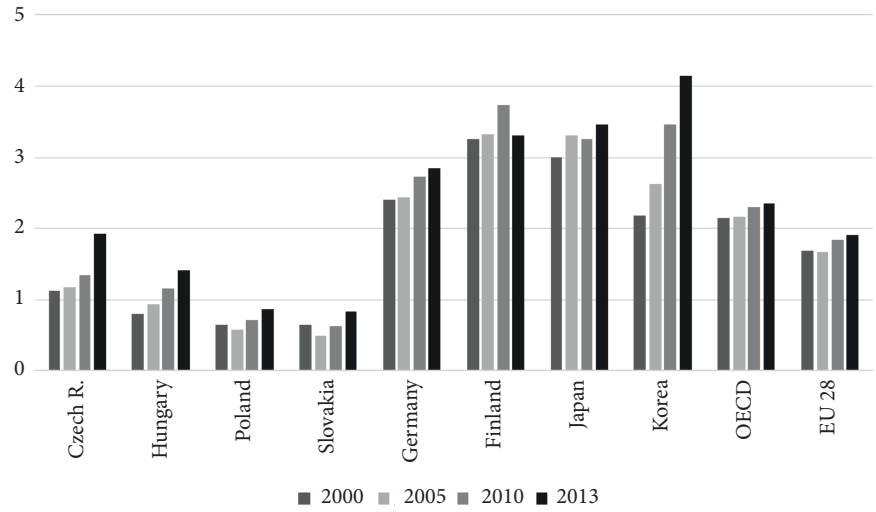


Figure 2. GERD as a percentage of GDP
Source: Own analysis based on: [OECD 2015a]

It is worthy to note that, compared to the rest of the world, the four countries discussed are characterized by too low a share of R&D expenditure in comparison to GDP (the EU share amounted to 1.91% in 2013, OECD equalled 2.36% in 2013, not to mention the world leaders such as South Korea, Japan, Finland or the strongest European economy of all – Germany – 2,85% of GNP in 2013), as shown on Figure 2. In 2012 the European Union adopted a new strategy of research and innovation in which individual goals for all member states were introduced assuming that significant differences in the level of R&D expenditure would make it impossible to reach the goal of 3% by 2020 for a number

[3] In 2013 Finland (3.32%) was ranked in fourth place worldwide after Israel (4.21%), Korea (4.15%) and Japan (3.49%), and was followed by Sweden (3.30%) and Denmark (3.06%).

of member states. Thus for the Czech Republic the goal was set at the level of 2.7%, for Hungary – 1.8%, for Poland – 1.7% and for Slovakia – 1.2% [Eurostat 2012; European Commission 2010].

The effectiveness of R&D expenditure constitutes a serious problem in the V4. The level of the innovativeness in the countries analyzed shows the weakness of the R&D systems which is exposed by Gardocka-Jałowiec [2012], Golejewska [2013] and Hudec and Procházdzková [2015].

The effects of R&D on the economy may be illustrated by the summary innovation index (SII) developed by the European Union. SII is based on 25 aggregated metrics in eight groups: development of human resources, research systems, financing and support, enterprise investment, entrepreneurship, intellectual assets and economic results. Values from 0 to 1 are adopted, wherein a higher value means a higher innovation ratio for that country [European Commission 2013a: 8–10].

The countries discussed do not distinguish themselves with impressive results amongst the so-called moderate innovators and within the European Union; they occupied the following positions in 2014 respectively: the Czech Republic 14th with SII at the level of 0.447, Hungary – 20th with an SII of 0.369, Slovakia – 22nd with an SII of 0.360 and Poland – 24th with an SII of 0.313 [European Commission 2015b: 5, 81]. It should be pointed out that in 2014 the SII ratio for the EU 28 amounted to 0.555 whilst the leader, Sweden had an SII of 0.740. The results of the four countries analyzed here reflect a low level of innovation in their economies, including a low level of effectiveness of R&D expenditure. Although in the years 2007–2014 an average annual rate of SII increase amounted to 2.6% in the Czech Republic, 1.9% in Slovakia and 1.3 in Hungary, i.e. the rate was slightly higher than the EU average, in the case of Poland the speed was lower than the EU reference value (1%) [European Commission 2015b: 13, 15]. In the years 2007–2014 the Czech Republic improved its ratio from 72% to 81% of the EU average, Hungary – in spite of continuous fluctuations – from 65% to 67%, Slovakia – from 62% to 64%, however the Polish ratio dropped from 58% to 56% though it is worth noting that Poland was long-ranked among the lowest group of modest innovators and presently it is placed in the higher group [European Commission 2015b: 47, 61, 65, 69; European Union 2015].

2. Structure of R&D investments

The deficit of research and development expenditure in Poland, the Czech Republic, Slovakia and Hungary should be viewed as a result of structural difficulties concerning financing and the implementation of R&D investment which is a very serious problem requiring systematic long-term actions to resolve [Eurostat 2013; OECD 2012, 2014].

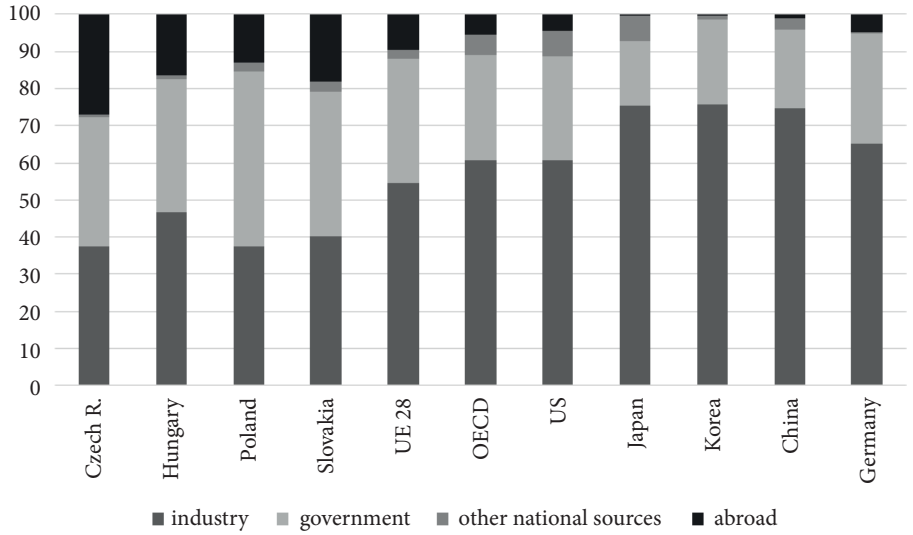


Figure 3. Structure of financing GERD in 2013 (%)
Source: Own analysis based on: [OECD 2015a]

If the sources of financing R&D are analysed then it becomes clear that the key source is government financing, which constituted in Poland 47.2%, in Slovakia – 38.9%, in Hungary – 35.9% and in the Czech Republic – 34.7% in 2013 (Figure 3).

In contrast to the global leaders in R&D who boast government financing at a level of 17.3% in Japan, 21.1% in China, 22.8% in Korea, 27.8% in the USA and 29.8% in Germany (Figure 3), for the countries discussed here this appears to be a serious barrier to dynamic development, commercialization and obtaining economic results from R&D. Moreover depending mostly on government financing of R&D may create difficulties if it increases budget deficit and public debt, since the often-occurring necessity of curtailing public spending may be detrimental to research and development activities. R&D expenditures, however critical for the building of innovative potential in the future, may easily be overshadowed by the current needs of public financing.

The strongest dependency of R&D funding on government support may be observed in Poland and Slovakia whilst in the Czech Republic and Hungary that dependency is weaker but still much above the EU 28 ratio (33.5%), not to mention the OECD countries with a ratio of 28.3% (Figure 3).

An important source of R&D financing is industry which provides a guarantee that its involvement in R&D secures quick commercialization of know-how as well as the selection of ideas into which it invests funds based on economic calculation. It is worthy of note that global R&D leaders base the financing of research and development on industry: in Korea 75.7% of R&D is financed by industry, in Japan – 75.5%, in China – 74.,6%, in Germany – 65.2%, and in the

USA – 60.9% (Figure 3). With this background in the analyzed group of countries we may note one more barrier: the share of industry is clearly insufficient and amounts only to 37.3% in Poland, 37.6% in the Czech Republic, 40.2% in Slovakia and 46.8% in Hungary (Figure 3).

Other domestic sources represent a relatively small source of financing with shares ranging from 0.51% in the Czech Republic to 2.94% in Slovakia. On the other hand an important source for these countries, which does not play any significant role in other countries is foreign funds, the most significant being R&D financing by the European Union within the programme of support rendered to member states[4]. For this reason in the Czech Republic as much as 27.2% of the R&D financing comes from abroad, in Slovakia 18%, in Hungary 16.6% and in Poland 13.3% (Figure 3). Unfortunately the share of foreign financing in Poland is only half that of its Czech neighbour. As has been shown in earlier analyses the latter presents itself most favourably amongst the four countries discussed. Thus effectiveness in obtaining foreign financing is a reflection of the economy's research and development activity.

One consequence of the structure of R&D financing is the share of entities engaged in the implementation of research and development projects as shown in Figure 4. We should note that the global leaders in research and development are characterized by a domination of the business sector in the realization of R&D. In South Korea, Japan and China over 76% of the research projects are done by enterprises, in the USA it is 70%, in Germany nearly 67%. In the group analysed only Hungary, with its figure of 69.4%, comes close to the world's leaders and this is a higher ranking than the EU 28 average (62,7%) and OECD (68.2%). In the Czech Republic enterprises implement 54.1% of R&D investment. Poland has a very low share of business involved in the realization of R&D (43.6%) (in Slovakia this figure is 46.3%). The very weak engagement of enterprises in the realization of research and development projects seems irrational in the context of contemporary market competition which requires an innovative approach to conducting business activity and offering new and improved products. This explains the weakness of Polish and Slovak enterprises since insufficient engagement in research and development may hinder the competitiveness of their companies on both domestic and global markets.

The second entity carrying out R&D tasks is the sector of higher education which handles one third of R&D in Slovakia (33.1%), in Poland (29.3%) and in the Czech Republic (27.2%). Hungary is an exception with only 14.4%. It might be worthy to note that in leading economies in terms of R&D the share

[4] The Framework Programme Horizon 2020 with a budget of 80 billion euro integrates the EU funding of research and innovation based on competitive calls for proposals. For the countries analysed it could present a possibility for increasing R&D financing of excellent and worldclass projects, however the low innovation capabilities constitute the most important barrier. The EU Structural Funds play a crucial role in augmenting R&D financing of the Visegrad countries [Bočková 2013: 875].

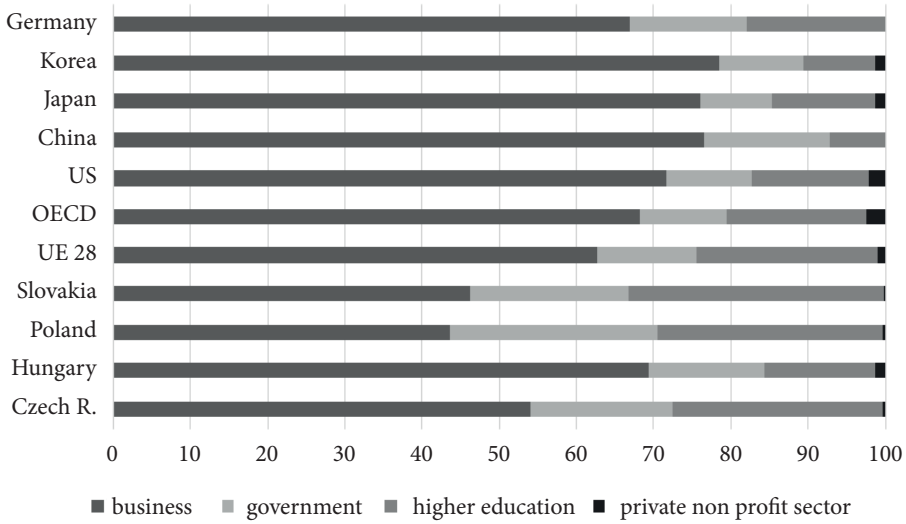


Figure 4. Structure of entities realizing GERD in 2013 (%)
Source: Own analysis based on: [OECD 2015a]

of higher education amounts to a dozen or so percent and in China and in South Korea less than 10% (Figure 4).

The third entity for the implementation of R&D activity is government and in particular state research and development institutions which in Poland carry out one quarter of R&D tasks and in the Czech Republic and in Slovakia – nearly one fifth. Hungary is an exception with approximately 15% of R&D being done by state institutions (similar to China and Germany). In comparison in the USA, Japan and South Korea the government covers about 10% of R&D (Figure 4).

The fourth group of entities which carry out R&D to a minor extent should also be mentioned, i.e. the sector of private, non-profit institutions which finance an insignificant share of 0–2.4% (Figure 4).

3. Problems of R&D enterprises in the countries analysed

One of the key considerations for R&D investments is the active involvement of business. Enterprises invest first of all in development and applied projects with the aim of a quick commercialization in order to improve their own competitiveness on the market. Implementation of new knowledge in the economy brings profits not only to the company involved in its creation, but through synergy effects, it can influence other enterprises and the whole country's domestic market [European Commission 2011, 2012; UNCTAD 2011]. For this reason the effects of R&D financed by the business sector seem better than

those financed from public sources although financing from public funds is indispensable in every economy such as those designated for higher education (securing development of human capital) and for basic research[5]. These are projects which due to their character do not necessarily attract the attention of enterprises.

One of the fundamental problems in the R&D structure in Poland and in Slovakia is that they have one of the OECD's lowest shares of business involvement (BERD – business expenditure on R&D) in the total funding of research and development activities, as depicted by table. Nominally, investments from enterprises in R&D keep growing and the progress in 2013 is evident in all four countries, nevertheless relative judgement against GERD are satisfactory only in the case of Hungary. Poland in the years 2000–2013 displayed stagnation in this respect although minor improvement in 2013 may be observed. On the other hand Slovakia in 2000 recorded better business R&D relative results than in the following years, including 2013. In the Czech Republic as well (although here the situation seems the best) business R&D did not grow at the same rate as the total investment (hence the falling share of BERD in GERD) but one should note that in 2013 the research and development investment of the business sector grew above 1% of GDP. Business R&D funding in Hungary also came close to this level.

In the leading economies of the world (the USA, China, Japan and South Korea) business operators realize approximately 3/4 of the total R&D, and in the often-criticized EU 28, the ratio is nearly 3/5 of GERD (table). This could lead one to conclude that in Poland and Slovakia poor involvement of the business sector in R&D activity is a barrier to the growth of innovation in these economies and the results of research and development projects are not visible since it is mostly the business sector which should support R&D that is easy to commercialize [OECD 2008, 2012].

Without a doubt the insufficient engagement of business operators in R&D in the four countries analysed results from their potential and the strength of their enterprises on the global market which in all four cases is rather poor. None of the countries are home to companies with the highest spending on research and development in 2014. The ranking of the 2500 top enterprises includes only Hungarian Richter Gedeon – 538th overall (141.1 m EUR), Czech CEZ – at 1405th (38.5 m EUR) and the Polish ASSECO POLAND – at 2261th (18.6 m EUR). The rankings do not include any Slovakian companies [European Commission 2015a, 2013b].

[5] In Slovakia, the Czech Republic and Poland R&D activity in large part consists of basic research, respectively: 37.3%, 32.8% and 26.4% of GERD. In Hungary basic research constitutes 16.3% of GERD which is a result of the stronger presence of business in Hungarian R&D. By comparison Japan devotes 12.7% of GERD for basic research. South Korea – 18.1%, and the USA – 17.1%. In China basic research constitutes only 5.0% of GERD [own calculation based on OECD 2015a].

BERD in the selected countries

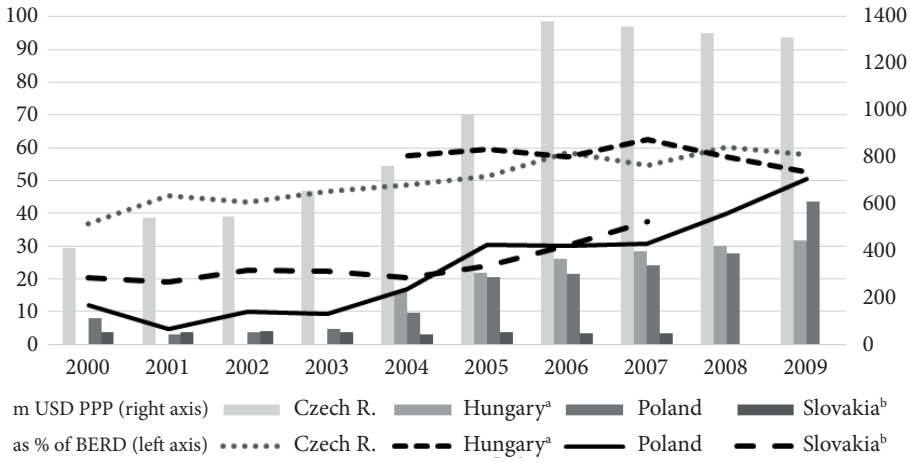
Country	2000			2005			2010			2013		
	bn USD PPP	as % of GERD	as % of GDP	bn USD PPP	as % of GERD	as % of GDP	bn USD PPP	as % of GERD	as % of GDP	bn USD PPP	as % of GERD	as % of GDP
Czech R.	1.12	59.96	0.67	1.58	59.26	0.69	2.19	57.70	0.77	3.15	54.12	1.04
Hungary	0.43	44.32	0.35	0.70	43.18	0.40	1.48	59.81	0.69	2.26	69.43	0.98
Poland	0.94	36.09	0.23	0.95	31.75	0.18	1.52	26.63	0.19	3.45	43.62	0.38
Slovakia.	0.25	65.81	0.42	0.22	49.85	0.25	0.34	42.09	0.26	0.55	46.26	0.38
UE 28	117.25	63.64	1.07	143.29	62.24	1.04	188.75	61.16	1.13	214.86	62.74	1.2
OECD	427.44	69.35	1.48	528.83	67.69	1.46	663.96	66.47	1.53	768.91	68.14	1.61
USA	199.96	74.19	1.94	226.16	68.92	1.73	278.98	68.03	1.86	322.52	70.58	1.92
Japan	70.07	70.96	2.13	98.38	76.45	2.53	107.58	76.51	2.49	121.93	76.09	2.64
Korea	13.73	74.05	1.61	23.53	76.85	2.02	39.03	74.80	2.59	54.13	78.51	3.26
China	19.58	59.96	0.54	58.56	68.32	0.91	156.40	73.42	1.29	257.79	76.61	1.6
Germany	36.84	70.33	1.68	44.59	69.34	1.68	58.92	67.09	1.82	67.57	66.91	1.91

Source: Own analysis based on: [OECD 2015a].

On the other hand Poland, the Czech Republic, Slovakia and Hungary are home to regional branches of transnational corporations (TNCs) and these foreign branches are often R&D entities or are involved in R&D activities connected with their production or commercial plans (Figure 5).

In the years 2000–2009 foreign subsidiaries located in the Czech Republic carried out R&D projects to the value of 9.3 bn USD whereas since 2006 these investments have exceeded 1.3 bn USD annually. Thanks to the R&D of foreign corporations the R&D activities of Czech business are ranked highest amongst the analyzed countries. Foreign companies located in the Czech Republic have a higher and higher share in BERD which has grown systematically from 37% in 2000 to approximately 58% in 2009. In Hungary in the years 2004–2009 foreign companies carried out R&D to a total value of 2.2 bn USD which translated to BERD as 53% (2009) to 63% (2007). The years 2000–2009 in Poland witnessed foreign business investments amounting to only 2.2 bn USD and since 2005 the R&D of foreign enterprises has started to increase. In Poland the share of foreign enterprises in BERD increased from 30% in 2005 to approximately 50%. The lowest interest of foreign TNCs in R&D was recorded in Slovakia: in the years 2000–2007 foreign companies made R&D investment to a value of 0.4 bn USD and their share in BERD increased from 20% in 2000 to approximately 37% in 2007 (Figure 5).

Amongst the benefits brought about by the location of branches of foreign R&D enterprises in a country we may list: creation of jobs for highly qualified employees, acceleration of economic growth based on innovation, increased



[a] Lack of data covering the period 2000–2003
[b] Lack of data covering the period 2008–2009

Figure 5. R&D expenditures of foreign affiliates
Source: Own analysis based on: [OECD 2015a, 2015b]

total research and development investment and a stimulation of business activity. The accompanying transfer of know-how and technology, along with cooperation with domestic market operators, creates a chance to increase the impact of R&D on the economy. On the other hand involvement of TNCs in R&D financing exposes the weakness of domestic companies in terms of innovation and is alarming considering the risk of a foreign branch being relocated or the TNC's research strategy being changed following a decision taken at the headquarters located abroad. Decisions made in the TNC's home country may cause significant fluctuations of R&D investment in the subsidiary country which seems dangerous for economies strongly dependent on foreign corporate investments, such as those of Hungary, the Czech Republic, Poland or Slovakia.

Conclusions

The Czech Republic, Hungary, Poland and Slovakia are striving to improve their innovative potential through increasing research and development investment however one may still observe a considerable flaw in their R&D: inadequate financing. Poland and Slovakia are in the worst situation, whilst the Czech Republic is in the most favourable.

Barriers concerning the structure of research and development activity are similar in all of the four countries analysed. Although they are not equally of conscern across the group we may conclude that:

1. R&D activity is insufficiently financed by business whilst the proportion of government funding is too high. The analysis presented in the article indicates that the financing structure of R&D expenditure in Visegrad Countries is just the opposite to the pattern of the global leaders and as recommended by the European Commission.
2. Realization of R&D depends too much on higher education and public institutions, whereas business engagement is insufficient (apart from Hungary). In consequence the effects of R&D expenditure still remain ineffective from the point of view of increasing the innovativeness of the countries analysed.
3. The weaknesses of domestic enterprises in introducing innovation are manifested by a strong dependence on foreign companies for R&D funding. This type of investment, although it may be desirable and bring much benefit to local economies is burdened with the risk of the relocation of the investing companies.

The problem, which should be further considered given the structural barriers indicated above as well as the obstructed research and development endeavours in Poland, the Czech Republic, Slovakia and Hungary, definitely includes the effectiveness of activities and programmes within their R&D poli-

cies. Their aim is to strengthen competitiveness and the innovative potential of the business sector and its stimulation to finance R&D so that it becomes an attractive partner for TNCs in cooperation on research and development.

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Aims and Scope

Economics and Business Review is the successor to the Poznań University of Economics Review which was published by the Poznań University of Economics and Business Press in 2001–2014. The Economics and Business Review is a quarterly journal focusing on theoretical and applied research work in the fields of economics, management and finance. The Review welcomes the submission of articles for publication dealing with micro, mezzo and macro issues. All texts are double-blind assessed by independent reviewers prior to acceptance.

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