IMPACT OF ECONOMIC CRISIS ON THE R&D INTENSITY AND ON POSITION OF THE CZECH REPUBLIC AND SLOVAKIA IN THE EVALUATION OF INNOVATION PERFORMANCE (IUS)

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Abstract

Innovation activity of firms and effective support of spending on research and development at the macro level are a prerequisite for obtaining and maintaining the competitiveness of firms and national economies. The continuing economic crisis in some European countries can be linked to structural deficiencies of innovation. The first objective of the article is a comparison of changes in the innovation performance of Czech and Slovak economy. The analysis of changes in innovation performance is based on the interpretation of results of the two countries and to help determine whether two countries in terms of the crisis converge to the average SII for the EU-27. The second objective of the article is to compare the strengths and weaknesses of the innovation systems of both countries. The third objective of the article is a comparison of changes in the innovative behaviour of firms in both countries – using the statistical data about innovation performance of the high-tech manufacturing industry regularly conducted by Czech and Slovak Statistical Office. Finally, the article follows, if both countries show a negative trend in the decline in participation of SMEs in the innovation process.

Key words: Innovation Union Scoreboard, high-tech manufacturing industry, R&D expenditure, R&D intensity, Summary Innovation Index

JEL Code: O11, O30, O38

Introduction

According to the selected factors of competitiveness the position of the CR worsened due to the continuation of the economic recession in year 2012. The share of exports of goods and services in the world exports decreased this year (for the first time since the start of monitoring in 1994). (Dubska, 2013) In the support of sophisticated activities however, the CR (and the SR as well) accelerated the convergence to the EU average, if I consider relation

of R&D expenditure to GDP[1]. This expenditure in business sector, especially in manufacturing industry, are considered to be an input indicator of innovation and innovative behaviour and crucial prerequisite for future competitiveness. Therefore this article deals with the innovation performance of the CR and SR – from macroeconomic and microeconomic point of view. Firstly, I mention some findings of special studies focused on the innovative performance. The results of these studies confirmed the complexity of the relationship between innovation and competition. Empirical studies showed that the relationship could be positive or negative depending on specific competition perception and specific innovation activity. (Pu-yan Nie, 2013)

Analysis of Zemplinerova and Hromadkova (2012) proved that the innovation input significantly increases the innovation output. However, with extending firm's size, ceteris paribus, the innovation output is decreasing. This means that bigger firms are less efficient in the transformation of the innovation input into the output. (Zemplinerova, Hromadkova, 2012). The results of this analysis correspond with the hypothesis, that market power lowers the incentive to innovate.

Other studies emphasize that the relationship between innovation and competition is widely explored, while the transportation costs are always neglected in the extant literature. Actually, transportation costs have heavy effects on both competition and innovation. (Pu-yan Nie, 2013) Studies taking into account transportation costs imply that a big firm with cost advantage will have a larger incentive than its rivals to further extend its cost advantage as new opportunities for innovative behaviour. This paper was inspired by these relationships between innovation and competitiveness. The first aim of this paper is therefore to analyse the changes in innovation intensity measured on macro level by share of R&D expenditure in relation to GDP, and on micro level by R&D expenditure in relation to the value added[2]. The second goal is to evaluate the innovative performance of the CR and the SR using Innovation Union Scoreboard (IUS, 2014).

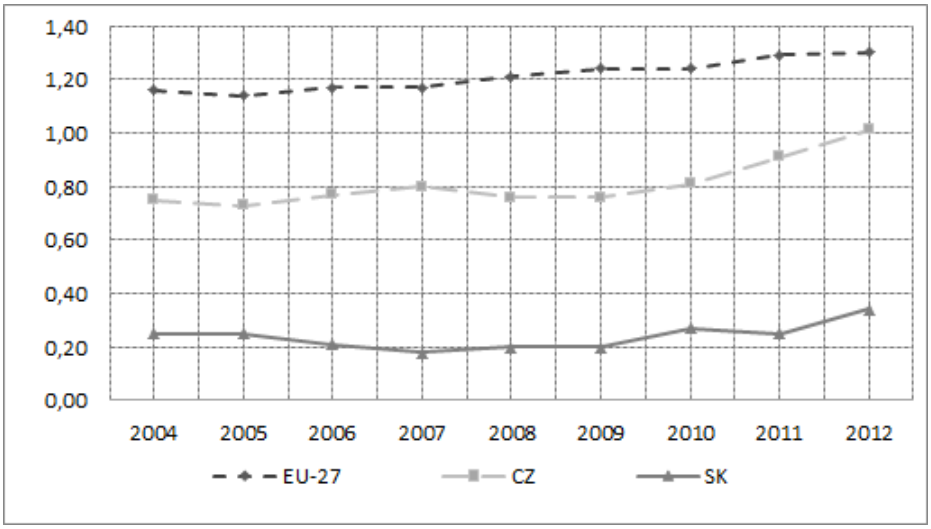
[1] On the other hand, the CR and the SR despite the growth of R&D expenditure, both in relation to GDP and recalculated per one inhabitant, so far is not even nearing the limit, which was in directions of the Lisbon stratégy set at 3 % of GDP. (Dubska, 2013)

[2] Value added is defined as the difference between production and production consumption. Production includes sales w/ gross trading margin, yet unsold goods in storages and changes in enterprises' properties.
Production consumption is defined as the amount of money spent for purchasing material, energy, external services, etc. (CZSO, 2014)

1 R&D intensity in the business enterprise sector – comparison of the CR, SR and EU-27

In terms of the economic downturn, it is important for companies to persuade customers to buy their products. The investment in R&D is therefore a crucial factor of firm competitiveness. Figure 1 shows that the innovation intensity in the business sector (measured as a share of R&D expenditure to GDP) in conditions of the deepest economic downturn stagnated in both countries.

Fig. 1: R&D intensity in business sector (BERD/GDP, in %)



Source: Eurostat, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database, online 28. 4. 2014, own processing

BERD in the Czech Republic in the years from 2007 to 2009 declined only in 2009 (the decrease of 7.3 %, see Table 1), but due to the decline of GDP the R&D intensity in Czech business sector stagnated that year and then rose (see Table 1). In the period 2009-12 BERD in the CR increased by 41.8 % and the average annual growth rate of R&D expenditure was 7.5 %.

Tab. 1: BERD – annual changes (in %)

	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-27	2,7	3,2	7,9	6,5	3,8	-3,4	4,2	7,3	2,6
CZ	11,2	10,5	20,1	15,9	10,9	-7,3	11,2	16,8	9,2
SK	-8,3	13,2	-3,8	6,9	31,2	-4,9	40,9	-0,6	39

Source: Eurostat, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database, online 28. 4. 2014, own processing

Observed statistical data for the SR (SK, Slovakia) have proved that annual changes in BERD have shown bigger fluctuations in countries with subnormal expenditure per inhabitant. Average annual growth of BERD (in the period 2009-12) in the SR was 18.6%, while the average annual growth in the EU-27 was 2.7 %[3]. Faster growth of BERD in both countries reflects gradual convergence to the EU-27 average. The significant annual increase in BERD in the SR in 2008 and 2010 and the great change from baseline of BERD indicate a positive impact of the adoption of the Euro on FDI inflows (the Euro reduces transaction costs and eliminates foreign exchange risk). In both countries, foreign funds have become more important for financing of R&D (and BERD), particularly in the manufacturing industry (MI). While the importance of foreign financial funds increases in the CR (their share on financing R&D expenditure increased from 3.4 % in 2006 to 14.7 % in 2011), the share of foreign funds in the SR rose before the adoption of the Euro (from 10.8 % in 2006 to 20.6 % in 2009), and in 2011 returned to 11 %.

Some disadvantages can be observed in directing of R&D expenditure in business sector in the CR and SR. The majority of these expenditures represents funds heading into the technical research, mostly in the cyclical branches of medium-tech sector (the motor vehicle industry). (Dubska, 2013)[4]

R&D expenditure in the high-tech manufacturing industry (HT-MI) is reckoned as a key factor of the long term competitiveness of manufacturing industrial products, in the following text I will therefore focus on comparison of R&D intensity in firms of the HT-MI in both countries.

2 R&D intensity in HT-MI (2008-12) – comparison of the CR and SR

In this part of the paper, our first aim is to describe the change in the share of the HT-MI on R&D expenditure in the MI (see Tab.2). In the CR the share of the HT-MI on R&D expenditure is higher than in the SR, but has declined. In terms of the absolute level of R&D expenditure, the medium-tech MI (the automotive industry) is the innovative leader, even

[3] The growth of R&D (and BERD) expenditure in Slovakia in time of European boom in the last decade as well as after crisis in 2009 were in the European context very high and also higher than for the Czech Republic. Slovakia however expended very low share of its GDP on research and development. In 2011 it belonged in the ranking of EU countries with 0.68 % of GDP as far as the fourth place from end before Bulgaria, Cyprus and Romania. (Dubska, 2013)

[4] Financing of other areas, where given the nature of things participates mostly the state, were in the previous years limited by the restriction of budget funds, even with respect to the common state expenditures and even more so of the expenditures on development , which do not have a mandatory character. (Dubska, 2013)

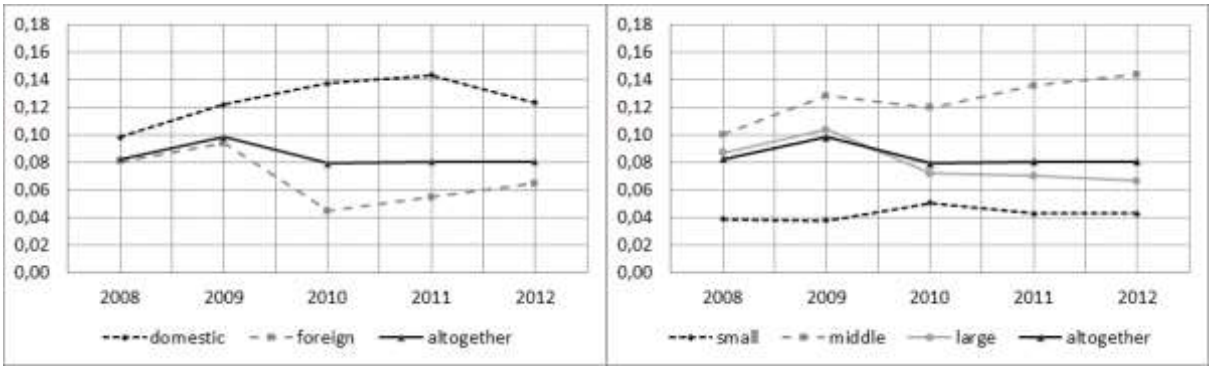
though the branches in the HT-MI (the pharmaceutical industry) have achieved higher R&D intensity. (R&D Council, 2014) In the SR, the overall R&D expenditure in the business sector (in manufacturing) has grown at a faster pace than in the CR (see Table 1). The share of the HT-MI on R&D expenditure in Slovak MI has fluctuated in connection with the inflow of FDI, but on average has not changed. The following graphs in Figures 2 and 3 (4 and 5) show the development of R&D intensity in the HT – MI in both countries from different points of views. Our figures allow to evaluate the changes of R&D intensity (R&D intensity is measured as the share of R&D expenditure in relation to the value added) in firms owned by domestic and foreign owner and in small, medium and large firms.

Tab. 2: R&D expenditure –share of HT-MI in MI (in %, national currency)

	2008	2009	2010	2011	2012
Czech Republic	**17,9%**	**17,6%**	**15,7%**	**14,0%**	**13,9%**
Slovakia	**10,5%**	**9,9%**	**11,4%**	**14,9%**	**10,3%**

Source: Own processing from data of Eurostat, 2014.
http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

Fig. 2 and 3: Intensity of innovation in HT-MI(the CR)[5]

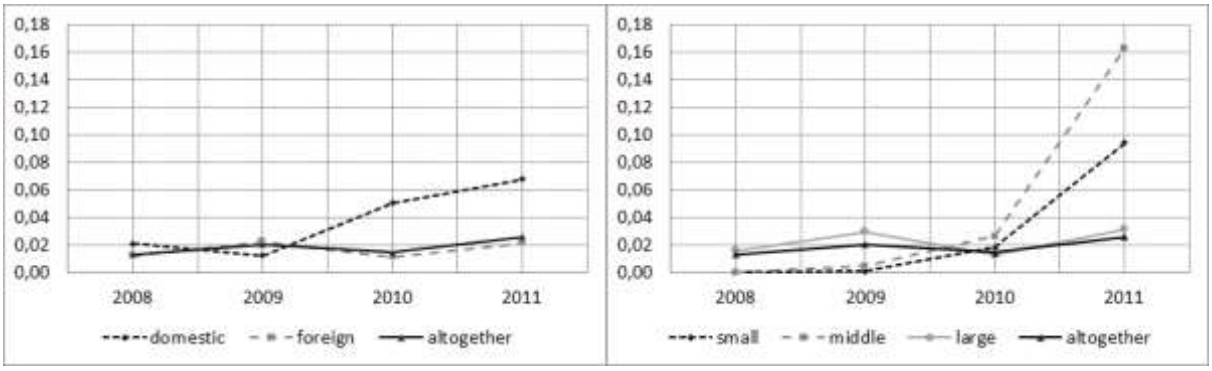


Source: Own processing from data of Czech Statistical Office 2014

Due to the economic crisis R&D expenditure in the HT- MI decreased in 2009 in both countries, while R&D intensity increased. The reason for that may be the higher inertia and the associated lower customization crisis conditions, particularly in large innovative firms. (Scholleova, 2013) In 2010, absolute decline of R&D expenditure (in Czech HT-MI) continued - especially in large firms with foreign owner. In the SR, annual expenditure has increased in all mentioned types of firms (see fig. 4 and 5).

[5] statistical data in national currency

Fig. 4 and 5: Intensity of innovation in HT-MI (the SR)[6]



Source: Own processing from data of Slovak Statistical Office 2014

Unfortunately, it is impossible to interpret the growth of R&D intensity in Czech HT-MI in 2009 as a positive signal for future competitiveness of firms in the HT-MI. The reason is the decline in both input indicators - while R&D expenditure in the CR decreased by 5 %, the decline in the value added was significantly higher (by 24 %). The biggest drop of the value added was observed in large companies with foreign owners (foreign affiliates). The fall in R&D in 2010 is both a manifestation of austerity (R&D expenditure generally dropped year on year by 5 %) and increase of the value added (overall increase of 17 %). The sharp fall in R&D expenditure of foreign affiliates (53 %) is related with the change of ownership and size structure of firms. (Scholleova, 2013) This fall was balanced out by nearly doubling the R&D expenditure in domestic firms and SMEs. The innovative behaviour of medium-sized firms should have had a positive effect on innovation performance in 2008-12. In the CR, the importance of medium-sized firms has been evident for the whole period, while in the SR medium-sized firms have been innovative leaders only since 2010.

Czech Statistical Office (CZSO) and Slovak Statistical Office (SSO) does not publish detailed distribution of the innovation expenditures in statistics of the HT-MI, hence, for evaluation of the predominant type of innovation, I have to use conclusions of the last survey of the CZSO. This survey confirms a direct link between the firms' size and the number of companies inside the chosen size group, which deals with product and process innovation. In terms of ownership, technical innovations are implemented more in companies with foreign owner. Analysis of the impact of innovation on the growth of SMEs in the CR (Pazour, Pokorny, Kucera, 2010) identified the kinds of innovation that have a positive impact on the competitiveness of SMEs. This study concluded that processed and product

[6] statistical data in national currency

innovations have the most significant influence on the high growth, especially for the medium-sized firms. This analysis also revealed that fast growing SMEs tended to be more internationalised in terms of ownership and market orientation, even though a clear causality link of foreign ownership and competitiveness was not evidenced. (OECD, 2010) Our analysis corresponds with these conclusions – in terms of change in R&D intensity SMEs with domestic owner have a good growth perspective in both countries.

3 Innovative performance of the CR and SR in Innovation Union Scoreboard (IUS)[7]

A composite indicator (Summary Innovation Index – SII) is compiled to measure the average innovation performance using 25 indicators[8]. The findings, published in the latest rankings, reflect the real innovation performance in the years 2011/2012 - this is the time delay in the disclosure of the relevant statistical data[9]. Last year's edition showed the impact of the crisis which resulted in the disturbances of the innovation convergence process between the Member States (IUS, 2014). From the latest edition it is clear that the innovation performance of countries has improved and the catching up process of less innovative countries has been restored, but the convergence process slowed down (the convergence level in innovation performance went back to the level of 2009). (IUS 2014).

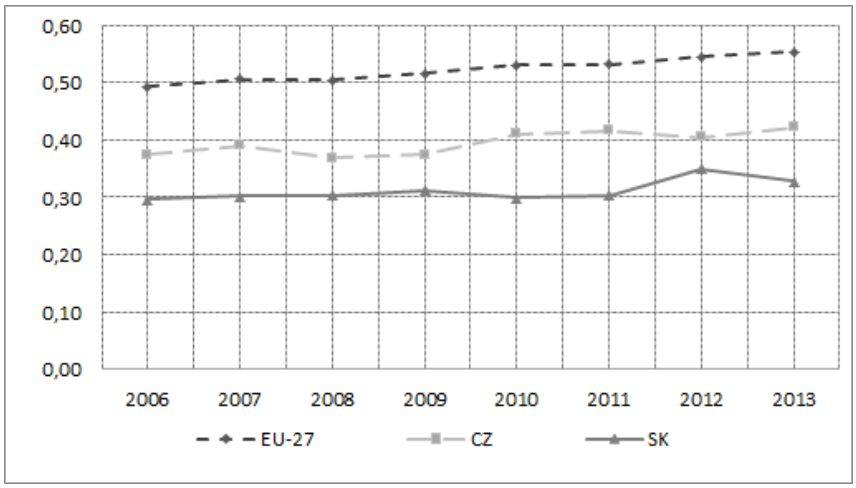
The biggest differences between the Member States exist particularly in knowledge excellence and internationalisation, and business innovation cooperation (as measured by Linkages and entrepreneurship). The overall change of performance was negative in two dimensions: Firm investments and Finance and support. Fig.6 shows the changes in pace of convergence for the CR and the SR.

[7] The Innovation Union Scoreboard (IUS) is an instrument of the European Commission, developed under the Lisbon Strategy and revised after the adoption of the Europe2020 Strategy to provide a comparative assessment of the innovation performance of EU member states. It follows the European Innovation Scoreboard established in 2001. In the last edition, published in March 2014, the measurement framework distinguishes between 3 main types of indicators (enablers, firm activities, outputs) and 8 innovation dimensions, capturing in total 25 different indicators. (IUS, 2014). Countries are divided into four groups – according to their results in Summary Innovation Index. The performance of Innovation leaders is 20 % or more above that of the EU-27; the performance of Innovation followers is less than 20 % above but more than 10 % below that of the EU-27 average.
Moderate innovators, among them the Czech Republic and Slovakia, reach 50 to 90% of the EU-27, innovation performance of modest or catching-up innovators is below 50% that of the EU27 (Pavelka, 2013).

[8] The worst possible result is 0, the maximum possible result has a value of 1.

[9] IUS 2014 uses the most recent available data from Eurostat a other internationally recognised sources with dat reffering to 2012 for 11 indicators, 2011 for 4 indicators, 2010 for 9 indicators and 2009 for 1 indicator. (IUS 2014).

Fig. 6: SII - convergence



Source: Own processing from data of Innovation Union Scoreboard, 2014

Despite the fact that the innovation performance of the CR has been quite volatile over the past 8 years, the innovation index has improved. The innovation performance of the SR has been lower than in the CR, with greater fluctuations. The SII for Slovakia strongly increased in 2012, in particular due to the improvements in new doctorate degrees and product or process innovators. It is however followed by a sharp decline in 2013, as a result of decline in new doctorate degrees. The Slovak performance (relative to the EU) was the highest in 2012 at 64%, but fell to 59 % in 2013. (IUS, 2014)

Czech performance was at its highest in 2012 at 78 % and after a decline in 2012 it reached 76 % of the EU average in 2013. (IUS, 2014)

Table 6 shows the extent of both countries' gap in the innovation performance, compared to the EU-27 average. The best and the worst results per dimension are coloured.

Tab.6: Innovation performance scores per dimension (IUS 2014) – comparison with the EU-27 average (in %)

SII 2014	human resources	research systems	finance and support	firm investments	linkages & enterpreneurship	intellectual assets	innovators	economic effects
CZ	-2	-53	-28	-7	-8	-46	-11	-18
SK	5	-71	-35	-44	-41	-74	-45	-24

Source: Own processing from data of Innovation Union Scoreboard, 2014

The value of the SII in both countries is decreased by results in Open, excellent and attractive research systems (the indicators: International scientific co-publications, top 10%

most cited scientific publication worldwide, Non-EU doctorate students) and in Intellectual assets (especially PCT patent applications, PCT patent applications in societal challenges).

Relative strengths of the CR are in Human resources, firm investments and linkages & entrepreneurship. Good evaluation in the economic effects is mainly due to the relatively high employment in high-tech and medium high-tech industries, and also a relatively high share of these sectors in total exports. Relative weaknesses of the CR are in Non-EU doctorate students and in Venture capital investments.

Relative strengths of the SR are in Human resources (Youth with upper secondary level education), in Sales share of new innovations and international scientific co-publications. Relative weaknesses of the SR are in Open, excellent and attractive research systems and Intellectual assets. Relative large weaknesses are in Non-EU doctorate students, License and patent revenues from abroad and PCT patent application in societal challenges.

Conclusion

The advancement of a country and effort for its future competitiveness is often measured by the proportion of money, which are expended on R&D. The CR and SR have belonged among countries in which the share of these expenditures in relation to GDP grew between years 2002-2006. Innovation intensity stagnated or mildly decreased in years of strong boom (due to the impact of relationship of the high value of GDP as a denominator). This effect[10] most likely caused the growth of innovation intensity in crisis year 2009 and in period 2010 -2012. This positive development of strengthening investment on R&D in relation to GDP in the international comparison shows, that the rate of growth was insufficient in contrast to the EU average. Analysis of the changes in R&D intensity in the HT-MI indicates a) that large firms with foreign owner show higher sensitivity to fluctuations of business cycle, and b) that the importance of SMEs with the domestic owner grows in both countries.

According to IUS 2014 both countries share majority of relative strengths and weaknesses of innovation performance. When considering strategic changes, more importance should be given not only to the inputs (Youth aged 20 to 24 the upper 2nd level education, International scientific co-publication), but also to monitoring the outputs (Venture capital investments, SMEs innovation, Knowledge-intensive services exports).

[10] the effect of value of GDP as a denominator

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