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RESEARCH AND DEVELOPMENT CONTRIBUTION TO THE CZECH INDUSTRY BRANCH GROWTH

Abstract:

GDP growth is one of the most closely watched macroeconomic aggregates. To predict its growth, it is very important to know the importance and development of individual structural components - this article has been focused on the Czech industry NACE C and its role for GDP growth in the Czech Republic. The research was mainly focused on the impact of research and development, as the revised methodology of the national accounts system in the Czech Republic has been pursuing this factor differently since 2014. For better outlook, the development has also been compared with the Visegrad countries, where the Czech Republic is a member. The years 2005 to 2016 were selected for the period under review, when the effects of the economic crisis were reflected. The end of the survey period has shown a boom in economic growth, so research has covered all the important phases of the business cycle.

Keywords:

GDP growth, ESA 2010, Visegrad countries, Research and Development, NACE C Manufacturing

JEL Classification: E30, F43

1   Introduction

Research and development are very important factors in productivity growth and are one of the important components of GDP as well. The first key issue for this article is the relationship between the Research and Development (R & D) and the overall economic growth (measured by GDP growth) in the Czech Republic and neighbor countries - Germany, Austria, Slovakia and Poland - after accession to the European Union (EU) 2005 to 2016. The Czech Republic is very strongly oriented towards industry (especially NACE C Manufacturing) and therefore the second important objective of this article is to examine the relationship of R & D with the development of the NACE C Manufacturing.

Important indicators of research and development are defined by the OECD Frascati Manual of 2002, which is followed by the National Statistical Offices and Eurostat. In its Annual Research on R & D (VTR 5-01), the Czech Statistical Office (CZSO) monitors primarily the basic indicators of human and financial resources entering the R & D activities in the given year.

Yazgan, Şekip and Ömer Yalçinkaya (2018) focused on R & D investment and investigated the effects of research and development investments on Sustainable Economic Growth in OECD Countries over the long period (1996-2015). Their results indicate that R & D variables have positive and statistically significant effects on economic growth. Freimane (2016) investigate the empirical relationship between research and development expenditures and economic growth in the European Union member states in the period of 2000–2013. Economic growth and economic development are key issues for the economic policies of each country and of the European Union as a whole. It is therefore the interest of fiscal policy to directly or indirectly support the development of R & D. For example, Edler, Shapira, Cunningham, and Gök (2016) report on the effectiveness of innovation policy intervention.

In addition to the macroeconomic point of view, the impact of direct support for R & D on innovation in companies is also important, as Cunningham, Gök and Larédo (2016) have devoted to independent research.

Heřman, Horová and Jakl (2008) dealt with both the development of R & D in the Czech Republic and the transfer of its results into practice. They emphasized entrepreneurship as an endogenous force of economic growth in the Czech Republic and systematized support for innovation and R & D from public budgets of the Czech Republic and EU structural funds. As a significant direction of the further development of R & D in the Czech Republic and its economy (especially industry) they have seen in the science and technology parks and their development.

Technical innovation in industry is regarded by many people as the best way of making industry more profitable. A great deal of energy and time is being expended by businessmen and by governments discussing how best to bring about technical

innovation. Hakansson (2015) focused primarily on the network approach and co-ordination of technical research and development with suppliers and customers.

Povolná and Švarcová (2017) show that production and exports in the Czech industry (especially machine tools) are directly related to fluctuations in GDP and the economic cycle. Domestic investment in machine tools did not show this dependence according to that research. Investments in machinery in the Czech Republic can be compared with R & D investments, but this issue was not the subject of their research yet.

If we understand the patterns of past developments, we improve our chances to anticipate developments in the near future. Karel and Hebák (2018) emphasize that forecasting future path of macroeconomic aggregates has become crucial for monetary and fiscal policymakers. Forecasts of the development of the economic environment are also important for other economic subjects, especially companies.

However, the relationship between R & D and GDP is more complex - the international methodology of the national accounts system (SNA), which is the basis for measuring GDP, has been developing for decades. The last major methodological change of the SNA took place in 2008, and Eurostat incorporated it into ESA 2010. The Czech Republic subsequently adopted methodological changes in 2014. These methodological influences are also of interest to this article.

2   Influence of ESA 2010 methodological changes on GDP growth and GERD in selected EU countries

The first part of this paper focuses on methodological influences in comparing the economic performance of the economy measured by GDP and Gross domestic expenditure on R & D (GERD). Dunn, Akritidis and Biedma (2014) measured the magnitude of the impact of ESA 2010 changes on the GDP of each EU country. The following Figure 1 shows their results when measuring the impact of ESA 2010 changes on key indicators of national accounts for 2010. For the purposes of this article, the Czech Republic, Poland, Slovakia, Austria and Germany were selected, compared to the average of all 28 countries in Europe in 2010.

**Figure 1 Impact of ESA 2010 on GDP growth in selected countries in Europe**
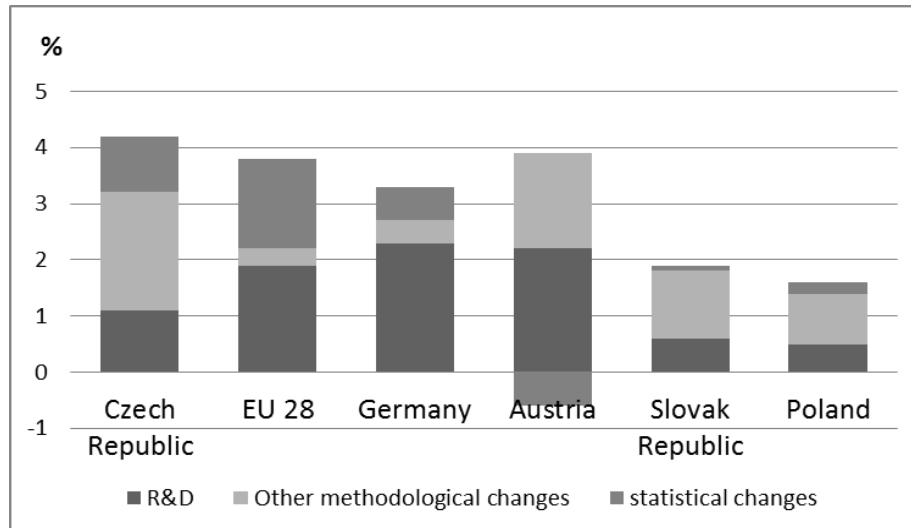
Source: Dunn, Akritidis and Biedma (2014)

Figure 1 shows the significant impact of the change in the ESA 2010 national accounts methodology, in particular in R & D, which in the EU-28 reflected a growth of approximately 2% of GDP in 2010 compared to ESA 1995. In Germany, the R & D impact on GDP growth was even higher (2.3%) and 2.2% in Austria. In the countries that joined the EU in 2004, impacts were lower. In the Czech Republic, GDP grew by 1.1% thanks to a new calculation of R & D, 0.6% in Slovakia and 0.5% in Poland. Dunn et al. (2014) showed the different impact of R & D engagement on the performance of national economies.

The Czech Statistical Office (CZSO) has incorporated ESA 2010 procedures in 2014. Research and development, as part of science and technology, is a key driver of productivity growth, economic growth, employment, sustainable development and social cohesion, the CZSO commented. The Czech Statistical Office monitors the main characteristics of research and development in the Czech Republic through a comprehensive statistical survey conducted since 1995. This survey provides insights into the state of human and financial resources in all entities (enterprises, public research institutions, universities) performing R & D as their main or secondary activity in the territory of the Czech Republic. The investigation fully respects the EU and OECD principles set out in the Frascati manual and in Commission Implementing Regulation (EU) No 995/2012. For the determination of data, the CZSO uses the Annual Research and Development Report VTR 5-01.

The following Figure 2 calculates the GDP indicator according to the new ESA 2010 methodology and shows Gross domestic expenditure on R & D (GERD) in the Czech Republic.

**Figure 2 Gross domestic expenditure on R&D (GERD) in the Czech Republic**
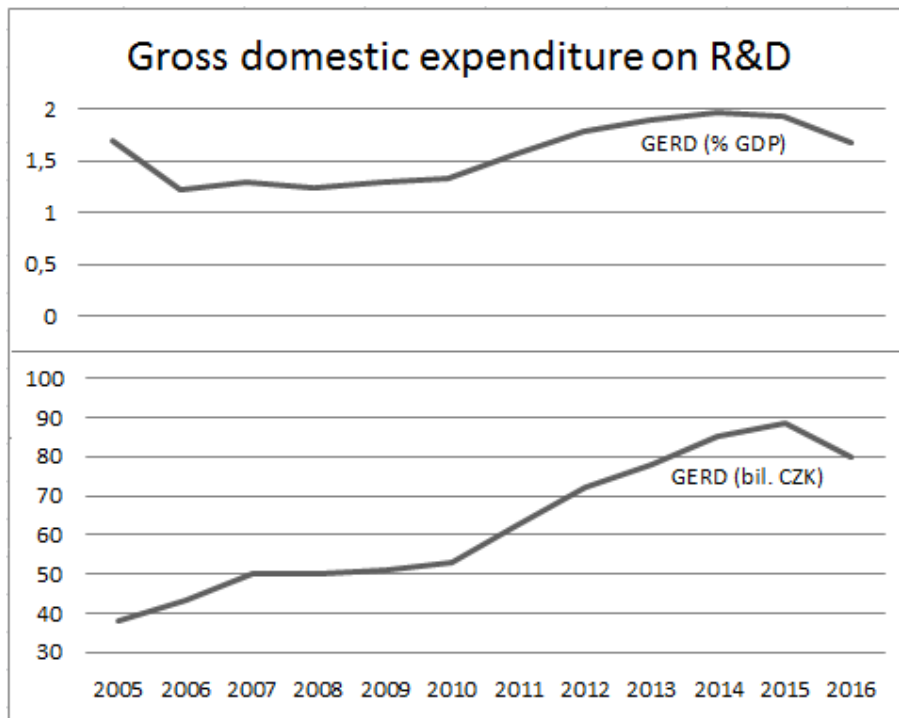
Source: CZSO (2018 a, b).

Figure 2 illustrates the growth of R & D expenditures (GERD) in billions of CZK in the Czech Republic in the years 2005-2015; only in 2016 there was a decrease in expenditures. However, if we monitor the GERD indicator in the percentage of R & D expenditures on GDP, it should be stressed that the boom between 2005-6 and 2014-2016 meant that R & D expenditures in these periods grew more slowly than the overall GDP growth in the Czech Republic. The GERD indicator in the Czech Republic evolves differently than the development of the whole economy - GERD lagged behind GDP growth during the economic boom, while it was a stabilizing element in the economic crisis of 2008 and even grew during the economic decline of 2012-2013. This behavior can be influenced by the fact that a number of research and development projects in the Czech Republic were funded from EU foreign sources. In the future, after the end of the use of these sources, this effect can be eliminated.

The impact of the change in the ESA 2010 national accounts methodology (see Figure 1) was calculated for 2010. Figure 2 shows the total R & D share of the Czech Republic at 1.34% of GDP according to the new methodology for 2010. The subsequent development showed an increasing share to 1.97% in 2014. However, in 2015 and 2016, the share fell again.

Comparing with neighbor countries and the EU average (28 countries) and the Eurozone (19 countries) as shown in Figure 3, it is interesting to note that it is clear that Austria and Germany have higher gross domestic expenditure on R & D (GERD) Euro area (19 countries) and the EU (28 countries). Since joining the EU in 2004, the Czech Republic has reached about half of its level, but this indicator has grown rapidly and in the period 2013-2015 it was almost the EU-28 average. Slovakia and Poland strongly lag behind the Czech Republic in this indicator. Slovakia recorded a decline in 2016 as well as the Czech Republic.

Figure 3 Gross domestic expenditure on R & D (GERD) in selected countries EU
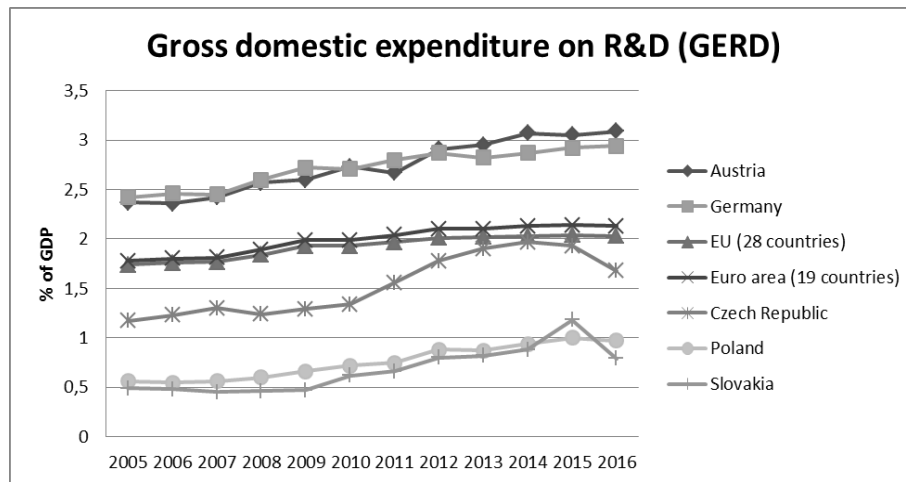

Source: Eurostat 2018

The TARGET 2020 Europe strategy is to reach 3% GERD - here it is worth pointing out that this is a realistic goal and for example Austria has exceeded this indicator since 2014. For the Czech Republic this goal is very difficult to reach. For Poland and Slovakia, GERD at 3% of GDP is unrealistic in 2020.

3   Analyze of the Czech industry and R&D indicators

The second part of this paper focuses on a more detailed analysis of R & D indicators in the Czech Republic. The breakdown of basic R & D indicators in the Czech Republic is: R & D workplaces, R & D personnel (FTEs) and R & D expenditure (CZK mil.). These indicators are based on the CZSO's annual survey using the VTR 5-01 report.

**Figure 4 R&D workplaces in specific sectors of the Czech economy**
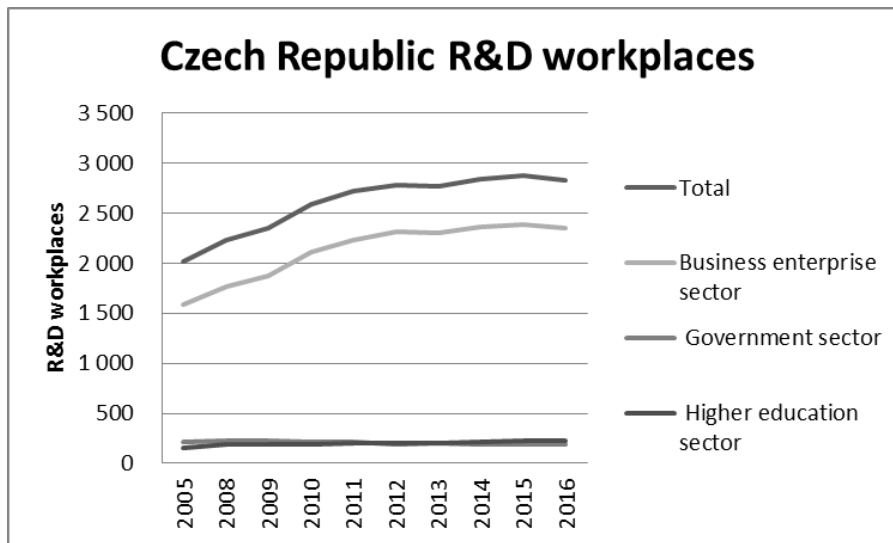
Source: CZSO (2018 a).

Figure 5 R&D personnel in specific sectors of the Czech economy
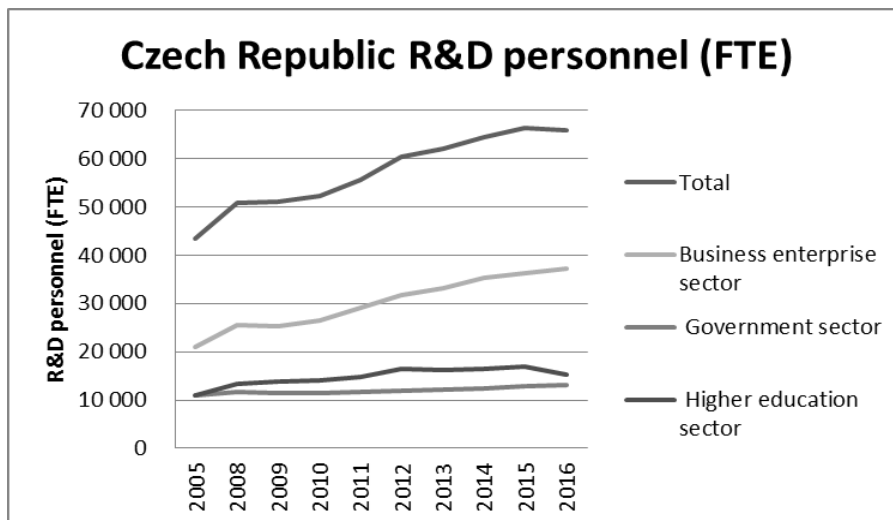
Source: CZSO (2018 a).

Figure 4 and Figure 5 show that the business sector is the most important for both R and D indicators in the Czech Republic. The third indicator counts R & D expenditures in specific sectors. Figure 6 confirms that the business enterprise sector is also the most important for the R & D expenditure indicator in the Czech Republic.

**Figure 6 R&D expenditures in specific sectors of the Czech economy**
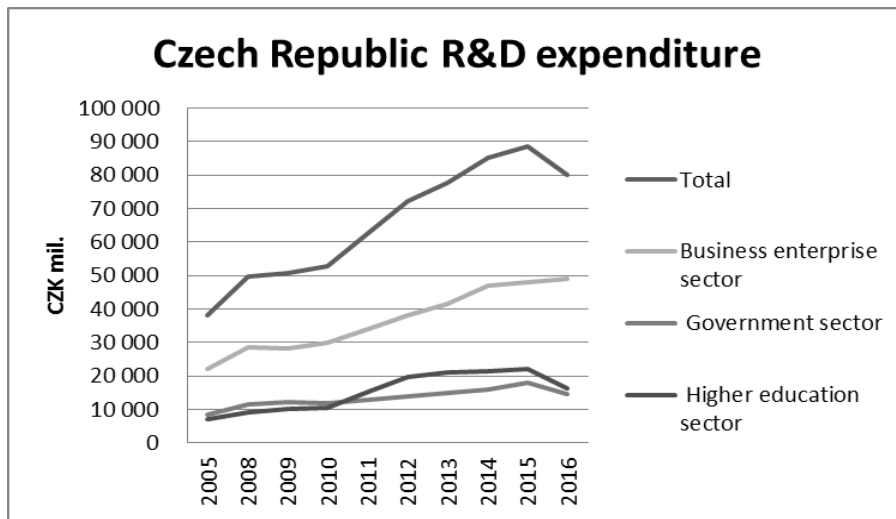
Source: CZSO (2018 a).

Furthermore, this article focuses on the analysis of R & D involvement in the Czech business sector. The following charts show the evolution of the structure and the number of R & D workplaces (Figure 7) and the development of expenditures broken down into Labor costs and Capital in 2005 – 2016 (Figure 8).

Figure 7 R&D workplaces in business enterprise sector
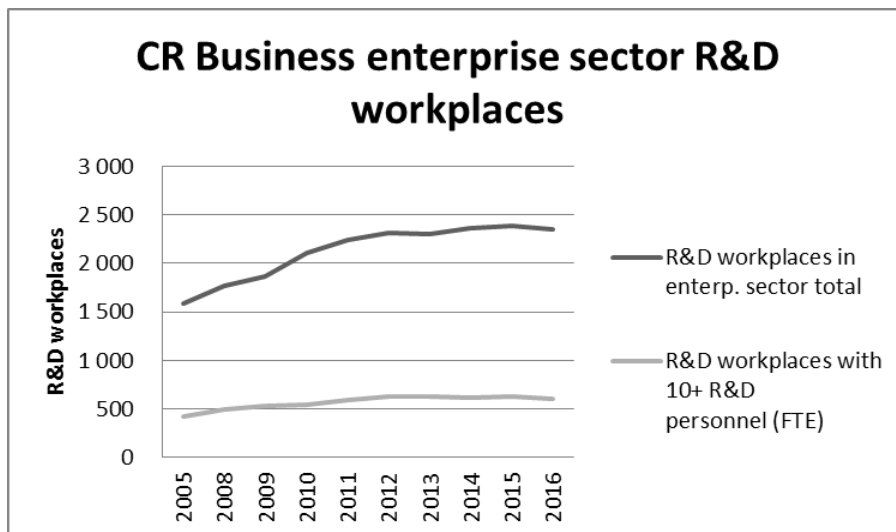
Source: CZSO (2018 a).

Figure 8 R&D expenditures in business enterprise sectors
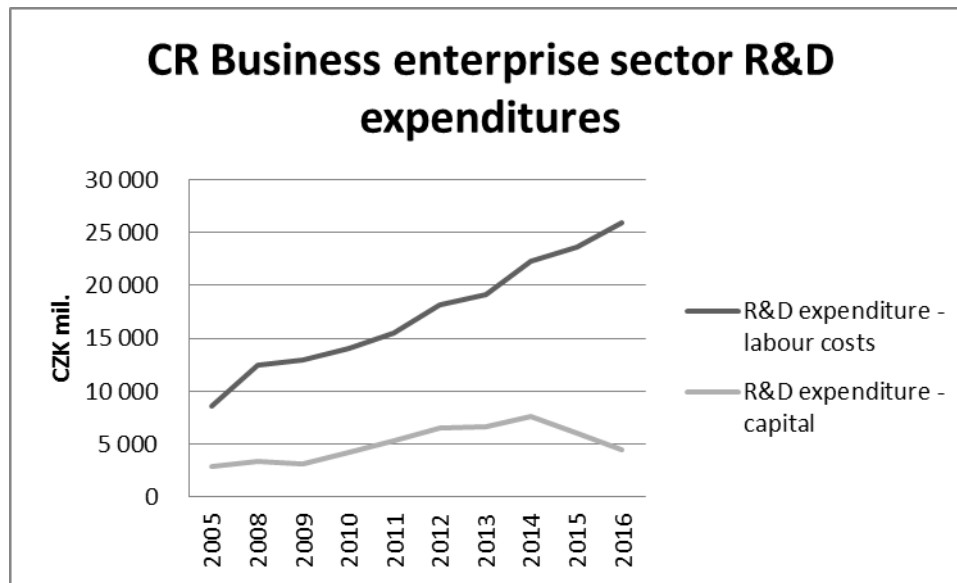
Source: CZSO (2018 a).

The following Table 1 focuses on the comparison of total industry and NACE C. Manufacturing (NACE C) is very significant for GDP of the Czech Republic.

Tab 1 NACE C Manufacturing Important indicators

		2010	2013	2014	2015
a	**Numbers of enterprises industry total**	176 978	182 693	187 066	189 590
b	**Numbers of enterprises NACE C Manufacturing**	167 344	167 688	170 041	172 054
c	**c=b/a %**	94,56	91,79	90,90	90,75
d	**Employed persons NACE C**	1 194 000	1 212 000	1 230 000	1 265 000
e	**R&D personnel NACE C**	14 057	16 872	17 529	17 727
f	**f=e/d %**	1,18	1,39	1,43	1,40
g	**Outputs, incl. trade margin NACE C (CZK mil.)**	3 138 678	3 497 614	3 884 887	4 016 817
h	**Acquisition of fixed assets NACE C (CZK mil.)**	142 895	183 179	208 430	220 054
i	**R&D expenditure NACE C (CZK mil.)**	15 794	22 066	24 264	25 277
j	**j=i/h %**	11,05	12,05	11,64	11,49

Source: CZSO (2018 a, b).

Numbers in Table 1 document several trends from 2010 to 2015. NACE C Manufacturing's share of the total number of firms in industry is slightly declining (line c). However, the share of NACE C R & D personnel in the total number of employees in industry is slightly increasing. The volume of NACE C outputs is growing very strongly (nearly a quarter in the monitored period). Purchase of fixed capital (NACE C) was even faster (154% growth comparing 2010 and 2015). R & D expenditure NACE C (measured in CZK) increased by 160%. In this issue, however, both Labor costs and capital expenditures are included. By comparing lines h and i (line j), the share of R & D expenditure NACE C to the total Acquisition of fixed assets NACE C thus remained between 11 and 12%.

These trends can be assessed by the gradual increase in R & D personnel and R & D expenditure of NACE C in the Czech Republic. This may indicate that Czech industrial firms are trying to make more use of R & D to increase outputs, including trade margin.

4   Discussion

It is to be expected that the trend of greater R & D involvement in Czech industry NACE C will continue to strengthen. In 2018, Czech industrial enterprises had the problem of gaining new workforce despite the fact that they had a number of orders due to the strong boom. The Czech Republic had General unemployment rate of 2.4% and Employment rate of 58.8% (CZSO, 2018 b) in the first quarter 2018, which can be interpreted as having very high employment and very low unemployment, i.e. the domestic labor market has been practically exhausted; enterprises had to recruit workers from abroad. This state of affairs is not sustainable and companies are forced to replace labor force by integrating R & D results into Czech industry. Robotics and automation in the Czech Republic are the fastest in the automotive and electro technical industry. The whole process is supported by the Industry 4.0 Initiative, which builds on the National Policy for Research, Development and Innovation of the Czech Republic for the years 2016-2020.

The question remains about the extent to which the NACE C results could be influenced by the change in the methodology of the ESA national accounts system. The 2010 results show that the Czech Republic has an impact on the GDP size by changing the methodology when calculating the R & D of more than 1% (see Figure 1).

Due to the fact that Germany has GERD nearly 3% (see Figure 3) and at the same time Germany is one of the key business partners for Czech companies NACE C, an important role of knowhow transfer in supply chains can be expected.

5   Conclusion

Dunn et al. (2014) showed the different impact of R & D engagement on the performance of national economies. In the countries that joined the EU in 2004, the impacts of methodological changes ESA 2010 were lower than the EU28 average (2%) for 2010. In

the Czech Republic, GDP grew by 1.1% thanks to a new calculation of R & D, 0.6% in Slovakia and 0.5% in Poland.

The GERD indicator in the Czech Republic does not follow the development of the whole economy - it lagged behind GDP growth during the boom, while in the economic crisis 2008 it was a stabilizing element and even grew during the economic decline of 2012-2013. This behavior can be influenced by the fact that a number of research and development projects in the Czech Republic were funded from EU foreign sources. In the future, after the end of the use of these sources, this effect can be eliminated.

Manufacturing (NACE C) is very significant for GDP of the Czech Republic. The volume of NACE C outputs is growing very strongly (nearly a quarter in 2010 - 2015). Purchase of fixed capital (NACE C) was even faster (154% growth comparing 2010 and 2015). R & D expenditure NACE C (measured in CZK) increased by 160%. This may indicate that Czech industrial enterprises are trying to make more use of R & D to increase outputs, including trade margin.

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