CHANGES IN INVESTMENT RATE AND INNOVATION INPUTS IN CZECH AND SLOVAK MANUFACTURING AND HIGH-TECH MANUFACTURING INDUSTRY

Hana Scholleova – Marta Necadova

Abstract

Macroeconomic competitiveness can be based on quantitative or qualitative factors. Qualitatively based competitive advantage must be continuously supported by investments, therefore it is accompanied by a relatively high investment rate.

For Czech and Slovak economies, where the manufacturing industry is of some significance to the export performance, the key prerequisites for long-term competitiveness of firms in the globalised economic environment are R&D expenditures and employment of R&D personnel. The result of the comparison of the changes in investment rate, R&D expenditures and in the number of R&D personnel in the business sector, manufacturing and high-tech industry can be seen as an indicator of future competitiveness.

The first aim of this paper is therefore to compare the changes in the indicators of innovative performance in the aforementioned industry sectors.

This paper also analyses the status and development in high-tech manufacturing in years 2008 - 2015 and provides spatial and trend comparison (development is compared in the Czech Republic and the Slovak Republic).

Our paper compares changes in the abovementioned indicators in high-tech manufacturing performance according to the size of the company (small, medium, large).

Key words: R&D expenditures, R&D personnel, business sector, manufacturing industry, high-tech manufacturing industry, rate of investment, gross fixed capital formation

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Introduction

The natural reaction of companies on the economic crisis is to reduce costs and thus reduce investment spending. Instantaneous competitiveness of companies can be seen in sales (or value added.) Long-term competitiveness of companies and higher performance of economy is conditioned by increasing the investment spending (i.e. gross fixed capital formation).

Indicator Investment rate connects capital expenditure with the power companies. At the macroeconomic level it indicates future economic performance. In conditions of the economic crisis, investment rate in the Czech Republic and in the Slovak Republic has fallen, but this indicator has been developing differently since 2010 in the two countries. The decline in investment rate in the Czech Republic is considered to be a negative signal for the future competitiveness of the Czech economy. Analysis at the level of a specific sector can identify concrete factors that participate in the development at the macroeconomic level. This analysis examines the investment behavior of companies in sectors important to the future competitiveness of the economies - in high-tech manufacturing sector. Our analysis shows the different impact of the economic crisis on the rate of investment companies by size and ownership. The analysis also allows to identify the changes inside the sector and also the different adaptation companies on crisis conditions.

Methods

Although the importance of the high-tech manufacturing industry in the process of increasing technological intensity is frequently mentioned in the literature, an discussion about the relevance of the various taxonomies of industries and products by technological intensity for cross-country comparisons is not very widened. As Srholec (2005) alerts, it is typically assumed that high-tech exports reflect the technological intensity of the local business activity, but limited attention is given to the possibility that actual technological content may differ across countries. Lall (2000), Srholec (2005) and others show that a significant part of the high-tech industry outbreak in developing countries and in new member EU contries might be "something of a statistical illusion", as they specialize in labour-intensive processes within high-tech-intensive industries. The study of Srholec (2006) focuses in detail on the role of international production sharing for high-tech exports. This study shows, that many latecomer countries experienced a rapid growth of high-tech exports, but gained little in terms of contribution to upgrading of local technological capabilities. Srholec (2005) and others discussed the phenomenon behind the contrast between specialization in high-tech exports and indigenous R&D capabilities. The explanation is possible to find in the increasing fragmentation of value chains. The key assumption for increasing of benefits from innovative activities is efficiency of R&D expenditures. The analysis of Fagerberg and Srholec (2007) identifies four different types of "capabilities"; the development of the "innovation system",

the quality of "governance", the character of the "political system" and the degree of "openness" of the economy. The results of the other analysis of Srholec (2011) indicates that the increase of public R&D expenditures might turn out to be futile for achieving innovation-based growth, because in developing countries there does not seem to be a direct connection between the extent of public research infrastructure and the propensity of firms to innovate. The necessary prerequisite for better using of innovative spending is improving our understanding of the relationship between democracy and innovation.

To redirect our economy competitive advantages from cost-orientation to qualitative competitive advantage, innovation performance of firms is a key prerequisite in the high-tech sector. High-tech sector is defined as a set of economic activities for whose production advanced technologies are widely used. At the same time the development of such activities accompanies the high cost of innovation or research and development (R&D). These economic activities also generate higher added value. High-tech sector in the Czech Republic and in the Slovak Republic is defined through Classification of Economic Activities (CZ-NACE, SK/NACE) and is divided into two main categories: high-tech manufacturing and high tech services. High-tech manufacturing industry includes the following activities: manufacture of pharmaceutical products and preparations, manufacture of computers and electronic components, production of consumer electronics and optical equipment, manufacture of measuring, testing, navigating and medical equipment, manufacture of aircrafts and spacecrafts and their equipment. (Czech Statistical Office, 2017a)

The statistical data collected by the statistical offices was used for the analysis.

For the evaluation, these data (for each sector and years)

- value added,
- gross investment in tangible assets,
- R&D expenditure for different sectors,
- R&D personel cost for different sectors.

The following indicators were created for comparison in different years and environments:

Investment rate (IR) = gross investment in tangible assets(IN) / value added(VA)

Expenditure ratio HT/MI = R&D expenditure in HT/ R&D expenditure in MI

Expenditure ratio MI/BS = R&D expenditure in MI / R&D expenditure in business sector

Personel ratio HT/MI = R&D personel in HT/ R&D personel in MI

Personel ratio MI/BS= R&D personel in MI/ R&D personel in business sector

We used the logarithmic method (Synek et al., 2009) to describe the effect of change in gross investment in tangible assets and value added on the change of investment rate.

For the indicators A and B in the multiplicative relation is correct:

If $\quad X = A \cdot B$

then $\quad I_x = I_A \cdot I_B$

then $\quad \log(I_x) = \log(I_A) + \log(I_B)$

it means, that all change in X

$100\% = \log(I_A)/\log(I_x) + \log(I_B)/\log(I_x)$

where $\qquad$ effect A (%) $= \log(I_A)/\log(I_x)$

and $\qquad$ effect B (%) $= \log(I_B)/\log(I_x)$

Similar is possible use also for case $X = A/B$.

1 Rate of investment in HT MI during 2008-2015

The development of capital expenditures during this period confirms the fact that these expenditures are the most volatile item of expenditures at the macroeconomic level. Our analysis provides a more detailed view of the changes in the rate of investment in the sector, which is crucial for the future competitiveness of both economies. Differences in rate of investments between between small, medium and large companies make it possible to identify the different reaction of these companies to the economic crisis (see table 1).

Tab. 1: Effect of change in IN and VA on change in the rate of investment (IR) in Czech Republic (2008 - 2015) and Slovakia

country	size	2008	2009	2010	2011	2012	2013	2014	2015	averagea
Czech Republic	small	23%	24%	18%	20%	30%	20%	17%	21%	22%
	middle	36%	18%	25%	23%	17%	17%	19%	18%	22%
	large	44%	36%	24%	22%	18%	18%	20%	19%	26%
	altogether	**40%**	**30%**	**23%**	**22%**	**19%**	**18%**	**20%**	**19%**	**24%**
Slovakia	small	9%	70%	9%	10%	7%	15%	11%		19%
	middle	11%	12%	13%	29%	16%	14%	13%		15%
	large	50%	45%	31%	28%	12%	17%	20%		29%
	altogether	**43%**	**43%**	**28%**	**27%**	**12%**	**17%**	**18%**		**27%**

Note: The investment ratio = gross investment in tangible assets / value added, in current prices (CZK, EUR)
Source: own processed by Czech Statistical Office (2017a) and Statistical Office of the Slovak Republic (2017a)

The investment ratio for the whole HT sector fell in both countries (in the Czech Republic by 20 pp, in Slovakia by 25.1 pp) during the monitored period. The biggest influence are large companies where the investment rate declined the most in 2010. This decrease was caused by both the absolute lower amount invested in HT in the acquisition of fixed assets in 2015 compared to 2008 (in the Czech Republic, a decrease of 30% In the Slovak Republic by 59%), and by the increase in added value creation in the Czech Republic (VA created in HT in 2015 was 43% higher than in 2000) and almost identical created VA in HT in Slovakia (total VA created in HT in 2015 was just 1.7% higher than in 2008). The absolute level of investments in the whole HT sector in the Czech Republic was 30% lower than in 2008 in the Czech Republic in 2015, with the added value increased by 43%. Figure 1 illustrates the evolution of the investment rate in high-tech MI by size.

Fig. 1: The investment ratio by firm size (HT sector in the Czech Republic and Slovakia)
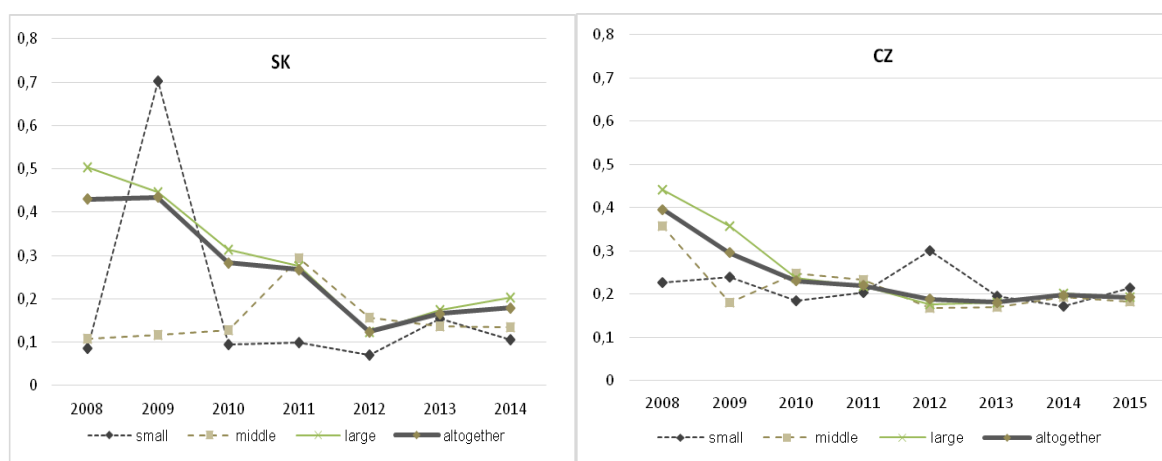
Note: The investment ratio = gross investment in tangible assets / value added, in current prices (CZK, EUR)
Source: own processed by Czech Statistical Office (2017a) and Statistical Office of the Slovak Republic (2017a)

In both countries, the average investment rate in the monitored period was the highest in large companies (25.1% in the Czech Republic, 29% in Slovakia), but in the largest companies it recorded the largest decrease (in the Czech Republic by 25 pp, in Slovakia by 30 pp) . A moderate increase in investment rates in small and medium-sized HT firms in Slovakia (by 2015 ratio was 2 and 2.6 percentage points higher than in 2008) and only a very small drop in small firms in the Czech Republic (by 1, 3 pp) testifies to the importance of investment activity to maintain the competitiveness of this business segment, as well as to the growing importance of this segment of companies in HT sectors.

The growth in investment rates in small HT firms in Slovakia is a result of higher investment growth (39%) than added value (13.3% growth). In Slovakia, the segment of medium-sized HTs significantly strengthened in the period under review - investment in the acquisition of fixed assets was almost three times higher (2.65 times higher) in 2008, an increase in the importance of medium-sized firms is also evident from the increase in VA , Which was more than doubled in 2014 (2.13 times higher). The significant decline in the size of the large firms' investment is a result of both investment declines and VA generated by large firms (the investment was almost three times higher in 2008 and VA 2.5 times higher than in 2014).

In the Czech Republic, investment in large firms (by 25 pp) has also fallen mostly as a result of a drop in investment of 44%, their importance for the HT sector has increased, however, compared to Slovakia - the VA generated by large firms was 50% higher than in 2015 In 2008. Also, medium-sized companies show a lower investment rate (down by 17.5 pp) in the year 2015 with an increase in VA (51.6%).

2 Effects changes in investments and value added and impact on change on investment rate (2008-2015)

In the next phase, we were interested in how changes in IR and VA contributed to the change of IR during the period. The observed period was divided into two parts in relation to volatility of the confidence index. The first phase (2008-11) is a phase of fluctuating expectations, the second phase is associated with stable expectations (2012-2015), although they are lower than before (bases on values from year 2005). The development of the confidence index for business in the Czech Republic in 2008 - 2015 is shown in Fig. 2. The data for the years 2008 - 2015 were then summarized in two major periods. Investment for 2008-2011 (analogously for 2012-2015) summarizes all investments. Value added (VA) then sums up all created VA for this extended period.

Fig. 2: Trend of indices of Confidence business indicator in Czech Republic 2008 -2015
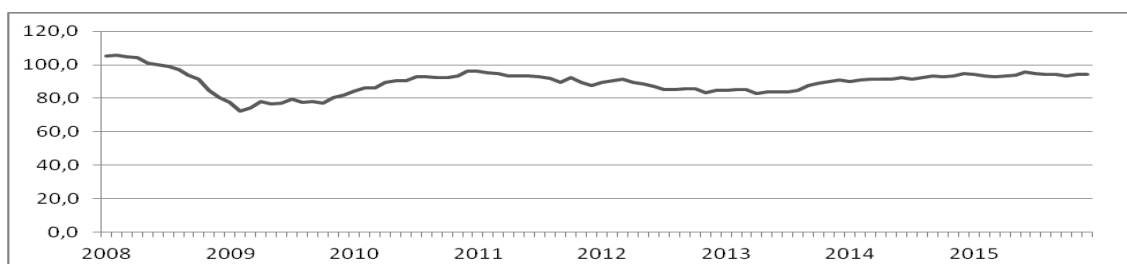
Source: own processed by data Czech Statistical Office (2017c)

In tab. 2 it is possible to monitor the changes in PP and the impact on change caused by change in investment (IN) and the change in value added (VA) for the Czech Republic where the change is monitored between the IR (Investment Rate) index for the period 2008 - 2011 (economic recession) and 2012-2015 (economical growth).

Tab. 2: Effect of change in IN and VA on change in the rate of investment (IR) in Czech Republic (2008 - 2015)

size	IN (mil. CZK)		VA (mil. CZK)		IR		Effect on 100 % change IR	
time	08-11	12-15	08-11	12-15	08-11	12-15	IN	VA
alltogether	39 517	38 251	138 937	200 777	0,284423	0,190514	8%	92%
small	4 425	4 520	20 764	200 777	0,213092	0,022511	-1%	101%
medium	7 159	6 249	28 190	34 797	0,253956	0,179593	39%	61%
large	27 933	27 482	89 983	145 433	0,310428	0,188966	3%	97%

Source: own processed by data Czech Statistical Office (2017a)

Tab. 3: Effect of change in IN and VA on change in the rate of investment (IR) in Slovakia (2008 - 2014)

size	IN (mil. EUR)		VA (mil. EUR)		IR		Effect on 100 % change IR	
time	08-11	12-14	08-11	12-14	08-11	12-14	IN	VA
alltogether	899	332	2 643	2 154	0,3401	0,1538	126%	-26%
small	60	14	199	125	0,3011	0,1128	147%	-47%
medium	49	56	311	397	0,1565	0,1398	-117%	217%
large	790	262	2 133	1 632	0,3706	0,1604	132%	-32%

Source: own processed by data Statistical Office of the Slovak Republic (2017a)

In tab. 2, we can see a decline in IR, but we can also see that in all sectors, thre declide was more due to the growth in value added than the declined investment. It can therefore be said that investment in time brings greater effects. This is particularly striking for small companies - their investments are small but very effective. In tab. 3 we can follow (in a shorter period, 2015 in SK was not published) the same facts for the Slovak Republic.

When comparing tab. 2 and tab. 3 we can see that while the rate of investment in the Czech Republic is rather due to the growth of value added, the cause in Slovakia is more

concentrated on the fall in investment. The exception are only medium-sized companies, where the change in IR was very small and the influence on it was primarilly the added value.

3 Innovation inputs

Innovation is considered one of the most popular acts in business, but one of the hardest to pull off. According to Bain's Innovation Assessment Survey (2013) innovation leaders consistently outperformed laggards on five manageable capability areas (see Figure 2).The disparity suggests that innovators rely on a systematic approach, not just on finding people who happen to be innovative. Innovation's top performers see higher sales growth, higher employee loyalty and decision effectiveness. All these necessary assumptions for innovative effectiveness are connected with systematic firm's interest in qualified employees and effectively spent R&D expenditure.

One of our aim is to briefly analyse the assumption for succesful innovative behavior of the HT MI firms in both countries, therefore in Table 4 and 5 we compare the rate of innovative activities (measured by the ratio the HT MI to the MI and the MI to the business sector) inside the business sector. This analysis helps us to estimate the future role of the HT MI sectors in economic performance of both countries.

Fig. 2: Attitude of innovation high performers
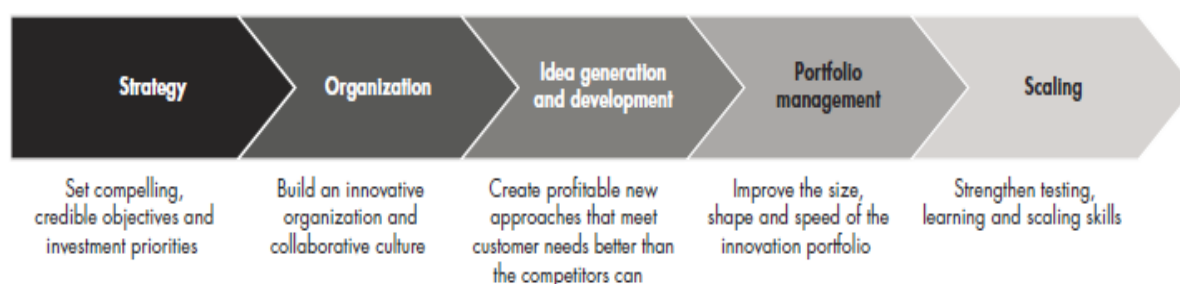
Source: Almquist, E., Leiman, M., Rigby D., Roth, A. (2013)

4 R&D expenditure and R&D personnel

The following tab. 4 describes the evolution of High Tech (HT) and Manufacturing Industry (MI) in R & D spending in the business sector (BS), and allows assessing whether one of the prerequisites for successful innovation performance is actually fulfilled, which is sufficient R & D expenditure.

Tab. 4: R&D expenditure - position of HT MI and MI in business sector (share in %)

country	*ratio*	2008	2009	2010	2011	2012	2013	2014	2015
CZ	HT/MI	19%	19%	17%	15%	15%	14%	16%	15%
	MI/BS	54%	53%	53%	52%	51%	53%	52%	52%
SK	HT/MI	10%	10%	11%	15%	10%	4%	5%	5%
	MI/BS	63%	67%	69%	61%	54%	57%	67%	66%

Note: HT/MI = the ratio of R&D expenditure in HT MI and R&D expenditure in MI (in CZK and EUR), MI/BS= the ratio of R&D expenditure in MI and R&D expenditure in business sector (in CZK and EUR)
Source: own processed by data Czech Statistical Office (2017b) and Statistical Office of the Slovak Republic (2017b)

The share of the manufacturing sector (R & D) in R & D expenditure in the business sector (see Table 4 and 5) is relatively stable in both countries (average 52.6% in the Czech Republic, 63.1% in Slovakia in the monitored period). The share of R & D expenditure in HT and MI decreased in both countries. The stability and share of R & D of HT expenditure on MI expenditures in the Czech Republic (in 2008 the share of HT companies in the Czech Republic was twice as more than in Slovakia and in 2015 even three times as much) and is an evidence of a more robust position of HT firms in the Czech Republic in European value chains. In the Czech Republic, R & D expenditures grew absolutely in all the sectors compared: 67.6% in the business sector, 62.2% in manufacturing, and the lowest in the HT MI. The evolution of the share of expenditures in HT was influenced by their year-on-year decline in 2009, 2010 and 2015.

In case of Slovakia, it is obvious that the processing industry is more focused on activities related to the medium high-tech sector (automotive). R & D spending in the business sector was 1.9 times higher than in the start-up year in 2015, more than doubled (by 100.7%) in the manufacturing industry. The lower importance of the HT sector for economic performance can be deduced from a decline in R & D spending in this sector (by 2015 by 9.4% less than in 2008). The change in the share of HT to MI was influenced by the absolute year-on-year decline in HT spending in 2009, 2012, 2013 and 2015. In the R & D manufacturing industry, expenditure fell year on year between 2009 and 2011.

A positive trend can be seen in the increase in the amount of R & D workers in both countries. The share of HT workers in R & D workers in the manufacturing industry in the Czech Republic corresponds to the share of this sector in R & D expenditures (compare Table 3 and Table 4). In Slovakia, higher R & D staff involvement can be monitored in the HT sector rather than in the spending sector.

Tab. 5: R&D personnel - position of HT MI and MI in business sector (share in %)

country	*ratio*	2008	2009	2010	2011	2012	2013	2014	2015
CZ	HT/MI	18%	18%	16%	15%	15%	17%	15%	15%
	MI/BS	54%	53%	53%	52%	51%	51%	50%	49%
SK	HT/MI	9%	7%	8%	9%	10%	9%	8%	9%
	MI/BS	53%	52%	52%	57%	53%	49%	61%	66%

Note: HT/MI = the ratio of R&D personel in HT MI and R&D personel in MI (in CZK and EUR), MI/BS= the ratio of R&D personel in MI and R&D personel in business sector (in CZK and EUR)
Source: own processed by data Czech Statistical Office (2017b) and Statistical Office of the Slovak Republic (2017b)

Due to the lower starting base in 2008, the employment of R & D personnel in the business sector in Slovakia was 60.6% in 2015, due to the growth of the importance of the automotive industry, the number of R & D workers in the manufacturing industry was doubled, but also in the HT MI. From the change in the number of R & D workers in 2015 compared to 2008 in the CR, a broader portfolio of R & D-focused industries can be considered in the Czech Republic than in Slovakia, A higher starting base and a "longer tradition" of these activities in the automotive industry in the Czech Republic. The number of R & D personnel in the business sector was 42.4% higher in the business sector than in the baseline year of analysis; in the manufacturing industry, the number increased by 27.8%, the increase in HT MI was 6.7%.

Conclusion

The aim of the article was to analyze the situation in the part of economy, which is both very important for the competitiveness of the Czech and Slovak Republics and very sensitive to the need for continuous inflow of investment. This industry is high tech manufacturing industry. Article analyzed developments in high tech manufacturing in the years 2008 - 2015. Comparison of the development and status of the Slovak and showed other aspects of the problem. The indicators are relative terms to the comparability correct.

The comparison is a different development in companies depending on the size of the company (small, medium, large). The article shows the strengths and weaknesses in needs and appreciation of companies so that they can be purposefully supported with the direct impact on economic growth.

Analysis of selected performance indicators of high tech sector in recession and recovery in the beginning shows the impact of the recession on the company, but also the

sensitivity of firms to market fluctuations. On the other hand, we can see both the stability of small and medium-sized domestic companies, but also the flexibility to respond to changing circumstances. When taking into account not only innovation, but perspective in terms of building competitive advantage and other aspects such as the development of human potential and employment in the domestic small and medium-sized firms, we see that these companies are comparable in value added and are not by an order of magnitude smaller employer than the large firms. We see a decrease in the investment rate in investment development, but because it is due to the growth in value added, it can be positive. In case of any support for building competitive advantages in the Czech economy, support (whether direct or indirect) of companies, particularly medium-sized, should be emphasized, because they have the potential to create higher value added in next years and also product innovation and development of skilled labor.

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Contact

Hana Scholleova

Czech Technical University in Prague

MIAS School of Business

Kolejní 2a

160 00 Prague 6

hana.scholleova@cvut.cz

Marta Necadova

Department of Microeconomics, Faculty of Business Administration

University of Economics, Prague

W. Churchill Square 4

130 67 Prague 3

necadova@vse.cz