THE SECTORAL VIEW OF THE COMPETITIVENESS OF THE CZECH REPUBLIC

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Abstract

The paper explores development of the industrial structure of the Czech economy in the last fifteen years from the point of view of the gross value added and employment. It goes from the macroeconomic view at the level of the basic sectors to more detailed view focused on the individual branches. The accent is put on the labor productivity development and its main factors. The comparison is carried out in the time series, as well as within the EU member states. The qualitative aspects of the competitiveness are analyzed by the technology intensity of industries. The average position of the individual industries is analyzed and ranked by the Overall Index of Industrial Competitiveness. Besides the standard methods of the structural analysis the Input-Output approach is applied. Comparison of the output multipliers, which are important for analysis of impact of individual industries on the total economy performance, between 2000 and 2010 was made.

Key words: Structural changes, productivity, technology intensity, output multipliers

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Introduction

Over the last fifteen years the Czech economy experienced the period of rapid economic growth as well as deep recession, which can be illustrated on the dynamics of GDP indicator. This macroeconomic view can be more closely analyzed by its structural aspects. The aim of this paper is to analyze the development on the supply side of the economy and describe major trends that have occurred over the described period and can be detected through statistical indicators.

Examination of the supply side of the economy can be undertaken with various degrees of detail, from performance of the national economy as a whole to a variety of defined production sectors or individual entities. The more detailed the assessment is, the more it allows us to identify the driving forces behind the economic development. On the other hand, the vision of the economy as a whole is obscured with increasing detail. This is why a

combination of macro, mezzo and micro approaches appears to be the best solution. Industry analysis in this case serves as a link between macroeconomic analysis and analysis at the company level.

1 Macroeconomic view: development of basic sectors

From the point of view of the share of the main sectors in gross value added (GVA) and employment, services are a sector with the largest share in creation of gross value added, while agriculture is a sector with the smallest share. As Table 1 shows, the structure of the Czech economy changed very slowly between 2000 and 2015. The share of agriculture (from 3,4 % to 2,4 %) and construction decreased slightly (from 6,4 % to 5,6 %), while gradual growth in the share of services remained virtually unchanged – around 60 %. The share of industry in GVA slightly increased – by 1,6 pp. to 32,4 %. In the real terms the picture was somewhat different and the share of industry (especially manufacturing) increased significantly by one fifth. The share of services fell by one tenth which was caused by the different development of prices in various sectors. The structure of employment was influenced by more rapid dynamics of labor productivity in manufacturing than in other sectors and it's share decreased throughout this period.

Table 1: Structure of the gross value added and employment by basic sectors (in %)

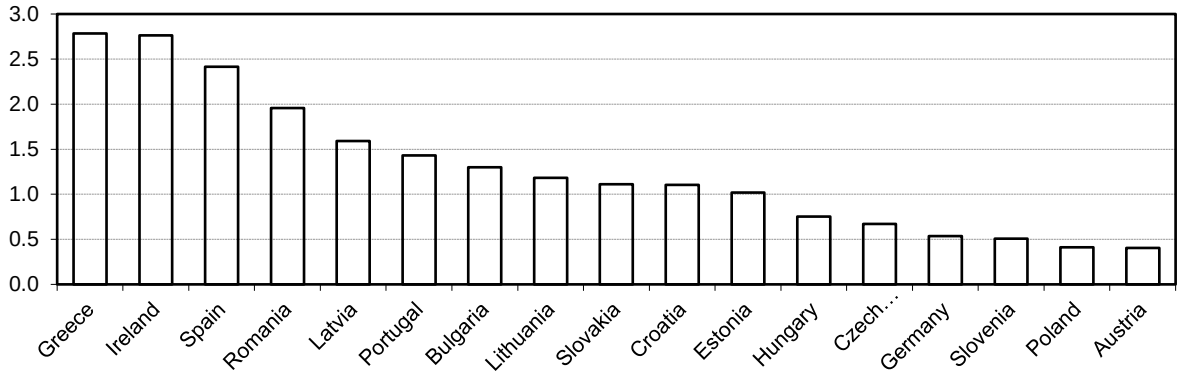
	Gross value added (curr.p.)				Gross value added (p. 2010)				Employment (persons)			
	2000	2005	2010	2015	2000	2005	2010	2015	2000	2005	2010	2015
Agriculture	3,4	2,4	1,7	2,4	3,7	3,7	2,4	2,5	4,6	3,7	3,1	3,3
Industry	30,8	31,0	29,9	32,4	35,9	38,9	42,8	43,6	30,5	30,1	27,3	28,7
Construction	6,4	6,7	6,9	5,6	4,6	4,3	4,0	3,6	8,6	8,9	9,3	8,0
Services	59,4	59,8	61,5	59,6	55,8	53,1	50,8	50,3	56,3	57,4	60,3	60,1

Source: CZSO (2016), author's calculations

The degree of structural changes over time can be illustrated in a condensed form by the so-called indicator of structural change intensity. We can see in figure 1 that the Czech Republic was one of the most stable countries in the EU. On the other side the most dynamic change in the industrial structure recorded Romania, Greece, Ireland, Spain and Cyprus. It is clear from the comparison that new member states from Central and East Europe have in the recent years much more stable industrial structure than in the 90's. On the other hand in some "old

member states" the global economic crisis after 2008 influenced also their structural characteristics.

Figure 1: Intensity of structural changes of GVA in selected EU countries (2014/2000)



Note: The coefficients are calculated on the 2-digit NACE level. Source: EUROSTAT (2016), author's calculations

2 Analysis of labor productivity

The overall development of productivity in the national economy may be influenced by development of productivity in individual industries, as well as changes in the structure of employment. The overall increase in labor productivity in the national economy can be divided into individual contributions through the so-called share breakdown analysis (Fagerberg, 2000). The total increase in productivity over a certain period is divided into three factors (see formula 1). The first factor (static shift effect) expresses net impact of changes in the structure of employment on the economy, while the third factor describes net impact of intra-industrial labor productivity (within growth effect). The second factor expresses combined impact of productivity and structure of employment (dynamic shift effect).

$$\frac{\Delta P}{P_0} = \sum_i \left[\underbrace{\frac{P_{i0}\Delta S_0}{P_0}}_{I} + \underbrace{\frac{\Delta P_i \Delta Si}{P_0}}_{II} + \underbrace{\frac{S_{i0}\Delta P_0}{P_0}}_{III} \right] \quad (1)$$

where *Pi* = labor productivity in the i-th branch, *Si* = share of the i-th branch on the total employment

Structural bonus hypothesis implies the shift of labor force from relatively low to higher productivity branches. Formally expressed:

$$\sum_i \left[\frac{P_{i0} \Delta S_0}{P_0} \right] > 0 \qquad (2)$$

Structural burden hypothesis implies the increase of the share of employment in relatively slow-dynamic branches. Formally expressed:

$$\sum_i \left[\frac{\Delta P_i \Delta Si}{P_0} \right] < 0 \qquad (3)$$

Similarly we can use this analytical tool for international comparison of productivity (see formula 4). This analysis serves for decomposition of the technology-based convergence and structural-based convergence to the level of developed countries.

$$\frac{P_T^{CZE} - P_T^{EU15}}{P_T^{EU15}} = \sum_i \left[\frac{\left(P_i^{CZE} - P_i^{EU15}\right) S_i^{EU15}}{P_T^{EU15}} + \frac{\left(S_i^{CZE} - S_i^{EU15}\right) P_i^{EU15}}{P_T^{EU15}} + \frac{\left(P_i^{CZE} - P_i^{EU15}\right)\left(S_i^{CZE} - S_i^{EU15}\right)}{P_T^{EU15}} \right] \qquad (4)$$

Table 2: The influence of factors on the differences in labour productivity among selected countries and EU-15 in 2000 and 2013 (in %, current exchange rate)

	2000				2013			
	LP to EU-15	I.	II.	III.	LP to EU-15	I.	II.	III.
BG	8,2	97,3	7,5	-4,9	16,6	97,1	4,9	-2,0
CZ	26,1	101,3	-15,7	14,4	44,6	114,6	-32,3	17,7
EE	19,8	101,0	-18,2	17,3	44,9	113,1	-27,9	14,8
HU	21,5	98,8	-9,5	10,7	34,0	108,4	-16,9	8,5
LT	16,3	95,0	10,5	-5,5	39,2	98,4	-0,2	1,8
LV	17,4	99,3	-9,9	10,7	36,7	109,7	-25,6	16,0
RO	7,1	94,1	13,5	-7,6	23,9	83,2	13,2	3,6
SI	43,6	81,3	6,7	12,0	54,0	97,3	-3,6	6,3
SK	20,5	100,4	-7,2	6,8	49,5	107,5	-11,6	4,1

Note: I. – technology gap, II. – structural gap, III. – combined influence of technology and structural gap.
Source: EUROSTAT (2016), author's calcualtion

Table 2 shows the productivity level in the new EU countries in comparison with its average and the decomposition of productivity gap to the share of change in structure and share of change in technologies. The decomposition shows the dominant influence of the technological productivity gap in individual industries. The Czech Republic has the highest share of technological gap in comparison with other EU countries; on the other hand it has the most favorable industrial structure of the economy (together with Estonia). The absolute comparison of productivity is influenced by using current exchange rate (which includes the price differences among countries) and the Czech Republic is on the third place between compared countries (behind Slovenia and Slovakia). Slovakia is country with relatively most

dynamic increase in productivity level in reporting period (from 20 to almost 50 % of EU-15 average).

3 Technology intensity of industries

From the point of view of the position of economy in the global value chain is important, how significant are the high-tech activities in the country. These activities usually brings positive effects for the economy as high wages and profits, rapid growth of trade and productivity and high rate of innovations (= positive externalities).

Table 3: The comparison of the level and dynamics of the labor productivity and gross value added by groups of activities by technological intensity (in %)

	Labor productivity (LP)		GVA	LP		Labor productivity (LP)		GVA	LP
			growth rate					growth rate	
	2000	2014	2001–2014			2000	2014	2001–2014	
High-tech	**624**	**1 302**	**11,9**	**9,8**	**Medium low-tech**	**441**	**739**	**3,6**	**3,3**
Manuf. of pharmaceutical products	1 270	1 318	4,0	0,7	Manuf. of coke and refined petrol. p.	1 394	2 665	...	...
					Manufacture of rubber and plastic p.	479	886	9,2	6,3
Manufacture of electrical equipment	491	1 298	14,8	13,1	Manuf. of other non-metallic mineral products	546	810	0,9	3,6
					Manufacture of basic metals	362	631	1,7	1,3
					Repair and installation of machinery and equip.	455	811	4,1	3,0
Medium high-tech	**488**	**949**	**8,7**	**7,2**	**Low tech**	**341**	**548**	**0,5**	**2,9**
Manufacture of other chemical products	774	1 214	1,0	2,8	Manufacture of food and beverages	478	686	-0,4	1,2
Manufacture of electrical equipment	359	775	9,9	8,3	Manuf. of textile, wearing and leather	221	411	-2,3	3,8
Manuf. of machinery and equipment	376	767	8,2	7,8	Manuf of wood; printing and reprod.	341	508	2,7	3,4
Manufacture of motor vehicles	637	1 174	10,5	7,3	Manufacture of furniture	270	371	0,6	0,6
Manufacture of other transport equipment	387	863	6,1	3,6	Other manufacturing	283	554	4,4	5,7

Note: The growth rate of GVA and LP in the Manufacturing of coke and refined petroleum products has negative value in some years and does not allow calculate average growth rate. Source: CZSO (2016), author's calcualtion

High-tech industries are able to compete by the quality at relatively high prices, which brings positive effect on the level of the national income. It is necessary to take into account not only classification of the activity, but also its position in the value chain (Arndt, 2001).

Table 3 shows the characteristics of individual groups of activities on various level of technological intensity. We can see that there is positive relation between technological intensity and the level and dynamics of productivity. High level of productivity is in both compared years in pharmaceutical industry, significant progress has been noticed also in the manufacture of electrical equipment (LP more than doubled between 2000 and 2014). Relatively high level and dynamics of productivity we can find also in the industries classified as "medium high-tech", especially manufacturing of motor vehicles or chemicals.

We can see significant differences in R&D intensity across EU countries The Nordic countries have more than 3% of R&D expenditures to GDP, whereas EU average is about 2%. Most of the new member states is below 1 % with the exception of Slovenia (2,4%), the Czech Republic (2,2%), Estonia (1,5%) and Hungary (1,4%).

4 Competitiveness scale of branches

The industrial characteristics of the competitiveness of the Czech Republic can be expressed in condensed form by The Overall Index of Industrial Competitiveness (OIIC). This composite indicator expresses the average position of industries in the Czech economy (Spěváček et al., 2012). The index is constructed on the basis of seven partial indicators, including: level and dynamics of productivity, share of exports in gross output, share of highly qualified employees, the ratio of cost of research and development to gross value added, share of businesses under foreign control in gross value added, output multiplier.

We can see in table 3 that pharmaceutical industry is the most successful industry in the Czech economy. It was caused by high share of export on the production which is close to 100%. There is also the third highest share of the research and development expenditure in comparison with the value added and rapid decrease of the unit labor costs contributed to improvement of the cost competitiveness. The pharmaceutical industry has the productivity level higher by 68% compared to the average of manufacturing (6th position among all activities). The dynamics of productivity was rather low in 3-year average (decrease by 1,1%). In all other characteristics the manufacture of pharmaceuticals was in the highest third of the scale.

Table 4: The scale of industries according to Overall Index of Industrial Competitiveness (2014)

	LP level	LP dynam.	Export perform.	Higher qualif.	R&D expend.	ULC dynam.	Foreign contr. GVA	Output multipl.	Average
Manuf. of pharmaceutical products	6	15	1	7	3	1	8	7	6,0
Manuf. of chemicals and chem. prod.	8	7	6	13	9	17	7	18	10,6
Professional, scientific and tech. act.	17	13	20	3	1	9	19	2	10,5
Information and communication	5	11	18	1	6	16	6	24	10,9
Manufacture of motor vehicles	9	29	7	18	7	10	2	4	10,8
Manuf. of computer, electr.& opt.p.	7	20	3	11	10	18	3	28	12,5
Manufacture of rubber and plastic p.	11	22	9	19	13	19	5	14	14,0
Manufacture of electrical equipment	13	12	5	17	8	20	4	16	11,9
Financial and insurance activities	4	10	24	2	16	3	29	23	13,9
Manufacture of basic metals	19	5	8	20	15	15	12	12	13,3
Manuf. of coke and refined petrol. p.	3	1	15	9	23	28	1	29	13,6
Manuf. of machinery and equipment	14	21	4	12	5	25	9	26	14,5
Other manufacturing	21	2	12	21	4	23	17	19	14,9
Water supply, sewerage, waste	15	30	16	15	20	6	11	15	16,0
Construction	25	4	26	22	17	2	23	9	16,0
Manufacture of food and beverages	18	27	13	28	18	12	10	20	18,3
Administrative and support serv. act.	27	3	22	25	22	4	18	5	15,8
Mining and quarrying	10	23	10	24	25	5	16	1	14,3
Wholesale and retail trade	23	6	28	16	21	13	14	11	16,5
Manuf of wood; printing and reprod.	26	28	11	23	26	11	13	8	18,3
Electricity, gas steam, air con. supply	1	26	23	10	28	14	20	10	16,5
Other service activities	28	24	21	14	12	8	26	22	19,4
Manuf. of textile, wearing and leather	29	17	2	27	11	24	15	17	17,8
Education	22	16	27	4	2	21	28	21	17,6
Transportation and storage	16	25	17	30	30	7	21	3	18,6
Agriculture, forestry and fishing	20	8	19	26	24	26	25	6	19,3
Real estate activities	2	18	30	6	27	30	24	25	20,3
Public administration and defence	12	9	29	8	19	27	30	30	20,5
Health and social work activities	24	19	25	5	14	22	27	27	20,4
Accommodation and food service act.	30	14	14	29	29	29	22	13	22,5

Note: The order of industries in the scale is influenced by the level of aggregation of industries. It means that some groups of industries are relatively heterogeneous, but it is necessary to keep „reasonable“ number of industries for comparison. Source: EUROSTAT (2016), author's calculations

5 Multiplication effects

Modern economies are characterized by strong inter-industrial connections. However, standard structural analysis tools focus on examining isolated industries and disregard mutual connections between these. This limitation of the structural analysis tools is eliminated by applying so-called input-output analysis, which uses tools for quantifying mutual connections between objects (industries or sectors) in the economy and the multiplication capacity of individual branches. The basic principles of input-output analysis were published for the first time by Wassily Leontief (1951). Input-output analysis can be expressed by the following formulas:

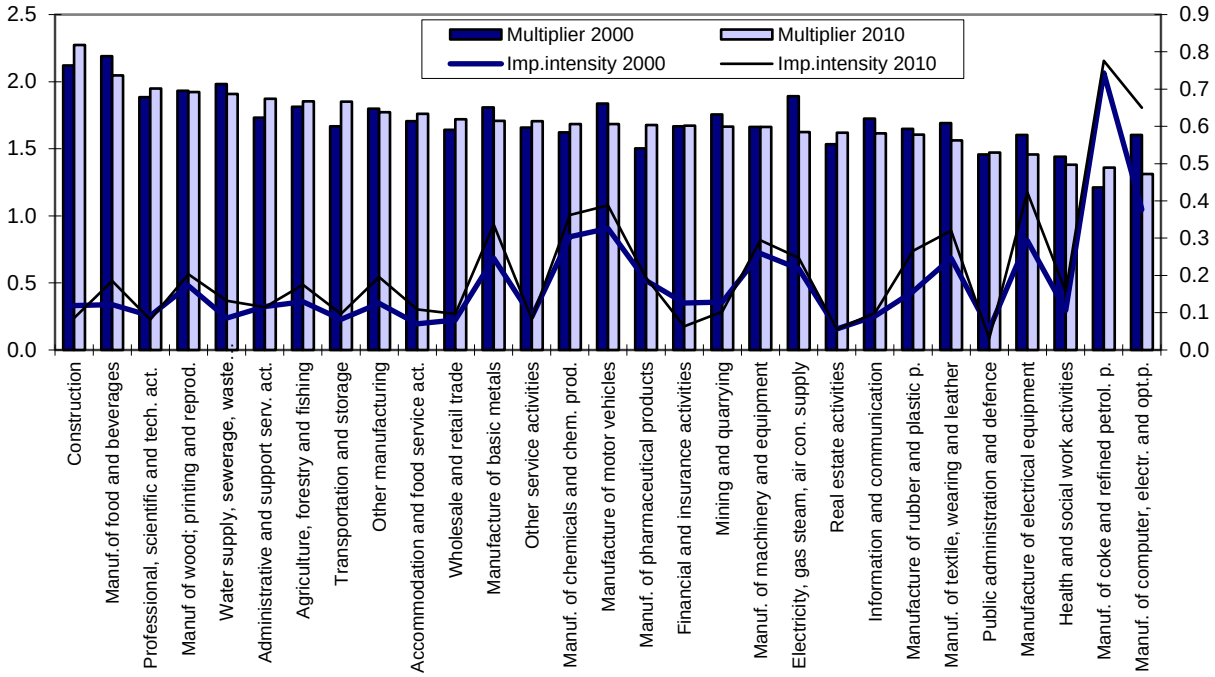
$$A_D x + f_D = x \quad (5)$$

$$x - A_D x = f_D \quad (6)$$

$$(I - A_D)x = f_D \quad (7)$$

where x = n-membered vector of output by industries, f_D = n-membered vector of final use from domestic production, A_D = matrix of direct coefficients from domestic production of order n x n.

Figure 2: Comparison of the output multipliers and import intensity by branches in the years 2000 and 2010



Note: The higher is the value of multiplier, the higher is the effect of individual industry on the total economy production. Source: CZSO (2016), author's calculations

Formula (5) expresses the equation of the source and use sides by the groups of commodities (ie. industries with homogenous production). It implies that production is either consumed in the following production process or become the part of the final use. All other relations within the structural analysis are derived from this equation.

By editing equation (5) we require formula (8), which expresses the relationship between the gross output and final use:

$$x = (\mathrm{I} - A_D)^{-1} f_D \quad (8)$$

Matrix $(\mathrm{I} - A_D)^{-1}$ expresses the process of multiplication, which we can formulate by the following expression:

$$\mathrm{I} + A_D + A_D{}^2 + A_D{}^3 + A_D{}^4 + ... + A_D \quad (9)$$

Output multipliers can be interpreted as the multiple of the original change in final demand and the overall effect (direct and indirect) on the total economy. The size of multiplication effect is positively influenced by the intensity of inter-industry relations and negatively by the import intensity of the industry (see figure 2).

We can see that the lowest multiplication effect is in the manufacturing of computers, electrical and optical products. This is caused by the position of this industry in the global production chain, where the factories in the Czech Republic are mostly oriented on the assembling operations. The second lowest industry in the scale is manufacturing of coke and refined petroleum products, which is done by dominant share (80%) of imported intermediate products (notably oil). On the other end of the scale is the construction industry with very low import intensity and major inter-industry links. On the following position is the manufacturing of food and beverages (strong link to agriculture sector). The professional, scientific and technical activities have the highest multiplication effect in the service sector.

Conclusion

The structure of the Czech economy does not changed significantly in the recent years. We can find more changes on the more detailed level than at the level of basic sectors. Industrial sector, especially manufacturing, is the most dynamic sector in the economy. This is influenced by rapid growth of some key industries, especially the Manufacturing of motor vehicles. The difference in productivity between CZR and more developed EU countries is caused dominantly by the intra-industry technological gap whereas the structural difference plays positive role. For the future it is necessary to strengthen the role of high-tech industry, where especially manufacturing of pharmaceutical products has good position in international competitiveness. On the other hand the manufacturing of electrical and optical products has much to do in increasing quality aspects of competitiveness, despite rapid growth of productivity in recent years. One of the key structural characteristic is the multiplication effect, which can help to disseminate the boom in some sectors to other ones. This effect is limited by the relatively high import intensity in some industries, which are connected in the global value chains.

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