

PRODUCTIVITY PERFORMANCE OF THE CZECH REPUBLIC - SHIFT-SHARE ANALYSIS

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Abstract

This paper presents analysis of structural changes in the Czech Republic through the prism of changes in productivity. For this purpose, Shift-Share Analysis methodology for labour productivity growth was used. The author distinguished two main categories for labour productivity growth: pure labour productivity growth and structural labour productivity growth. Pure labour productivity is a result of technological changes, while structural labour productivity is a result of transfer of labour from low-productivity sectors to high-productivity sectors. This study considers changes taking place in the structures of economy in the period 1996-2009.

In analyzed period, the Czech Republic improved both pure and structural productivity growth thanks to the changes and modernization of economic structures, but, impact of pure labour productivity was much smaller than structural productivity. Productivity increased in all sectors; however, the most significant rise was noted in Financial intermediation; real estate, renting and business activities. Simultaneously employment decreased the most in Agriculture, hunting and forestry; Fishing – the sector with the lowest productivity. Decomposition of productivity growth was mostly negative in 1996-2003; nevertheless, this trend has changed after accession to EU. It is also worth to underline that this research can be used by the government agencies for industrial development policies.

Key words: transition economies, structural changes, economic growth, Shift-Share Analysis

JEL Code: D24, G34, L33

Introduction

Fall of communist regime in Central and Eastern Europe in the beginning of 90's, started process of political and economic transformation. Czechoslovakia was one of the countries that had made the transition from a centrally planned economy to a market economy. In comparison to its neighbors Czechoslovakia had sound public finances and relatively low gross foreign debt, which were relatively favorable conditions for institutional reforms. Main reforms implemented were the trade liberalization, privatization, sharp devaluation and partial convertibility of the currency. Strict fiscal and monetary policy, and a fixed exchange rate were

aimed to counteract inflationary pressure (Freit, 2000). From the mid 90's the Czech Republic started intensively to prepare for EU accession and become EU member in 2004.

Main goal of the article is analysis of productivity performance of the Czech Republic economy in period 1996-2009. Analysis of years right after transition will verify if increasing productivity was caused mainly by rise in labour productivity or structural changes. Analyzed period can be divided into two sub-periods. During this first period from 1996 till 2003 the Czech Republic was implementing reforms set necessary for EU accession. The second period contains years after accession till financial crisis 2004-2009. Main research method employed is Shift-Share methodology. Statistical analysis was done based on data from OECD.

1 Structural changes, productivity and economic growth

The relationship between structure of the economy and its productivity growth is important topic in scientific literature. Many researches confirm that changes in economic structure are one of the most important driving forces of economic growth. Increasing productivity and reduction of productivity gaps between sectors are especially important for developing economies.

Lewis (1954) was one of the precursors of structural development theory. In his dual sector model, he pointed out productivity differences between capitalist and subsistence sectors of the economy. Lewis' model describes the economic growth of developing countries through labour transition between those two sectors. The urban capitalist sector is absorbing labour from rural low-income subsistence sector, holding down urban salaries, until the rural surplus is exhausted.

Kuznets (1967) stated that economic growth relates to structural transformation. Structural change occurs in several areas such as shift away from agriculture to nonagricultural, shift away from industry to services, shift from personal enterprise to impersonal, with a corresponding change in the occupational status of labor. The impact of structural changes to overall productivity vary over centuries and countries due to differences between sources of technological progress and sectors affected.

Feder (1986) focused on the contribution to economic growth of transfers of resources between industrial and non-industrial sectors. His research suggests that a substantial difference has existed between marginal factor productivity in industrial and non-industrial sectors. Countries that pursued an accelerated industrial growth had a tendency to grow faster as the resource allocation came closer to optimal.

Dowrick's (1989) studies confirmed that GDP growth from mid of twenty centuries has been higher in those countries that have been able to reallocate a greater share of their labor force out of agriculture into industry and services. He concluded that the marginal labor productivity in agriculture has been systematically lower than in the rest of the economy.

Fagerberg (2000) underlined that impact of structural changes for overall productivity is nowadays much stronger than twenty years ago. New advanced technologies are playing important role in generating structural change by expanding productivity at a very fast rate, but without simultaneously large increase in the share of total employment. In the first half of the 20th century, growth of output, productivity and employment were strongly correlated. Nowadays, this relationship has become more blurred.

McMillan et al. (2014) underline that developing countries can be characterized by large productivity gaps between economic sectors, but such disparities may be an important engine of economic growth. When labour and other production resources move from less productive to more productive activities, the economy grows even if there is no productivity growth within sectors. Labor flows from low-productivity activities to high-productivity activities are a key driver of development. High-growth countries are typically those that have experienced extensive growth enhancing structural change the speed of structural changes determines the country's economic success.

2 Shift-share analysis methodology

Shift-Share analysis is a method that divides the growth of an economic variable in a specific area into various components. Anderson and Fabricant (1943) introduced for the first-time shift-share analysis measuring reallocation of labour among economic sectors. Main benefits of using shift-share analysis is its simple procedure. This method requires only relatively modest amount of data, which make results fast and reasonably accurate. Regardless of its simplicity, it well captures changes in the variables under consideration over time (Fothergill & Gudgin, 1979).

In literature there are many extensions of shift-share use, especially for regional analysis. Esteban-Marquillas (1972) introduced the use of a homothetic employment in sector and region, which lead to the identification of an additional, allocation effect. In this model, the regional effect is decomposed into two components, which are isolating a regional shift component that is not correlated to the industrial mix. Arcelus (1984) developed method even further and decompose the national share and industrial mix effects into expected and differential components. Barff & Knight (1988) introduced dynamic shift-share analysis with

implementation of continuous change in both the regional industrial mix and the size of the employment base. Nazara & Hewings (2004) introduced recognition of spatial dimension into shift-share analysis. They underlined that location of particular region is an important element in the growth accounting.

There are few variants of shift-share analysis, which were applied to understand structural changes and their impacts on economic growth. The main difference in those variants is choice of base year or weights. Labour productivity growth in an economy can be achieved twofold. Pure labour productivity growth is achieved by technological change or improvement of production process. Change in productivity due to movement from low-productivity sectors to high-productivity sectors is called structural labor productivity. The basic shift-share equation for aggregate productivity introduced by McMillan et al. (2014) decomposes into a pure and structural change component:

$$\Delta AP_t = \sum_i \varphi_{i,t-k} \Delta SP_{i,t} + \sum_i SP_{i,t} \Delta \varphi_{i,t} \quad (1)$$

AP_t demonstrates aggregate labour productivity, $SP_{i,t}$ represents labour productivity level of sector- i at time t , while employment share of a sector- i at time t in overall employment is represented by $\varphi_{i,t}$. The first component in the decomposition equation represents the pure productivity growth and the second structural change component of the aggregate productivity growth. Pure labour productivity growth is weighted sum of productivity growth within individual sectors, where the weights are the employment share of each sector in total employment. Structural labour productivity growth is related to labour re-allocations across different sectors. It can be calculated as multiply of sector productivity and employment change within sector. Positive structural component indicates positive correlation between changes in employment shares and productivity levels, which increase overall economy productivity growth.

3 Productivity changes in the Czech Republic – results and discussion

In constructing our data, we took as our starting point the Organization for Economic Co-operation and Development (OECD) database, which provides gross value added and employment statistic for the Czech Republic disaggregated into 6 sectors for the period from 1996 to 2009. Data for gross value added in the sectoral breakdown is shown in Table 1. In all sectors, an increase in gross value added could be observed, however the highest dynamic was observed in Financial intermediation sector, which obtain 264% growth during analyzing period. The Agriculture sector scored the lowest dynamic in gross value added (101%). The

second and the third the most dynamic sectors turned out to be the Other services activities and Wholesale and retail trade, repairs, hotel and restaurants, transport sector, which obtain accordingly 237% and 229% growth. The Industry including energy sector in the last years of the analyzed period obtained the highest values. For instance, in 2009 obtained 989 134 mln [CZK] and was 30% higher than second Wholesale and retail trade, repairs, hotel and restaurants, transport sector, 40% and 42% higher than third Financial intermediation and fourth Other service activities sectors. It is worth to underline that also the Industry including energy sector obtained the highest average gross value added (750 559 mln [CZK]).

Tab. 1: Total gross value added at basic prices (The Czech Republic 1996-2009)

	1. Agriculture, hunting and forestry; fishing	2. Industry, including energy	3. Construction	4. Wholesale and retail trade, repairs; hotels and restaurants; transport	5. Financial intermediation; real estate, renting and business activities	6. Other service activities	7. Total gross value added
1996	71421	508851	126302	345241	226366	240515	1518696
1997	69242	542336	123447	405224	242204	259101	1641554
1998	76373	564789	146241	450051	295427	279950	1812831
1999	72386	598062	131073	461911	308219	308018	1879669
2000	77158	627180	127961	512358	321691	317098	1983446
2001	84167	671075	133750	546896	352705	343775	2132368
2002	74368	683627	139096	601373	360110	381508	2240082
2003	73331	691030	149213	626196	390320	412965	2343055
2004	83364	811567	164494	617535	417940	434778	2529678
2005	80996	845117	167996	663242	448409	469500	2675260
2006	75506	927855	183047	744006	475576	501670	2907660
2007	78288	1017610	204174	791328	555601	531010	3178011
2008	84474	1029590	219318	838649	593451	555981	3321463
2009	72375	989134	239902	790298	597288	570819	3259816
% change 1992-2008	101%	194%	190%	229%	264%	237%	215%
average (1992-2008)	76675	750559	161144	599593	398951	400478	2387399

Source: author's calculations based on OECD

Data for total employment in the sectoral breakdown is shown in Table 2, where the movement of labour from low-productivity to high-productivity activities raises economy-wide labour productivity. During the analyzed period, a drop of 0.133 mln people has been made in the Agricultural sector, 0.029 mln in Construction sector and Industry by 0.173 mln inhabitants, while increases could be seen in other sectors like: Financial intermediation from 0.481 mln to 0.695 mln inhabitants, other service activeness from 0.994 to 1.108 mln inhabitants. In

Wholesale and retail trade, repairs, hotel and restaurants, transport sector, there was a similar number of employed people. It could be noticed a decline in total employment at the beginning of the 21st century, however, after joining the EU, this situation was changing and the number of people employed increased to the higher level than in 90s.

Tab. 2: Total employment, in full-time equivalents (The Czech Republic 1996-2009)

	1. Agriculture, hunting and forestry; fishing	2. Industry, including energy	3. Construction	4. Wholesale and retail trade, repairs; hotels and restaurants; transport	5. Financial intermediation; real estate, renting and business activities	6. Other service activities	7. Total employment
1996	318	1635	508	1259	481	994	5195
1997	306	1667	502	1257	479	994	5205
1998	287	1624	497	1250	483	984	5125
1999	257	1517	455	1246	493	982	4950
2000	238	1503	431	1254	513	1002	4941
2001	229	1529	416	1264	525	1001	4964
2002	216	1512	424	1272	551	1017	4991
2003	206	1465	423	1252	548	1029	4924
2004	198	1465	431	1251	563	1032	4940
2005	191	1478	432	1254	593	1044	4992
2006	190	1509	441	1270	612	1067	5088
2007	188	1530	460	1303	656	1088	5224
2008	189	1550	472	1295	686	1096	5288
2009	185	1462	479	1297	695	1108	5226

Source: author's calculations based on OECD

Table 3 shows labour productivity gaps between different sectors. The highest productivity can be observed in sector 5 (Financial intermediation; real estate, renting and business activities), while the lowest productivity is shown in sector 1 (Agriculture, hunting and forestry; fishing). The productivity in sector 5 is twice as in sector 1. This disproportion is not large. In other CEE countries this disproportion is much higher. It is worth to underline that productivity in all sectors increase in analyzed period. Three sectors (4 - Wholesale and retail trade, repairs, hotel and restaurants, transport, 2 - Industry including energy and 6 - Other service activities) obtained similar change, which are 222%, 217%, 213%. Change above 200% gained also Construction sector. The lowest changes are observed in Agriculture, hunting and forestry; fishing and Financial intermediation; real estate, renting and business activities sectors, which obtained accordingly 174% and 183%. In 2009 labour productivity in financial intermediation was just two times larger than in Agriculture. Of course, it can be concluded that all employees

should work in the financial sector. However, it can be more meaningful to compare productivity levels across sectors with similar potential to absorb labour. As confirmed by analysis for other CCE countries made in other articles by Author, Agriculture sector turned out to be effective. In all analyzed years labour productivity in Agriculture comparing to all other sectors with similar potential to absorb labour is almost the same. For example, average labour productivity in construction (355,15) in years 1996-2009 is almost the same like productivity in agriculture (349,20). Just Industry ratio obtains bigger score ratio (493,28).

Tab. 3: Sector productivity in the Czech Republic (1996–2009)

	1. Agriculture, hunting and forestry; fishing	2. Industry, including energy	3. Construction	4. Wholesale and retail trade, repairs; hotels and restaurants; transport	5. Financial intermediation; real estate, renting and business activities	6. Other service activities	7. Total gross value added
1996	224,59	311,22	248,63	274,22	470,62	241,97	292,34
1997	226,28	325,34	245,91	322,37	505,65	260,66	315,38
1998	266,11	347,78	294,25	360,04	611,65	284,50	353,72
1999	281,66	394,24	288,07	370,72	625,19	313,66	379,73
2000	324,19	417,29	296,89	408,58	627,08	316,47	401,43
2001	367,54	438,90	321,51	432,67	671,82	343,43	429,57
2002	343,82	452,28	328,29	472,81	653,91	375,28	448,85
2003	355,80	471,85	352,50	500,16	712,00	401,17	475,89
2004	421,24	553,93	381,39	493,63	742,21	421,34	512,05
2005	424,28	571,95	389,15	529,11	755,66	449,54	535,96
2006	398,03	615,04	415,54	585,74	777,08	469,99	571,43
2007	417,31	665,15	444,24	607,45	846,95	488,06	608,37
2008	446,72	664,47	464,56	647,71	864,58	507,10	628,08
2009	391,22	676,42	501,15	609,37	859,28	515,09	623,74
% change 1996-2009	174%	217%	202%	222%	183%	213%	213%
average (1996-2009)	349,20	493,28	355,15	472,47	694,55	384,88	469,75

Source: author's calculations based on OECD

Since 1996 to 2006 huge fluctuations can be seen in productivity level. For example, on 1996 and 1997 labor productivity growth % (component due to: pure and structural productivity) was negative, then in 1998-1999 obtained positive scores. The same situation can be observed in following years, negative in 2000 and 2001 and positive in 2002, then negative in 2003 and positive in 2004 and 2005. Finally, the stabilization can be noticed since 2007. The highest productivity growth in the Czech Republic can be observed after 2007, when both pure and structural productivity were positive (except pure productivity in 2009) and together remained above 17%. The highest change in productivity could be observed in 2008 and it was above

20% (Table 4). It is worth to underline that the Czech Republic improved both pure and structural productivity growth through changes and modernization of economic structures. However, impact of pure labour productivity was much smaller than structural productivity.

Tab. 4: Decomposition of productivity growth in the Czech Republic (year over year 1996-2009)

	Pure productivity	Structural productivity	Labor Productivity Growth % (Component due to: Pure and Structural productivity)
1996	0,181	-3,639	-3,458
1997	0,078	-11,300	-11,222
1998	0,117	5,161	5,277
1999	0,072	9,310	9,382
2000	0,056	-4,633	-4,577
2001	0,069	-10,614	-10,545
2002	0,048	8,474	8,522
2003	0,060	-0,178	-0,118
2004	0,078	1,190	1,268
2005	0,046	5,014	5,060
2006	0,066	-1,894	-1,828
2007	0,060	17,119	17,179
2008	0,033	20,134	20,167
2009	-0,004	19,831	19,826

Source: author's calculations based on OECD

Table 5 presents decomposition of productivity growth in the Czech Republic into 2 periods: 1996–2003 and 2004-2009. In first sub-period average productivity obtained negative score - 0,842%, while in second sub-period the average increased by 11.1% From accession to EU (2nd period) average labour productivity growth achieved 10,2%. Considering the entire analyzed period (1996-2009) the Czech Republic experienced rapid labour productivity growth of almost 4% per annum, roughly most of which was accounted by structural change.

Tab. 5: Decomposition of productivity growth in the Czech Republic, sub-periods: 1996–2003, 2004-2009 and 1992-2008 (unweighted averages)

Period	Pure productivity	Structural productivity	Labor Productivity Growth % (Component due to: Pure and Structural productivity)
1996-2003	0,085	-0,927	-0,842
2004-2009	0,046	10,232	10,279
1996-2009	0,068	3,855	3,924

Source: author's calculations based on OECD

Conclusion

The aim of the study was analysis of changes in productivity in the Czech Republic economy. In analyzed period, the Czech Republic improved both pure and structural productivity growth

through changes and modernization of economic structures. However, impact of pure labour productivity was much smaller than structural productivity. Share of high-technology sectors in overall production increase over research period. Structural changes have played an important role in the Czech economy and made positive contribution to overall growth. Productivity increased in all sectors, the most significant rise was noted in Financial intermediation; Real estate, renting and business activities. Simultaneously employment decreased the most in the sector with the lowest productivity: Agriculture, hunting and forestry; Fishing. In all analyzed years pure productivity indicator was positive. Structural productivity indicator was negative after first years after transition during stabilization phase, but improved in the following years and obtained the highest value after accession to EU.

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