

BRANCHES PRODUCTIVITY IN THE CRISIS PERIOD

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Abstract

Productivity is one of the main factors which influences and determinates economic growth in economy. Productivity in each branches (sectors) reacts differently in periods of the economic downturn. The main aim of this paper is to define dissimilarities regarding particular productivity branches during a crisis period. Paper compares development of sectoral productivity in the context of the development business cycle. The branches were divided into three sectors; the technologically intensive sector, the knowledge intensive sector and other. Crisis period is defined as period of decreasing increases of gross value added. The theoretic part is based on the real business cycle theory and the neo-classical growth models of Solow. The analysis was conducted on data from the years 1995-2009 taken in the Czech Republic. The analysis has found that the sector of knowledge-intensive services has the biggest contribution to the average annual change in labour productivity and capital productivity in crisis period. In the period of increasing increments of gross value added has the biggest influence sector of technology-intensive industries. It was found out that agriculture have no significant influence to growth labour and capital productivity from the perspective of the business cycle.

Key words: gross value added, productivity, sector

JEL Code: D24, E01, E23

Introduction

The role of productivity is very significant from the perspective of economic growth. One of the basic sources of economic growth is factors productivity. Factors productivity is not constant but variable. Factors productivity is very often affected by the business cycle and sectors of the economy.

The basis for measuring productivity and economic growth is production function. The Neoclassical production function takes the form $Y(t) = F [K (t), L(t), T(t)]$ where $Y (t)$ is the flow of output produced at time t . Capital, $K (t)$ represents the durable physical inputs, such

as machines, buildings, pencils and so on. The second input to the production function is labour, $L(t)$ and it represents the inputs associated with the human body. The third input is the level of knowledge or technology, $T(t)$ (Barro, Sala-i-Martin 2004). Modern growth theory builds on the neoclassical model of exogenous growth which views the accumulation of physical capital, associated with a permanent flow of technical progress, as the driver of economic growth (Van Biesebroeck 2009).

Productivity is defined as the ratio outputs and inputs (Coelli 2005). We have many types of productivity. The most frequently measured indicator is labour productivity and capital productivity. Indicator of labour productivity shows the efficiency of utilization factors of production and the production possibility of all economy. The capital productivity shows how productively capital is used to generate value added. Generally there are many different productivity measures. The choice between them depends on the purpose of productivity measurement and, in many instances, on the availability of data. Labour productivity and capital productivity have different responses to changes in the national economy. Absolute increases in labour productivity during changes in technological ages are greater than capital productivity (Fatás-Villafranca et. al 2011).

Economic growth and productivity are influenced by business cycle. The basic theory is now a real business cycle theory. The main authors of the theory of real business cycles (real business cycles - RBC) are Kydland, Prescott (1982), whose model is considered as a standard RBC model. This concept is focused on explain economic fluctuations. The basic point is that prices, wages and interest rates adapt quickly. The causes of business cycle consist in real changes - real shocks. A important general characteristic of business cycles appears to be the tendency of outputs in different sectors to move together. This hypothesis was confirmed by Long and Plosser (1983). They told, that some sectors displays less coherence with other sectors (agriculture,...). On the other hand Bhattacharjee (2009) showed that development of productivity in business cycle has showed substantial variation in sectors. Significant role in change of productivity in business cycle have investment and investment-specific technological (Ireland at all 2008).

1 Data and methodology

The main aim of this paper is to define dissimilarities regarding particular productivity branches during a crisis period. Crisis period is defined as a period with decreasing increment of gross value added (GVA). For sectoral analysis were used sectors sorting by technological intensity. The theoretic part is based on the real business cycle theory and the neo-classical growth models of Solow. The analysis was conducted on data from the years 1995-2009 taken in the Czech Republic. The main the source of data was Czech Statistical Office (National accounts). To carry out temporal and spatial comparison it is convenient to part from indicators purified from inflation. Therefore macroaggregates in prices of 2000 were given priority.

The main used indicators were labour productivity (output Y / worked hours L), capital productivity (gross fixed capital formation K / worked hours L) and capital - labour ratio (gross fixed capital formation K / worked hours L), nominal unit labour costs (NJPN) (compensation of employees at current prices / gross value added at constant prices, Y), real unit labour costs (RJPN) (compensation of employees in 2000 prices / gross value added at constant prices, Y). Compensation of employees was defined as consumer price index. To calculate the consumer price index compared with the base in 2000 were used links between chain and basic indexes.

Definition of high-technology industries and knowledge-intensive services are based on definitions created by the OECD. Economic activity, based on the statistic classification of economic activities (division on the basis NACE (classification) in the following three groups:

group A: high technology manufacturing (industries)

group B: knowledge-intensive services

group C: others (agriculture, construction, mining and energy production) (Faltova Leitmanova, Krutina 2008)

Gross value added (growth rate) in the period from 1995 to 2009 was the basis for dividing the interval to 5 different developmental periods. Intervals 1995-1997 and 2006-2009 can be

described as a period of declining increases in gross value added (GVA). Period 1997-2000 and 2003-2006 are characterized by rising rates of GVA growth. The remaining period 2000-2003 is characterized by relatively stable increases in GVA (Novotna, Volek 2010).

For analysis of each sector's contribution to the development of gross value added can be used additive linkages between sectors, namely, gross value added is the sum of gross value added of individual sectors. The contribution of each of these sectors is equal to the product's growth rate (compare the intervals t-1) and the share of this sector in GVA interval t-1:

$$\left(\frac{HPH_{Si,t}}{HPH_{Si,t-1}} - 1 \right) * \frac{HPH_{Si,t-1}}{HPH_{t-1}},$$

$HPH_{Si,t}$ gross value added is the i sector at time t,

$HPH_{Si,t-1}$ gross value added is the i sector at time t-1,

HPH_{t-1} the total aggregate gross value added at time t-1.

The total aggregate GVA growth rate is then equal to the sum of contributions from each sector. Growth rate of GVA growth rate is the sum of the individual sectors weighted share of each sector in GVA. The average annual indices ie average productivity growth rates observed for the sub-intervals was made by using the geometric mean:

$$\bar{k} = \sqrt[n]{k_1 \cdot k_2 \cdot \dots \cdot k_n} = \sqrt[n]{\frac{u_1}{u_0} \cdot \frac{u_2}{u_1} \cdot \dots \cdot \frac{u_n}{u_{n-1}}} = \sqrt[n]{\frac{u_n}{u_0}},$$

\bar{k} the average growth rate respectively. average growth rate

$k_1 \dots k_n$ chain indices are indicators of productivity

$u_0 \dots u_n$ values of individual indicators of productivity.

In the paper is analyzed relationship between the development of real unit labour costs (RJPN) and the development of labour productivity $\frac{Iv}{IRJPN}$. It is correct, if the labour productivity grows faster than real unit labour costs. Labour productivity is calculated as the ratio of GVA at constant prices and number of hours worked. Real unit labour cost is calculated as the ratio of compensation of employees in constant prices and GVA at constant prices.

In case $\frac{I_v}{IRJPN} > 1$, a positive development (labour productivity grows faster than real unit labour costs). In the opposite case $\frac{I_v}{IRJPN} < 1$, inequality leads to faster growth real unit labour costs than labour productivity, which leads to an increase firms costs and inflationary pressure.

2 Results

2.1. Gross value added

Gross value added (GVA) is a basic indicator of the sectors performance. Table 1 illustrates the contribution of each sector to change of gross value added for the reference intervals. It is evident that in a period of rising rates of GVA growth (1997-2000, 2003-2006) contributed the most technologically intensive industries A. Especially in the second interval had significantly affects to the overall growth GVA knowledge-intensive services B. The period of stable growth in GVA (2000-2003), it is the knowledge-intensive sector B, which had a dominant influence to the change of economic output.

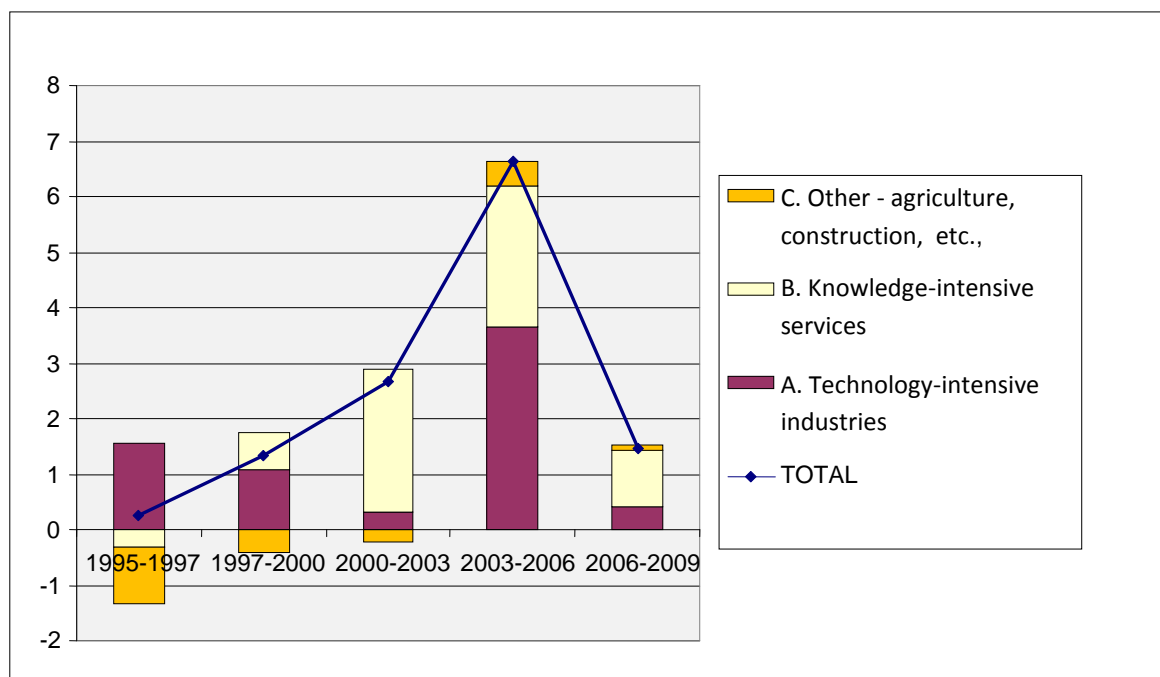
Tab. 1: Sectors contribution to the change GVA-year change - %

	1995-1997	1997-2000	2000-2003	2003-2006	2006-2009
TOTAL	0,25	1,33	2,67	6,64	1,47
A. Technology-intensive industries	1,56	1,08	0,33	3,66	0,43
B. Knowledge-intensive services	-0,32	0,67	2,55	2,53	1,02
C. Other - agriculture, construction, etc.	-1,01	-0,42	-0,22	0,45	0,09

Source: Czech Statistical Office

In the period of decreasing increments of gross value added (1995-1997, 2006-2009) the situation is not the same (Fig. 1) . The reason could be external influences that affect the change in the trend of economic performance.

Fig. 1: Sectors contribution to the average change GVA (%)

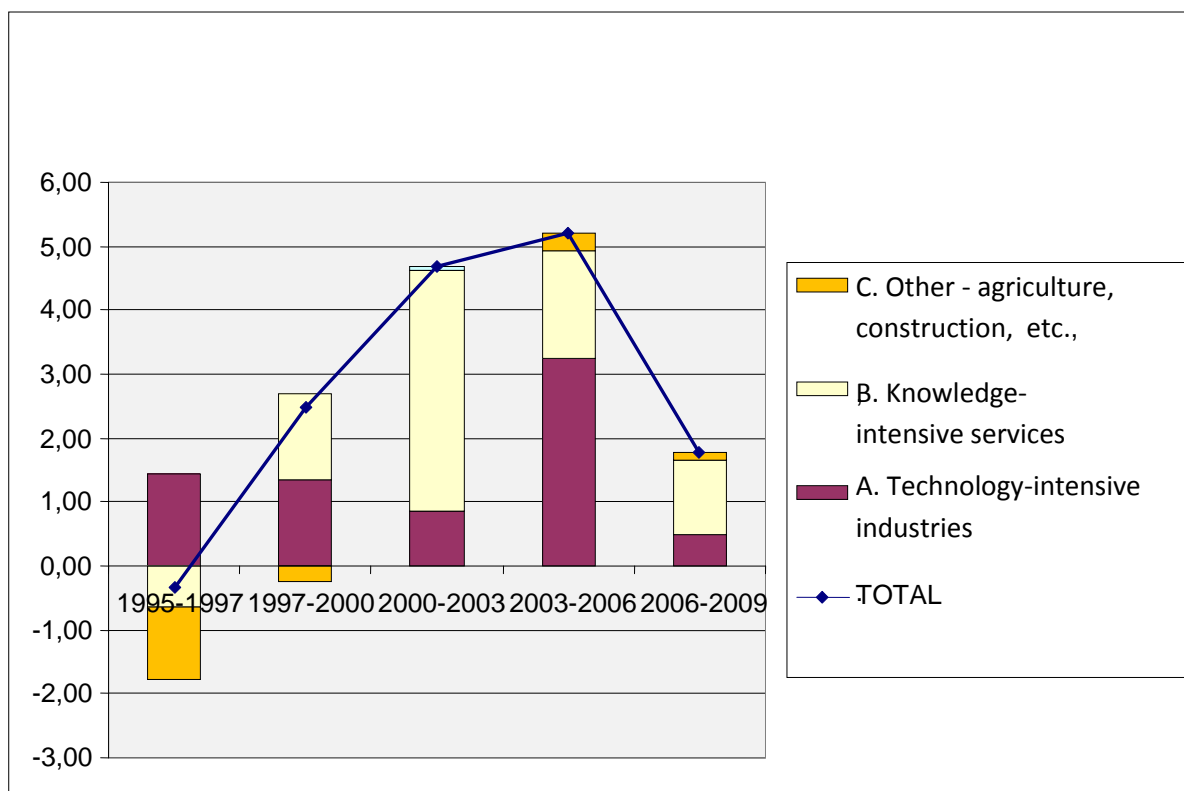


While in the period 1995-1997 has a negative effect especially the sector C (agriculture, construction, mining and energy production), then sector B, in the period 2006-2009, all contributions from the sectors rapidly declined (especially in sectors A), which meant reducing the average annual increment. The last interval was mainly influenced by the year 2009 (global crisis). In this year was the GVA growth rate of less than 1 and the increase in gross value added was negative.

2.2. Labour productivity

If we look at the field of labour productivity we can see, that in the periods with decreasing increment of gross value added (1995-1997, 2006-2009) is not the same situation (Fig. 2). In the periods 1995 - 1997 we can see the impact of transformation processes. In the time period 2006 – 2009 and in the period of stable economic growth had sector of knowledge-intensive services (B) the biggest contribution to the average annual change labour productivity. On the contrary, in periods of high economic growth had sector technologically intensive industries (A) the biggest contribution to the average annual change in labour productivity.

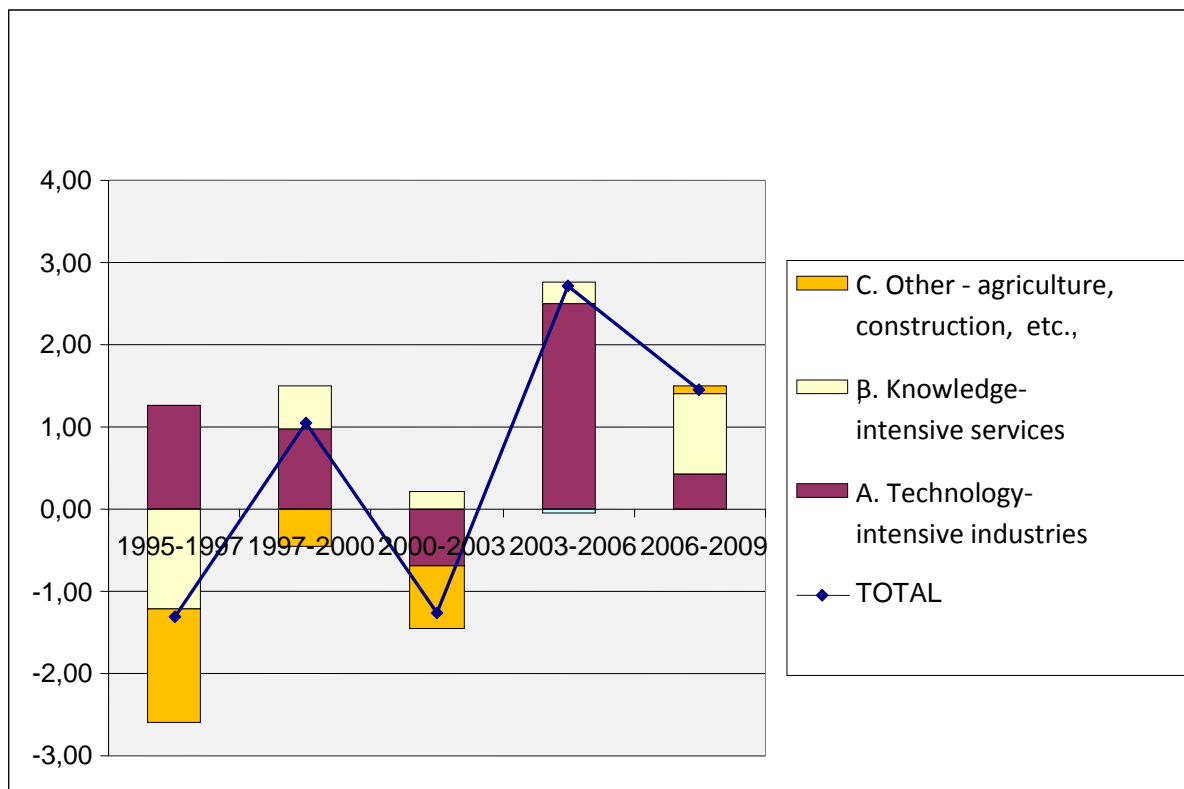
Fig. 2: Sectors contribution to the average change labour productivity (%)



2.3. Capital productivity

The capital productivity has the similar trend as labour productivity (Fig. 3). In the period with decreasing increments of gross value added (1995-1997, 2006-2009) is not the same situation. In the periods 1995 - 1997 we can see the impact of transformation processes. On the contrary, in 2006 - 2009 period and in the period of stable economic growth had the greatest contribution to the average annual change capital and labour productivity sector of knowledge intensive services (B). In periods of high economic growth had greatest contribution to capital a labour productivity growth sector of technologically intensive industries (A).

Fig. 3: Sectors contribution to the average change capital productivity (%)



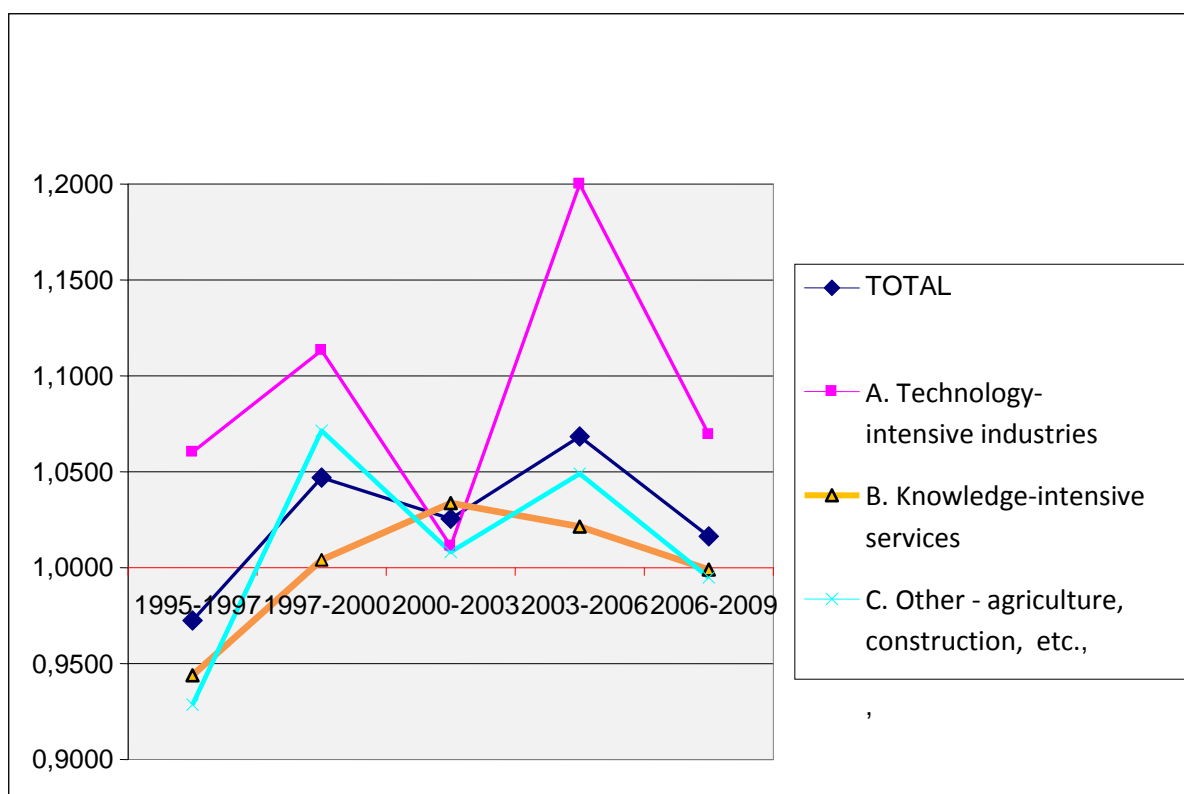
2.4. Labour productivity / real unit labour cost

It is obvious, that in the period with increasing increments of GVA (1997-2000 , 2003-2006) annual growth rate of labour productivity growth rate significantly exceeds real unit labour cost particularly in the sector Technology-intensive industries (A) (Fig. 4) .

In the period of stable increases GVA (2000-2003) development of these indicators are still positive, but index of labour productivity and index of real unit labour costs are very similar.

In the period of decreasing increments of GVA intervals 1995-1997 and 2006-2009 is given a negative relationship indicators, especially in knowledge-intensive services and sector C. On the other hand, the relationship of these indicators in the sector of technology-intensive industries (A) is positive. It means that the technology-intensive industries (A) has a good response to changes in business cycle.

Fig. 4: Ratio of the index of labour productivity and real unit labour cost index



Conclusion

Analysis showed that the economic downturn does not affect all sectors with the same intensity. Reaction of labour and capital productivity in aggregated sectors A, B and C are different. In times of crisis, we can say that technology-intensive industries (A) represented by the modern industry flexibly responds to the crisis period. When the decline production, firm reduce inputs in production and there is no significant change in productivity. In the knowledge-intensive services (B) and sector C are slow response to the crisis period. This state is caused by the orientation of these sectors to produce products and services that are not so much affected by the crisis (eg agricultural products) and by the limited possibility of a rapid reduction number of employees.

In the time of decreasing growth rates in gross value added (time crisis) had the most significantly contribution to growth labour a capital productivity sector of knowledge-intensive services. In the periods of economic growth is the main source of growth in labour and capital productivity technology-intensive industries (A). It was found out that agriculture a sector (C) have no significant influence to growth labour and capital productivity from the perspective of the business cycle. If we compare the growth rate of labour productivity and

growth rate of labour costs we find that the growth rate of labour productivity growth rate grows faster than growth rate of real unit labour costs. The largest response was observed in the technology-intensive industries.

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