

SECTORS LABOUR PRODUCTIVITY IN THE CONTEXT OF CAPITAL-LABOUR RATIO

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Abstract

Labour productivity is one of the main factors which influences and determinates economic growth in economy. Indicator of labour productivity is very often influenced by the situation on the labour market and by the size of investments in the economy. These investments increase the capital-labour ratio and consequently economic growth. The main aim of this paper is to evaluate the influence of the capital-labour ratio on sectors labour productivity. The paper also deals with the relationship between business cycle and sectors labour productivity. The paper is concentrate on the Czech Republic. The analysis was found a strong relationship between sectors capital-labour ratio and sectors labour productivity but only in the tertiary sector (commercial services) no secondary or primary sector. It has been proved strong relationships between the dynamics of sectoral labour productivity, sectoral capital- labour ratio and the economic situation in economy for secondary and tertiary sector.

Key words: capital-labour ratio, labour productivity, sectors

JEL Code: D24, E01, E23

Introduction

The labour market can be described by many indicators. A key indicator that shows the effectiveness of using human capital in the economy is an indicator of labour productivity. Absolute value and dynamics of this indicator is influenced by many factors such as capital-labour ratio or sectors.

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).

The most frequently measured indicator is labour productivity. Indicator of labour productivity shows the efficiency of utilization factors of production and the production

possibility of all economy. Labour productivity we can write as GDP per employee (Bolorgey 2006). There are two sources of labour productivity growth: technical progress and increases in the average capital-labour (K-L) ratio. The average K-L ratio can be affected by demographic change in two ways. The first is a mechanical effect as capital takes time to adjust to changes in labour for any equilibrium K-L ratio. This implies a short-run rise in the K-L ratio in response to population ageing. The second effect is a change in the equilibrium average K-L ratio. The average K-L ratio is affected by shifts in demand between sectors that have different K-L ratios (Guest 2011).

Labour productivity is influenced by many shocks. There are two types of structural shocks: (1) *technological shocks*, that is changes in the technological progress which affects labour productivity in the long-run. Greater use of computerised unit control systems, automated cleaning and scrubbing equipment, information and communication technology acceleration, product and process innovation can easily enter this class of shocks; and (2) *non technological shocks*, that is all the other shocks that affect labour productivity temporarily through its effects on capital accumulation and aggregate demand (Travaglini 2012). The productivity-driven model predicts that labour productivity is strongly correlated with employment, unemployment, vacancies, wages (Hagedorn, Manovskii 2011). A significant factor that affects the size of labour productivity is job characteristics (Fuchs-Schündeln, Izem 2012). Labour productivity shifts among sectors and industries and reflect recent events and economic conditions (Holman, et al.2008).

Labour productivity is also influenced by business cycle. The basic theory is now a real business cycle theory. The Real Business Cycle (RBC) theory claims that permanent productivity (or technological) shocks are the dominant source of economic fluctuations, while alternative models underline the role of innovations associated with nominal variables to explain the cyclical variation in the real variables. This approach allows for a causal relationship between decisions of policy-makers to the cycle as well as to the trend (Calcagnini 1995). Labor productivity is pro-cyclical in the real business cycle model, despite the assumption of diminishing marginal returns to labour input, because booms are periods in which technological conditions are particularly favourable. (Bernanke, Parkinson 1991). The development of labour productivity in business cycle has showed substantial variation in sectors (Bhattacharjee 2009), manufacturing (Faltová Leitmanová, Krutina 2009) and similar trend can be expected with capital-labour ratio.

1 Data and methodology

The main aim of this paper is to evaluate the influence of the capital-labour ratio on sectors labour productivity. The paper also deals with the influence of the business cycle on sectors labour productivity. The theoretical background is theory of real business cycle, which accounts the real variable. The analysis is concentrate on the Czech Republic. The main the source of data was Czech Statistical Office (National accounts) and EUROSTAT. Used dates were behind years 1995 - 2011 (17 years). To carry out temporal and spatial comparison it is convenient to part from indicators purified from inflation. Therefore macroaggregates in prices of 2005 were given priority. For the analysis relationship between indicators was used correlation analysis. The correlation analysis deal with interrelationship dependence.

The main used indicators were labour productivity (output (Gross value added) Y / worked hours L) and capital-labour ratio (gross fixed capital formation K / worked hours L). The fluctuation of output GDP (domestic product) is expressed by growth rate of gross value added.

The analysis is oriented on the market sectors. For detailed analysis was used general sectoral economy classification on the primary, secondary (manufacturing + construction) and tertiary (commercial services) sector.

Labour productivity is extended about calculation of labour productivity indicator. This indicator is clean-up from influence of structure output (added value). Index of labour productivity we can understand as index of variable structure.

$$\frac{\sum Y_1^i}{\sum Y_0^i} \cdot \frac{\sum L_1^i}{\sum L_0^i} = \frac{\sum_i Y_1^i}{\sum_i L_1^i} \cdot \frac{\sum_i Y_0^i}{\sum_i L_0^i} = \frac{\sum_i \gamma_1^i L_1^i}{\sum_i L_1^i} \cdot \frac{\sum_i \gamma_0^i L_0^i}{\sum_i L_0^i} = \frac{\sum_i Y_1^i}{\sum_i \frac{Y_1^i}{\gamma_1^i}} \cdot \frac{\sum_i Y_0^i}{\sum_i \frac{Y_0^i}{\gamma_0^i}}$$

Y is product (GDP), L_i is labour (working hours), γ^i labour productivity of i sector . This index we can write as harmonic average or arithmetical average. Difference between harmonic and arithmetical average we can find when we make analysis of the of constant structure index (Jílek 2005).

If we want to stabilize structure of product (current period) and analyze structural influence in labour productivity, it is suitable for comparability go out from two harmonic averages in form:

$$\frac{\sum_i Y_1^i}{\sum_i \gamma_1^i} \cdot \frac{\sum_i Y_1^i}{\sum_i \gamma_0^i} = \frac{\sum_i \frac{Y_1^i}{\gamma_0^i}}{\sum_i L_1^i} = \frac{\sum_i \frac{\gamma_1^i}{\gamma_0^i} \cdot L_1^i}{\sum_i L_1^i},$$

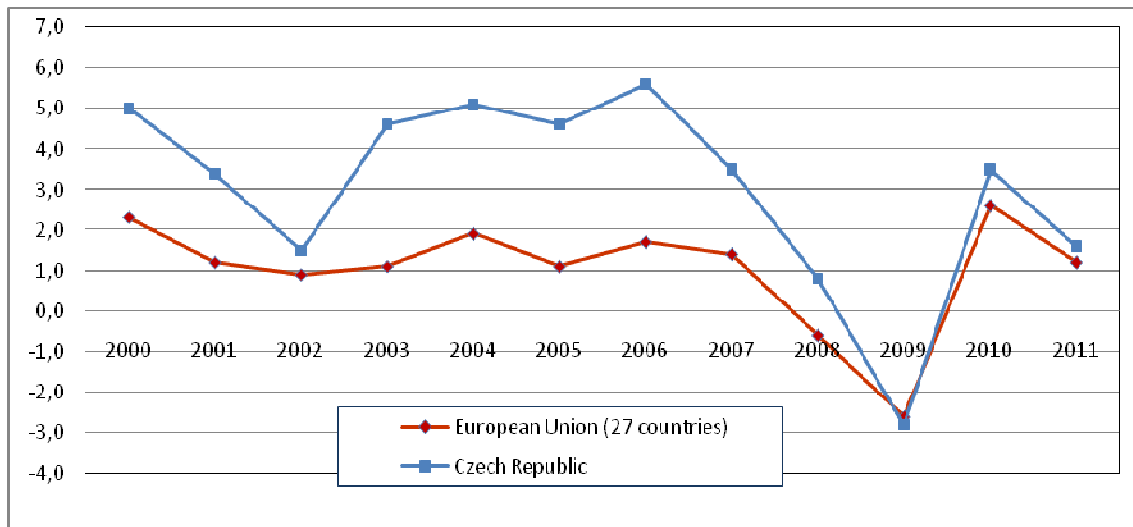
This arithmetical average goes out from sector indexes of labour productivity (Novotná, Volek 2011).

2 Results

2.1. Labour productivity

Labour productivity is a basic indicator of performance in the labour economy. Figure 1 illustrates dynamics of labour productivity in the Czech Republic and the EU. Cyclical downturn in the recession (2009) and dynamics of labour productivity has similar trend in both regions. The main reason can be strong interconnectedness of economies (EU and Czech Republic). More than 80% of Czech exports flow to the EU countries.

Fig. 1: Development of growth rate of labour productivity (%)



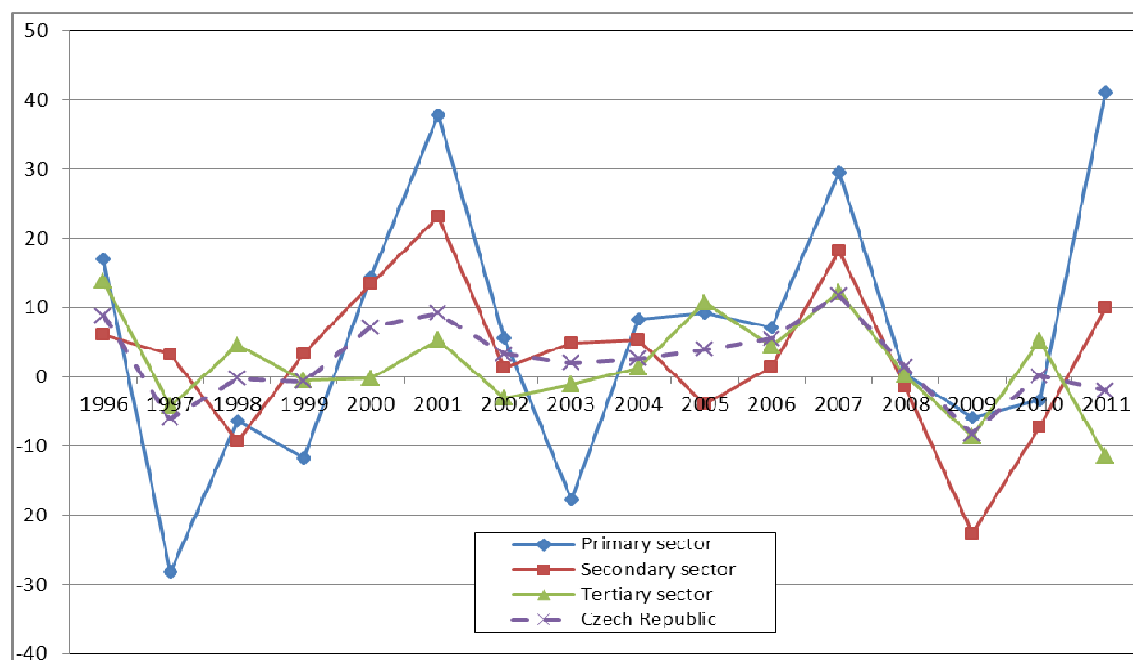
Source: Own calculations based on the data of Eurostat (National accounts)

For better analysis it is necessary to deal with the main sources of growth labour productivity from the point of view sectors of the national economy with focus on the business sector (primary sector, secondary sector and commercial services).

Figure 2 shows us the dynamics of growth labour productivity in individual sectors. The greatest importance has had for increasing productivity in the Czech Republic the secondary sector - industry (Novotná, Volek 2011). We can see that the smallest fluctuation in

dynamics of labour productivity (variation coefficient) has the tertiary sector and large fluctuations were statistically observed in the primary and secondary sector.

Fig. 2: Development growth rates of sectors labour productivity (%)

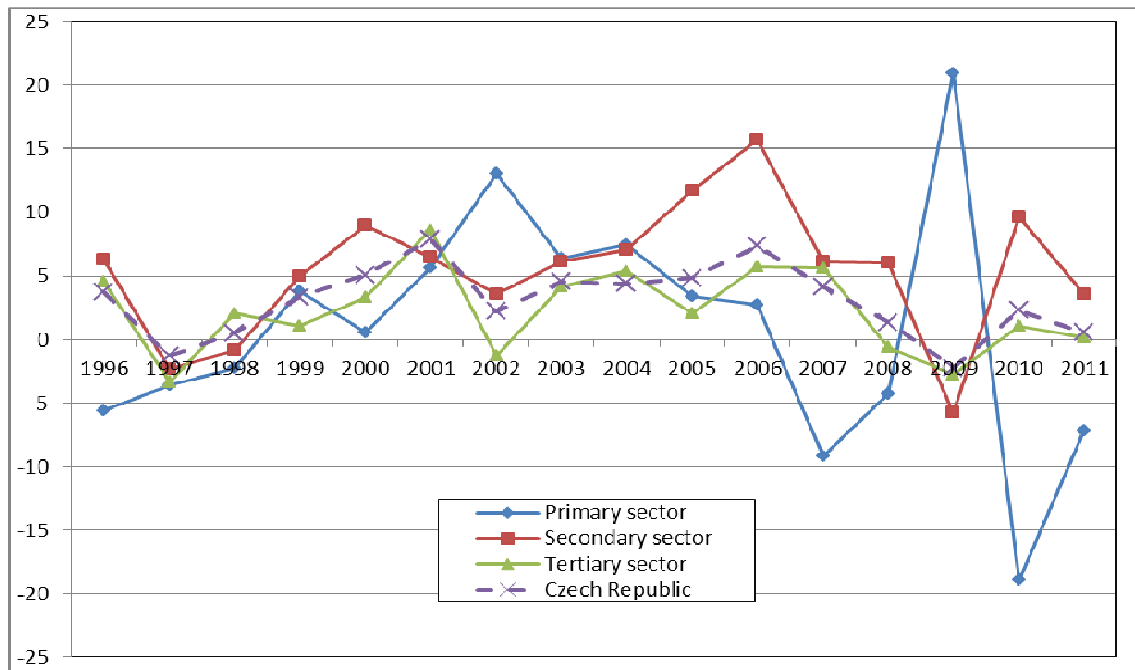


Source: Own calculations based on the data of Czech Statistical Office (National accounts)

2.2. Capital labour ratio

One of the main factors which affecting the dynamics of labour productivity is capital-labour ratio. The following graph (fig. 3) shows the development of dynamics capital-labour ratio in the sectors economy. We can see different development in the growth rates of primary and secondary sector. In the period of economic downturn (2009) the capital-labour ratio grows in the primary sector and on the contrary significantly declines in the secondary sector. The main reason is the small response of the primary sector to cyclical development of the economy. The primary sector is not such us influenced by the economic situation in the economy as it is very much dependent on the size of subsidies – agriculture or weather.

Fig. 3: Development growth rates of sectors capital-labour ratio (%)



Source: Own calculations based on the data of Czech Statistical Office (National accounts)

2.3. Capital-labour ratio and labour productivity

The next part is focused on assessment of the impact dynamics indicators capital-labour ratio on the dynamics of labour productivity with using correlation analysis. The results are shown in the correlation matrix (table 1).

Tab. 1: Correlation matrix of sectors labour productivity

Sectors labour productivity	I K-L ratio 1	I K-L ratio 2	I K-L ratio 3	I K-L ratio - CZ
I Labour productivity 1	-0,16	-	-	-0,23
I Labour productivity 2	-	0,38	-	0,65
I Labour productivity 3	-	-	0,62	0,82
I Labour productivity – CZ	0,43	0,63	0,56	0,81

Marked correlations are significant at the significance level of $p < 0,05000$ $N = 16$

In the primary sector has not proved influence of capital-labour ratio on the dynamics of labour productivity. In tertiary sector was this relationship confirmed, although there are also other factors that affect the dynamics of labour productivity. In the secondary sector as total is not statistical proved the relationship between the dynamics of labour productivity and capital-labour ratio, but the detailed analysis were identified two fields of manufacture where is the influence proven (Manufacture of wood, paper, printing and reproduction ($R = 0,69$), Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment ($R = 0,52$)). From the perspective of total

economy has proved that the increase in capital-labour ratio has positive impact on labour productivity, although there are other factors that affect it.

The last part deals with relationship between dynamics of sectoral labour productivity, sectoral capital-labour ratio and cyclical development of the economy. The correlation matrix 2 (table 2) shows us the relationship between the dynamics of correlation Gross value added (GVA) and the dynamics of individual indicators. In two sectors (secondary and tertiary) confirmed the strong link between the economic performance and labour productivity and capital-labour ratio. The exception is the primary sector, which did not show this relationship to the chosen level of significance.

Tab. 2: Correlation matrix

Indicator	correlation coefficient
I K-L ratio 1	0,41
I K-L ratio 2	0,5
I K-L ratio 3	0,61
I K-L ratio CZ	0,78
I Labour productivity 1	-0,31
I Labour productivity 2	0,94
I Labour productivity 3	0,65
I Labour productivity CZ	0,81

Marked correlations are significant at the significance level of $p < 0,05000$ $N = 16$

3 Conclusion

The first part of the analysis dealt with the dynamics of sectoral labour productivity. There was found a large variability especially at the primary and secondary sectors. The question is whether such fluctuation are healthy for the economy or, conversely, can lead to instability of the economy. The second part dealt with the relationship between sectoral productivity and capital-labour ratio. There was only found strong relationship in the tertiary sector and not primary or secondary, but the detailed analysis were identified two fields of manufacture where is the influence proven (Manufacture of wood, paper, printing and reproduction, Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment. In the end were proved strong relationships between the dynamics of sectoral labour productivity, sectoral capital- labour ratio and the economic situation in economy for secondary and tertiary sector.

4 References

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