

# Development of Value Productivity in Automotive Industry

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**Abstract**—This paper is focused on the investigation of productivity (total productivity and partial productivity). The value productivity is an indicator of level and changes in technical economic efficiency of production factors. It represents an important factor in achieving corporate objectives. This text works with the contemporary concept of value productivity that means that indicators of the productivity express the effect of economic efficiency not only of inputs consumption, but also of inputs binding efficiency. This approach is based on principles of the economic profit, respectively the economic value added (EVA). The research is done on the sample of Czech enterprises operating in the automotive industry in the regions of Liberec and the Central Bohemia. The data sample covers the time period 2006-2011 which allows the comparison of development before crisis and during crisis period. It enables to discover the companies' reaction during crises and the regional comparison allows to showing if there are significant differences between regions.

**Keywords**—Automotive industry, Czech Republic, economic efficiency, regional comparison, value productivity.

## I. INTRODUCTION

THE practice still uses the traditional criteria apparatus but it does not reflect efficiency in a broader concept which should work with the value productivity in the contemporary sense [1]. The tools, meeting current and future business needs in the production management, should reflect the productivity (especially total productivity) and other factors of the economic value added (EVA) creation. This should include factor's differentiation because it allows direct management at causes and process optimization.

The corporations are interested in the productivity measurement, including new approaches as well, as it was proved by an extensive recent survey among Czech companies performed in 2007 [2]. The results showed that 94% of respondents evaluate their productivity and even already 20% of respondents have used the new approach measuring total productivity (TFP) in the connection with the EVA analysis (or at least one of the elements of the new approach).

This paper is focused on an identification of the level and development of the productivity, expressed as total

productivity as well as partial productivity, of enterprises operating in the automotive industry in two Czech regions – Liberec Region and Central Bohemia Region in the time period 2006-2011. The second aim of this paper is an introduction of methodological tools for determining the productivity in the contemporary sense.

## II. PRODUCTIVITY

The productivity can be generally defined as the efficiency of using production factors in manufacturing, or widely in a production process, whose results are tangible as well as intangible outputs [3]. It is possible to distinguish between two types of productivity ratios [4] – total and partial productivity. These types of productivity are expressed by (1) and (2).

$$\text{total productivity} = \frac{\text{total output}}{\text{total input}} \quad (1)$$

$$\text{partial productivity} = \frac{\text{total output}}{\text{partial input}} \quad (2)$$

The productivity itself can be measured on the macro economical level, detail in [5], or on the level of enterprises, detail in [6]. This paper further aggregates enterprises' productivities on the level regional level of one industry branch.

## III. USED INDICATORS

Above mentioned ratios are too general and have to be modified for fulfilling the aim of measuring total productivity. Used indicators will be introduced in the following part. The choice of further presented indicators has been a compromise between the paper's aim and limited data availability. The value productivity in the contemporary sense is based not only on the consumption of inputs (accounting costs) but also on inputs binding (the costs of binding depending on the amount of total capital employed).

### A. The Total Productivity Ratio

The total productivity ratio takes into account all outputs as well as inputs. The value of inputs is expressed as the costs of consumption (and depreciation) as well as costs of binding (components of assets, converted to flow-related capital costs).

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The paper is one of the outputs from the research project "Competitiveness" (Konkurenceschopnost), its subpart "Resources and development prospects of European economies in the early 21st century in the context of contemporary globalization" (Zdroje a perspektivy rozvoje evropských ekonomik napočátku 21. století v kontextu soudobé globalizace) which is registered under the number VŠE IP300040.

$$\text{Total productivity} = \frac{\text{Total revenues}}{\text{Costs of consumption and binding of inputs}} \quad (3)$$

$$\text{Costs of consumption and binding of inputs} = \text{Total costs (accounting)} - \text{interests} + \frac{WACC}{1-t} \times \text{Total assets} \quad (4)$$

The economic value added (EVA) represents the differential expression of (3). The further analysis works with widely defined input and output (all revenues and costs – including costs of foreign capital and equity whose costs are derived from the opportunity costs). The production and production factors are expressed in the widest sense – not only operating, but also financial and extraordinary activities. This text uses the constant rate of WACC (the rate of binding costs) for the whole investigated period. The value is 11.86% which reflects the situation of the manufacturing industry in the

Czech Republic in 2011 [7]. Changes in prices are usually not changes in the sense of technical-economical rationality and therefore the prices are fixed or separated during the analysis of productivity.

#### *B. The Partial Productivity Ratios of Inputs Consumption*

The partial productivity ratios focus only on the selected production factors (inputs). The analysis is based on following ratios and equations.

$$\text{Productivity of consumption (depreciation) of an input} = \frac{\text{Total revenues}}{\text{Costs of consumption of an input}} \quad (5)$$

The costs of consumption are calculated as the difference between total accounting costs and interests of debts. Equation (6) contains narrower revenues because the inputs (material and energy) are also narrowed and using only the main part of revenues increases the explanatory power. Operating revenues

are used also in other presented indicators (7), (8), (13). In the case of labor productivity (9) the operating revenues are even narrower because the numerator is expressed as value added. This shape of the formula is used in the theory and practice for decades.

$$\text{Productivity of consumption of material and energy} = \frac{\text{Operating revenues}}{\text{Costs of material and energy}} \quad (6)$$

$$\text{Productivity of consumption (depreciation) of fixed tangible and intangible assets} = \frac{\text{Operating revenues}}{\text{Depreciation of fixed tangible and intangible assets}} \quad (7)$$

$$\text{Productivity of consumption (depreciation) and binding of fixed tangible and intangible assets} = \frac{\text{Operating revenues}}{\text{Depreciation} + \text{Costs of fixed tangible and intangible assets binding}} \quad (8)$$

The above mentioned costs of binding are expressed as  $WACC \cdot (1-t)^{-1}$  multiplied by the value of fixed tangible and intangible assets

The binding productivity ratios introduced in the following equations are focused on total inputs, fixed tangible and intangible assets, current assets and inventories. The costs of binding used in the denominator of formulas are expressed together at the end of the sub-part.

$$\text{Labour productivity} = \frac{\text{Value Added}}{\text{Number of employees}} \quad (9)$$

$$\text{Productivity of inputs binding} = \frac{\text{Total revenues}}{\text{Costs of inputs binding}} \quad (10)$$

$$\text{Productivity of fixed tangible and intangible assets binding} = \frac{\text{Total revenues}}{\text{Costs of fixed tangible and intangible assets binding}} \quad (11)$$

$$\text{Productivity of current assets binding} = \frac{\text{Total revenues}}{\text{Costs of current assets binding}} \quad (12)$$

$$\text{Productivity of inventories binding} = \frac{\text{Operating revenues}}{\text{Costs of inventories binding}} \quad (13)$$

The cost of binding are expressed as  $WACC \cdot (1-t) \cdot 1$  multiplied by the value of examined assets ((10) – total assets, (11) – fixed tangible and intangible assets, (12) – current assets and finally (13) – inventories).

#### IV. PRACTICAL PART

The presented analysis is a part of the processed extensive analysis and comparison of the productivity in the automotive industry for each region in the Czech Republic. This paper is focused on the selected enterprises which are located in the Liberec Region and the Central Bohemia Region.

##### A. Data Set

The data used in the analysis were obtained from the corporate database Albertina. The analysed data set finally consists of 40 businesses. 11 of them are located in the Liberec Region and 29 in the Central Bohemia Region. These 40 companies had the aggregated value of total assets 33 715 753 000 CZK in 2011 (8 059 182 000 CZK businesses in the Liberec Region and 25 656 571 000 CZK enterprises of the Central Bohemia Region). They employed together 12 526 workers (3 357 employees in the Liberec Region and 9 169 employees in the Central Bohemia Region). We have not included direct automobile manufacturers because they are significantly specific types of businesses in the automotive industry. The second constraint is caused by the data availability in the corporate database Albertina and therefore the data set does not give an absolute or relative view to the actual number of companies in the investigated regions. The studied productivity has a characteristic of a ratio and

therefore the limited representativeness of the data sample is not the distortion factor.

##### B. Results

Results obtained by the deep analysis are introduced in following figures. In the figures we can compare the differences between regions as well as significant decrease and subsequent fast recovering of different types of productivity in the context of the crisis around 2009.

Fig. 1 shows the development of total productivity in both investigated regions. The total productivity in the Liberec Region was 1.019 in 2006 and it slightly declined in 2007 and 2008 but it still remained above 1. The value above 1 corresponds to the effective production which creates financial as well as economic profit. In contrast, the total productivity of enterprises surveyed the Central Bohemia Region was lower and also decreased in the time period 2006-2008. The value was below 1. It means that the economic profit was not created but the financial (accounting) result was in positive numbers. The most significant decrease in the total productivity of the surveyed enterprises in the Liberec Region was in 2009 when the companies did neither create economic nor accounting profit (The accounting profit was in red numbers only this year). On the other hand the total productivity in the Central Bohemia Region has mildly increased since 2008 and even in 2009 it exceeded the level of the total productivity in the Liberec Region. It finished in 2011 with the value above 1. The total productivity of enterprises in the Liberec Region improved in 2010 compared to the previous year but it remained below the value 1 and below the total productivity of businesses in the Central Bohemia Region.

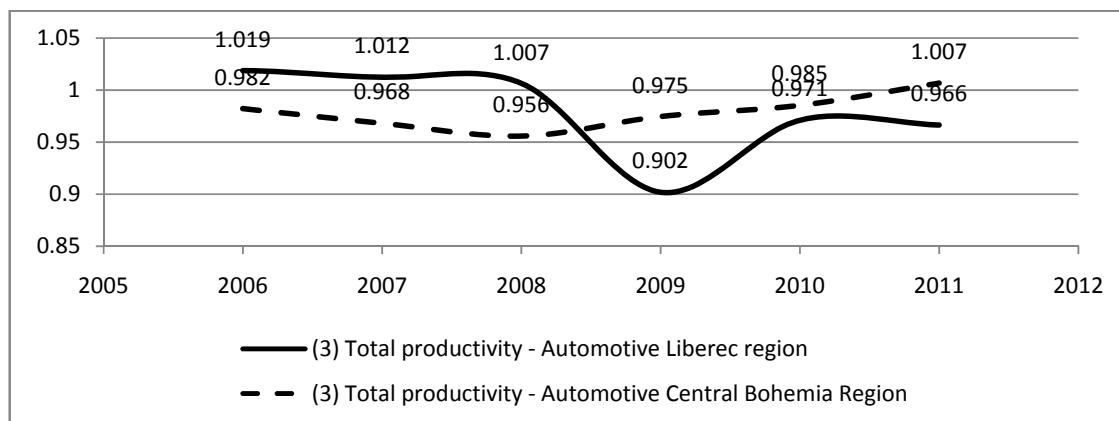


Fig. 1 Total productivity (The value of output in CZK / the value of consumption and binding of inputs in CZK)

The above mentioned changes in productivity were probably caused by the decline of a demand which meant reducing of the produced and sold quantities of the output. The development of the output (measured by total revenues), the value of input (expressed as costs of consumption and binding inputs) and their difference (modified economic profit) are displayed in Fig. 2 for the Liberec Region and in Fig. 3 for the Central Bohemia Region. The modified economic profit is an alternative of the economic profit used by microeconomics or

the economic value added used by business economics. The modification was explained in the part used indicators.

More significant and prolonged decline in revenues is evident for the companies in the Central Bohemia Region but the favorable development in the total productivity led to the creation of the economic profit. The decline in revenues was less significant and shorter in the Liberec Region but the total productivity improved less markedly (from a decline in 2009).

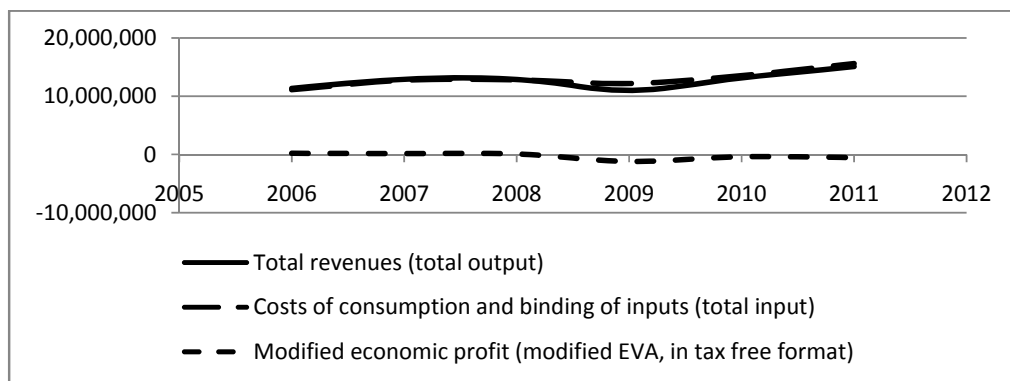


Fig. 2 Liberec Region - Revenues, costs of consumption and binding and modified economic profit (in thousands CZK)

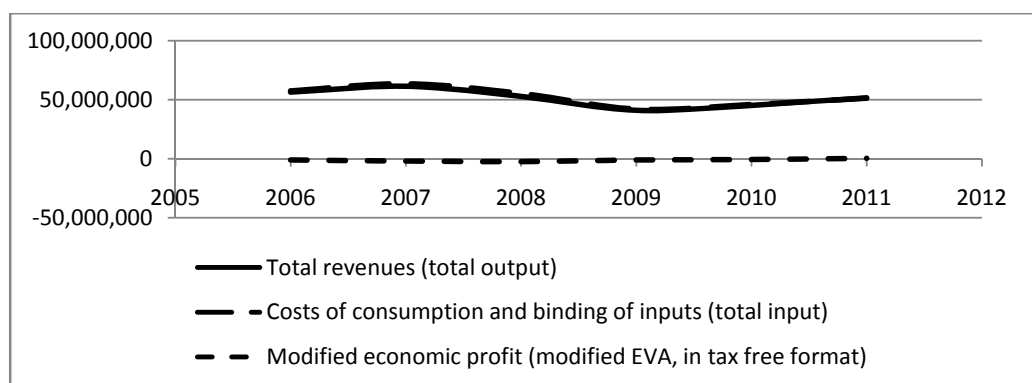


Fig. 3 Central Bohemia Region - Revenues, costs of consumption and binding and modified economic profit (in thousands CZK)

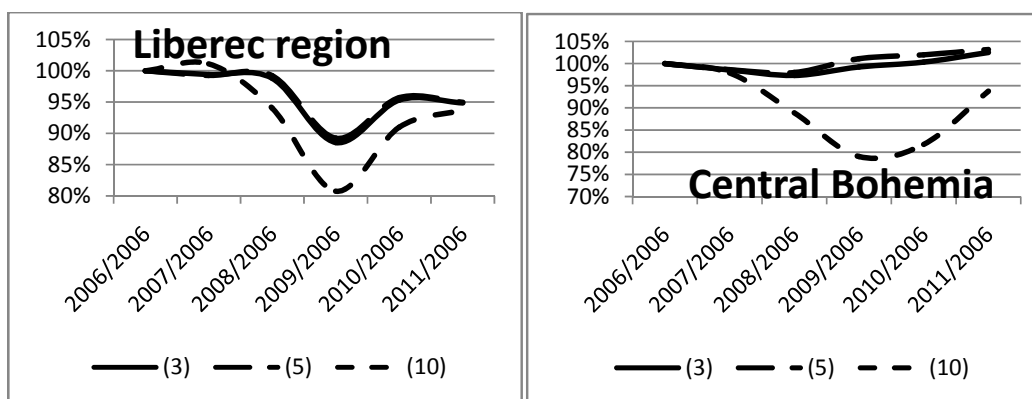


Fig. 4 The development of total productivity, productivity of consumption and productivity of inputs binding

Changes in productivity and differences among these variations between regions are shown in Figs. 4-6. The changes in productivity are expressed by their base indices (the year 2006 = 100). The curves are labeled by numbers that correspond to equations mentioned in the part used indicators. In the figures we can compare the differences between regions as well as significant decrease and subsequent fast recovering of different types of productivity in the context of the crisis

around 2009. Curves containing similarly large slump as the curve of revenues indicate a low flexibility of these production factors. This shape of the curve is typical for the labor productivity or the productivity of inputs binding. Contrary, the flatter curves prove greater flexibility of their production factor (productivity of material consumption or energy consumption).

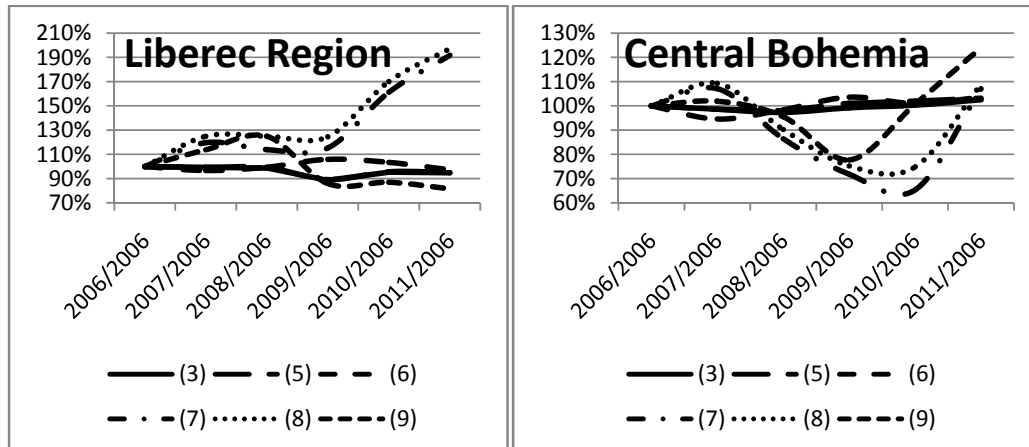


Fig. 5 The development of total productivity and productivity of consumption (depreciation) of an input

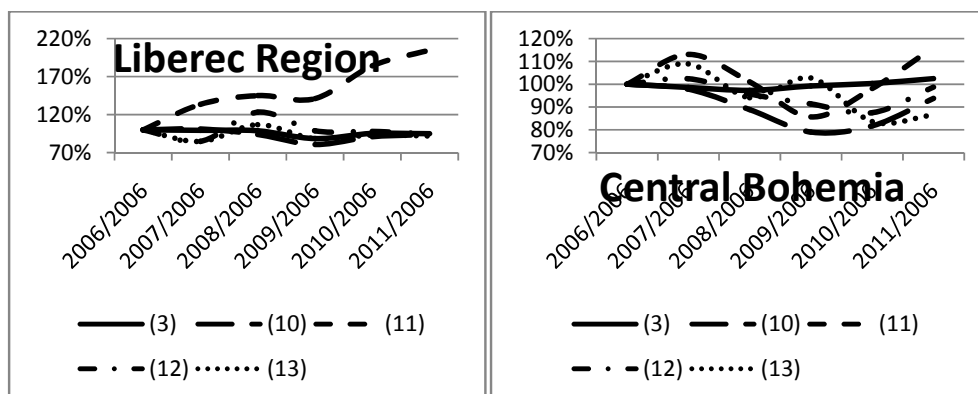


Fig. 6 The development of total productivity and productivity of inputs bindings

### C. Discussion

More specific data would be needed for the detection of specific causes that result in significant differences in the dynamics of partial productivity indicators between regions. We should answer questions such if the higher growth of the labor productivity in the Central Bohemia Region is caused more by greater leakage of employees or more by streamlining their work. Another question could be if the more significant dynamics of the fixed assets use in the Liberec Region is caused more by the increase of depreciation and amortization of fixed assets or more by sophisticated lean management.

We have to take into account that these differences are relative characteristics. The impact on the shareholder value or the performance of other business objectives depends on the importance of the production factor. The importance of the

production factor influences its costs and its share on the total costs. For example, the average share of costs of consumption on the costs of consumption and costs of binding was 92.6% in the whole period. Costs of binding (owning of assets) created only 7.4% of the total costs. It co-determines significant differences in the impact of changes these partial productivities on the shareholder value.

### V. CONCLUSION

This paper described the level and development of productivity in the automotive industry of two regions in the time period 2006-2011. The main advantage of this contribution is that the traditional criterial apparatus and the narrow concept of efficiency are replaced by the value productivity in the contemporary concept. The consequence of

using these tools is that changes in price and physical volumes are taken into account. These methodological tools were presented and after implemented in the analysis which described differences between two regions - Liberec Region and Central Bohemia Region.

This analysis is more usual for the micro level. Other possible benefits can be obtained from the specific intercompany comparisons of individual enterprises, or even more detailed comparison among different parts of the same company. It requires additional (more detailed) input data. This is not included in this paper because of its page limitation but this paper provides a methodological guidance for such analyses.

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