ECONOMICS & Sociology

Pavelková, D., Homolka, L., Knápková, A., Kolman, K., & Pham, H. (2018). EVA and Key Performance Indicators: The Case of Automotive Sector in Pre-Crisis, Crisis and Post-Crisis Periods. *Economics and Sociology*, *11*(3), 78-95. doi:10.14254/2071-789X.2018/11-3/5

EVA AND KEY PERFORMANCE INDICATORS: THE CASE OF AUTOMOTIVE SECTOR IN PRE-CRISIS, CRISIS AND POST-CRISIS PERIODS

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Received: November, 2017
1st Revision: April, 2018
Accepted: July, 2018

DOI: 10.14254/2071-789X.2018/11-3/5

JEL Classification: M2, G3, L6

ABSTRACT. The choice of a suitable measure for company's performance and identification of key performance indicators are among the most frequently discussed topics in the field of corporate management strategizing. This paper shows how the value-based measure represented by Economic Value Added (EVA) and its pyramidal breakdown could act as facilitators in revealing value drivers. The univariate sensitivity analysis and the Stochastic Frontier Analysis are employed to identify the key performance indicators. The analysis is based on the samples of original equipment manufacturers and suppliers in Czech automotive sector. The automotive industry, in general, is sensitive to the business cycle. Therefore, KPIs of the multiple EVA/Sales distinguished for the samples in the Pre-crisis, Crisis and Post-crisis periods are identified. The detailed sensitivity analysis reveals several differences in these periods in both samples and across companies of different sizes. Some of the results are further confirmed by the Stochastic Frontier Analysis. Besides other indicators, value added is demonstrated as the key driver with the highest positive impact and personnel cost with the highest negative impact on EVA in all periods although the magnitude of these effects is changing. Analysis of the technical efficiency scores reveals that companies in the crisis periods are more similar to each other and are closer to the best-performing companies than in other periods.

Keywords: economic value added, key performance indicators, sensitivity analysis, stochastic frontier analysis, business cycle, automotive industry.

Introduction

In today's highly competitive business world, companies need to manage and monitor their performance and accept an effective performance measurement system (PMS) with meaningful performance indicators. Any effective PMS has to include a limited number of indicators – key performance indicators (KPIs), e.g., value drivers. KPIs are a set of quantifiable measurements that highlight the critical success factors of an organization. Identification of key performance indicators is a complex multi-criteria decision-making process. A possible tool for application of the effective performance measurement system is Economic Value Added ® (EVA)[1]. Stern (2004) described EVA as an economic profit indicator which can motivate managers to improve corporate value. Using EVA, decisions on allocation of capital are accepted in accordance with the fundamental goal - to accept only such projects that generate value for the company. A great conceptual advantage of EVA is the possibility of linking strategic and operative decision-making and utilizing it at all levels of management by searching for and supporting of KPIs. McLaren (2005) depicts EVA as a complete measure of operating performance as it balances the secondary measures (value drivers) to maximize company value.

This paper identifies and tests the methods for effective identification of KPIs in the automotive sector using EVA, its pyramidal breakdown analysis, sensitivity analysis and stochastic frontier analysis (SFA). The samples of original equipment manufacturers ("Manufacturers") and suppliers ("Suppliers") operating in the automotive sector in Czech Republic are investigated.

To identify KPIs and their impact on the performance measured by EVA at different stages of the business cycle in distinction between small, medium and large companies in the samples of Manufacturers and Suppliers in the automotive sector, with the use of different methods for KPIs identification, the following research questions are answered:

RQ1: How can sensitive analysis of EVA and the stochastic frontier analysis be used to determine KPIs?

RQ2: Which key performance indicators (value drivers) influence the performance of companies operating in the automotive sector?

RQ3: Do the lists of Manufacturers' KPIs and Suppliers' KPIs differ?

RQ4: Is there any difference in the value-based performance and in the effects of KPIs across different company sizes (small, medium, large) and business cycle stages (pre-crisis, crisis and post-crisis periods) in the automotive sector?

Using the univariate sensitive analysis and SFA (with identification of their strengths and weakness for such investigation), besides other indicators, value added is demonstrated as the key driver with the highest positive impact and personnel cost with the highest negative impact on EVA in the automotive industry in all investigated periods, although the magnitude of these effects is changing. The lists of KPIs of Manufacturers and Suppliers slightly differ, although value drivers with the highest impact on performance measured by EVA are identical. Firm-size effect is observed at different levels of performance, sensitiveness to the business cycle, and the items of value added. Analysis of the technical efficiency scores reveals that companies in the crisis periods are more similar to each other and are closer to the best-performing companies than in other periods.

The remaining parts of this paper are structured as follows. Section 2 introduces theoretical background of company performance measurement, business cycle and firm-size effect. Section 3 describes the methodology and data. Section 4 presents and discusses the results of the research on the value-based performance of companies, KPIs identification and

[1]Economic Value Added ® is the registered mark of Stern Stewart&Co

analyses the impact of KPIs on companies' performance in the automotive sector in Czech Republic according to companies´ size and different stages of the business cycle. Manufacturers and Suppliers´ KPIs are discussed. Finally, in Section 5, conclusions and suggestions for future research are provided.

1. Theoretical background

1.1 Company Performance and EVA as the performance measurement system

The choice of the concept (tool and/or indicator) for the measurement of performance in order to achieve the most significant support of the basic financial goal of the company, which is a long-term maximization of the market value is one of the major problems of company theory and practice currently being discussed. There are numerous concepts, tools and indicators of performance. According to Stewart (2013), EVA measures the extent to which the company contributed by its activities in the given period to the increase or decrease of value for the owners:

$$EVA = NOPAT - WACC \times C \quad (1)$$

where: NOPAT - Net Operating Profit After Taxes
C - Invested Capital = NOA - Net Operating Assets
WACC - Weighted Average Costs of Capital

The allocation of capital should be in accordance with the fundamental goal, which is to accept only such projects that will generate value thus contributing to the creation of EVA. A great advantage of the concept EVA is the possibility of linking strategic and operative decision-making and utilizing it on all levels of management by searching for and supporting of KPIs. However, EVA is not only the indicator of performance; it is a complex concept helpful in measuring the financial performance but also in remuneration of company managers, evaluating the investment activities and in the valuation of the company. For evaluation and comparison of companies´ performance, Young and O´Byrne (2001) recommend using relative measures, e.g. EVA/Sales.

There are different views of the usefulness of EVA as a performance indicator. Appleby (1997) stated that EVA is a lagging indicator and tells the company only where it has been and not where it is going. This opinion is in a contradiction of Chamberlain and Campbell (1995), who consider as EVA's benefit that it allows management to quickly see in which direction the company is going.

According to O´Byrne (2016), EVA is not used by more than 10% of S&P 1500 companies, because its use undermines longer-term focus. It is easier to increase EVA in the short run by reducing capital than by investing in new projects that often have a long ramp-up to full profitability. A major consideration in the application of EVA is the adjustment of a large number of accounting variables. Peterson and Peterson (1996) note that data required in determining adjustments is difficult to obtain and that estimates of a firm's EVA are sensitive to the cost of capital estimation.

EVA is widely used in different studies and can be applied in various areas like industry, information technology (IT), tourism, education, etc. For example, Kim (2006) developed a study and tested the hypothesis on hospitality sectors firms, Geyser & Liebenberg (2003) examined introducing EVA as a performance measure for agribusinesses and co-ops in South Africa, Ghanbari & More (2007) focused on EVA in Indian automotive industry, etc.

1.2 Key Performance Indicators as value drivers

It is reasonable that any effective PMS has to include a limited number of KPIs. Identification of value drivers is a vital aspect of benefit sharing. It is critical in terms of the number of value drivers as well as the particular drivers to highlight. Too many or too few may mean that value could be destroyed. There are trade-offs to make, both in the short and long-term (CIMA Research Report, 2005).

Starting from 2006, UK listed companies are required to analyse their performance by using KPIs in specific sections of their annual reports and the Accounting Standard Board (ASB) provides companies with guidelines for the best practice regarding KPIs disclosure. Elzahar et al. (2015) found a significantly negative (weakly positive) relationship between disclosure quality of financial KPIs and the implied cost of capital (firm value).

1.3 Company Performance and Business Cycles

Business cycles – alternating periods of recession and recovery – are typical for all free-market economies. Each recession is unique, triggered by different reasons. This leads to wide latitude in assessing blame for a contraction and similarly, each recovery has a unique characteristic. Due to structural shifts in the economy, technological innovation, varying regulatory backdrops, and other factors, no one sector has behaved uniformly for every business cycle. Emsboo-Matingly et al (2017) describe four distinct phases of a typical business cycle: the early cycle phase, the mid-cycle phase, the late-cycle phase and the recession phase. Authors emphasize that it is important to note outperformance of some sectors as e.g. IT or industrials in early and mid-cycle phase and underperformance in late-cycle phase and in recession, in opposite underperformance of sectors as energy, telecommunication or health care in early-cycle phase and outperformance in late-cycle phase and in recession.

It is widely considered, that the automobile industry is a pillar of the global economy, the main driver of macroeconomic growth and technological advancement in both developed and developing countries, spanning many adjacent industries (ATKearney, 2013). The automotive industry is highly important by links to the other sectors having important multiplier effects on the economy (European Commission, 2017).

With the annual production of 118 vehicles per 1,000 inhabitants, the automotive sector in the Czech Republic makes up nearly 25% of the country's industrial production and exports and contributes approximately 7.4% to GDP (Kozelský & Novák, 2015). In 2016, cars were exported for the total amount of $18.7 billion and vehicle parts of $13.5 billion (OEC, 2016).

The automotive industry is highly sensitive to business cycles since economic activity in this industry moves in line with the overall business cycle. During the financial crisis its spillover effect of automotive which impacted the whole economy (Van Biesebroeck & Sturgeon, 2010). The global automobile industry has undergone structural changes in the supply chain – from key role of car companies produced almost the entire vehicle within their production lines, to the high proportion of value added outsourced with increasing the role of auto suppliers. According to Harrington (2015), this increased dependence changes the hierarchy of players away from the traditional power base where the big original equipment manufacturers held almost all the market power. It is driving manufacturers to form closer relationships with their suppliers.

There is considerable debate in both the theoretical and empirical literature about the differences in the cyclical dynamics of firms by firm size. The empirical evidence that risk-adjusted returns are larger for small firms than for large firms is known as the firm size effect.

This effect was shown initially by Banz (1981) a Reinganum (1981). Banz (1981) states that small firms tend to have higher returns that large firms with an average over the long period. In matured markets, theoretical models have emerged in favour of size effect (Berk et al., 1999, Gomes et al, 2003, Carlson et al, 2004), that small firms tend to reach higher returns than larger firms. On the other hand, Fama and French (2012), Dimson et al. (2011) observed that size effect does not persist over the last periods. Kim and Burnie (2002) investigated the hypothesis that the small firm effect is driven by the economic cycle. They confirmed that the small firm effect occurs in the expansion phase of the economic cycle and there is no significant small firm effect in the contraction phase of the economic cycle. Pandey & Sehgal (2016) confirm that small firms are more sensitive to the business cycle owing to the fact that their financial statements erode faster than those for large firm´s stocks during economic recessions.

2. Methodology of research

2.1 Data

The source of secondary data was a publicly available database of companies´ financial reports. All analysed companies were members of the Automotive Industry Association of the Czech Republic (AUTOSAP). AUTOSAP has a dominant position in this sector (share more than 86% of total sales in automotive). Micro-companies, companies with a negative value of equity and negative value of value added, are excluded from the sample.

Based on this selection, two samples of reported financial results of 1) 11 Manufacturers and 2) 87 Suppliers were compiled over the period from 2005 to 2012. Using analysis of total companies' sales over time, the "Pre-crisis period" (outlined in the years 2005-2007) was determined, when reported sales in both of samples had been steadily increasing. During 2008-2009, defined as "Crisis period", sales in the automotive sector declined due to a financial crisis and decreased in demand of the cars. In 2010, the value of reported sales returned to pre-crisis levels and the growth of sales continued until 2012 – this period was defined as "Post-Crisis period" (2010 – 2012). This recovery trend finished in 2013 and a decrease of sales in automotive and a growth slowdown of GDP in the Czech Republic were reported. For this reason, the period for this investigation was limited to 2012, to be able to analyse correctly behaviour of companies in the Post-Crisis period understood as recovery period. The development of sales of Manufacturers and Suppliers is demonstrated in Figure 1.

Figure 1. The development of sales in the automotive sector in the period of 2005-2012
Source: *own processing*

The companies are classified according to the size of the entity to Small (sales up to 8 mil. EUR): 16 companies, Medium (sales 8 – 40 mil. EUR): 31 companies, Large (sales over 40 mil. EUR): 51 companies.

2.2 Data processing

Due to impossibility to adjust accounting data of the companies, following formula was used for calculation of EVA:

$$EVA = (ROCE - WACC) \times C, \text{ where } ROCE = EBIT/C \quad (2)$$

According to Guenter and Michalski (2018), ROCE correlates very well with EVA and, in absence of EVA calculation, is the best measure to represent value creation. In our case, ROCE, calculated using accounting (not adjusted) data, is used for calculation spread and EVA. The costs of capital are calculated as the weighted average costs of equity and debt. The corporate interest rates are limited to a maximum of 20%. The methodology of the Ministry of Industry and Trade of the Czech Republic using built-up model is employed for calculation of the cost of equity (Ministry of Industry and Trade CR, www.mpo.cz). The cost of equity is calculated as the sum of the risk-free rate and risk premiums for financial structure, financial stability and business risk premium for company size.

A detailed pyramidal breakdown of EVA for identification of KPIs is demonstrated in Figure 2.

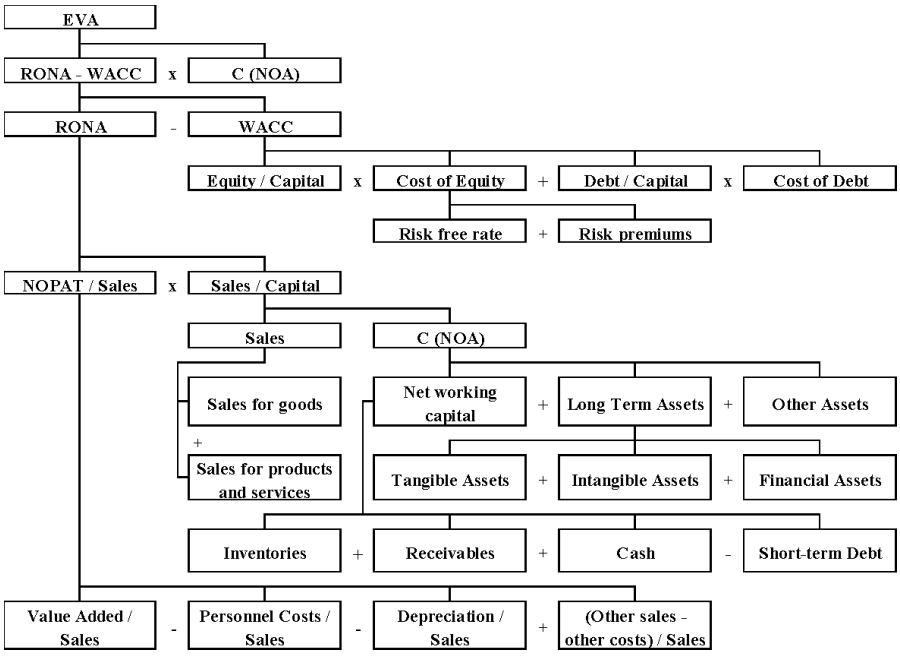

Figure 2. EVA's pyramidal breakdown. Source: *own processing*

The sensitivity analysis of EVA on performance indicators identified by EVA's pyramidal breakdown calculation was performed. The univariate sensitivity analysis was applied since only one parameter was changed at one time. The change of individual indicators of +15% was examined. This analysis was conducted for each year, distinguishing the samples of Manufacturers and Suppliers. For data aggregation, a weighted arithmetic mean with weights of total sales was applied. For the comparability of results across companies with difference sizes and production types, EVA was scaled by total sales. New

ratio indicator EVA/sales was subjected to the sensitivity analysis. Resulted changes were measured by differences in the ratios instead of growth rates. It allowed measuring the change when the zero value is crossed (i.e., change from -3% to 1%). Winsorisation was performed on ratio data which were summarized by their mean values. Outliers (5 % of most irregular values) were removed by shrinking to the main part of the data as described in Khan et al. (2007).

Subsequently, the Stochastic Frontier Analysis (SFA) was adopted to assess elasticity of EVA on its determinants and to evaluate technical efficiency of companies in the sample. This approach is preferable to OLS regression because it does not evaluate the average-company model. Instead, best technological frontier, to which all companies are being compared, is estimated. Technical efficiency (TE) indicates how the company utilises its resources to achieve maximal outcome compared to the most efficient decision-making units which define the efficient frontier. The value of TE ranges from 0 to 1 where the latter means company constitutes the frontier. Panel data structure allows estimating the time-varying Error Component Frontier model as defined in Battese & Coelli (1992). The model is as follows:

$$\mathrm{Y}_{it} = f(x_{it})\exp(V_{it} - \mathrm{U_{it}})\mathrm{Y}_{it} = f(x_{it})\exp(V_{it} - \mathrm{U_{it}}) \quad (3)$$

where Y_{it} is the value of EVA of the company i at time t. We have used Cobb-Douglas production function f with a set of covariates X_{it} which were identified as important determinants of the EVA. Production function f was parametrised by β parameters which reflected the average elasticity effect of corresponding covariates. Random error was decomposed into two parts: V_{it} which accounts for external factors and $\mathrm{U_{it}}$ containing technical inefficiency relative to the frontier. $\mathrm{U_{it}}$ is assumed to follow truncated Normal distribution. Technical efficiency is computed as:

$$TE_{it} = \exp(-\mathrm{U_{it}}) \quad (4)$$

The sample was restricted to suppliers with positive EVA. Production inputs (assets and costs) were identified from the pyramidal breakdown in Figure 2. Costs were used as proxies for true inputs (e.g., personnel costs convey an information about the labour force). SFA is designed to analyse variables in levels (i.e., not in a form of financial multiples) to inspect the size effect of analysed units. Application of Cobb-Douglas production function requires all variables to be positive. These two conditions have influenced selection of variables. Replacing Net Working Capital by Working capital allowed retaining from 6% to 15.6% of companies in the sample across years. Similarly, Long Term Financial Assets and Long Term non-Tangible Assets were dropped from the SFA analysis as standalone variables.

SFA is a parametric model estimated by iterated maximum likelihood technique. It requires explanatory variables to be non-correlated. It implies that it is not possible to have Value Added, Sales and Value Added/Sales in the estimated function. The same applies to Risk-free rate which is used directly to determine the cost of equity. This is, however, possible to do in a sensitivity analysis of the EVA decomposition. Changed value of the analysed variable is passed through the whole "pyramid" to see the effect on the outcome. No elasticity parameters are estimated therefore collinearity is not a problem.

The final model uses EVA as an outcome of the production function. As inputs were chosen Long Term Assets (LTA), Working Capital (WC), Value Added (VA), Personnel Costs (PC) and Depreciation (DEP). Models with time-invariant efficiencies were selected based on the Wald test of the additional variable (Year). As in the previous analysis, we run models for three periods. Models with the detailed decomposition of LTA or Working Capital were unable to estimate the effects reliably (standard errors of estimates were large).

3. Results and discussion

3.1 Development of automotive sector in Pre-crisis, Crisis and Post-crisis periods

The automotive industry directly contributes to the overall economic development of the country and also influences other sectors in both positive and negative direction. *Figure 3* shows the development of annual GDP growth rates and annual changes of EVA/Sales in the automotive sector in the period of 2005-2012. This figure demonstrates a sensitivity of the automobile sector on the general economic conditions throughout the whole business cycle. This sensitivity was evident for both Manufacturers and Suppliers, although the magnitude of changes differed. The highest decrease of the sector's performance was recorded in 2009 when the average value of EVA/Sales dropped by 8.1% compared to the previous year. Annual changes of GDP in the investigated period were higher than changes of the winsorized mean of EVA/Sales for both Manufacturers and Suppliers, except of the year 2010.

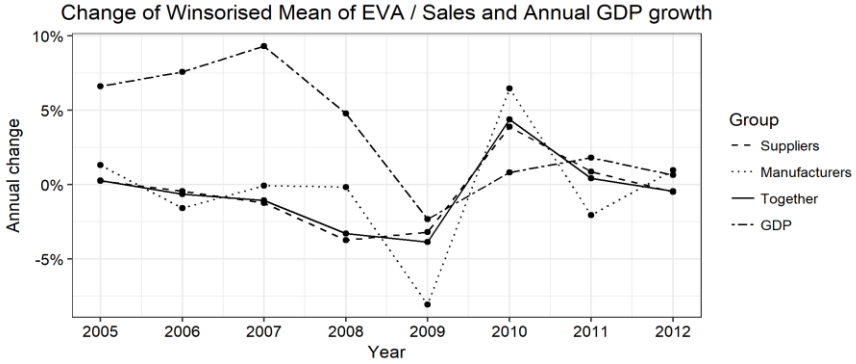

Figure 3. Growth of winsorized mean of EVA/Sales in the automotive sector and GDP annual growth in the Czech Republic in the period of 2005-2012
Source: *own processing*

Figure 4 shows different level and development of companies´ performance measured by mean values of EVA/Sales, differed by size in the period of 2005-2012. The most cyclical development and the lowest level of performance were evident for Small companies, while Large ones showed the slightest fluctuations and highest performance throughout all reporting periods.

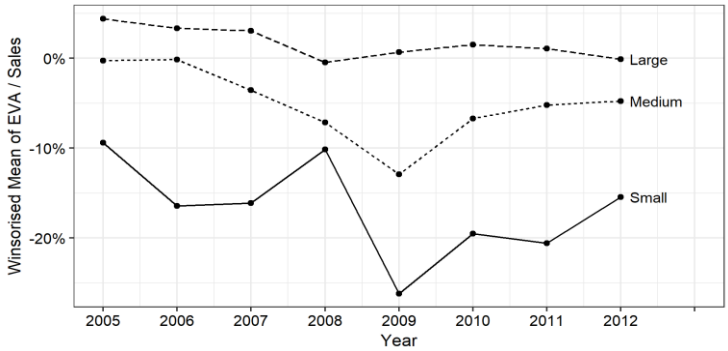

Figure 4. Development of winsorised mean values of EVA/Sales according to the company size in the period of 2005-2012
Source: *own processing*

Figure 5 demonstrates changes in relative frequencies of companies with positive and negative EVA in a period of 2005-2012. There is a huge decrease of companies with positive EVA within the crisis period. A higher share of the companies with negative EVA (except of

2007, 2008 and 2010) is reported by Manufacturers during the whole following period. In the Pre-crisis period Manufacturers kept a stable proportion of companies with positive EVA. This proportion had dropped to 27% in 2009 which was also the worst year for Suppliers (37%). The proportion of Suppliers with a positive value of EVA has been increasing since then. This growth trend was more robust due to the number of companies in the sample. Also, declining proportion of Manufacturers after rebounce in 2010 was caused by the increased value of Personnel Costs (see Value Added decomposition in Figure 10).

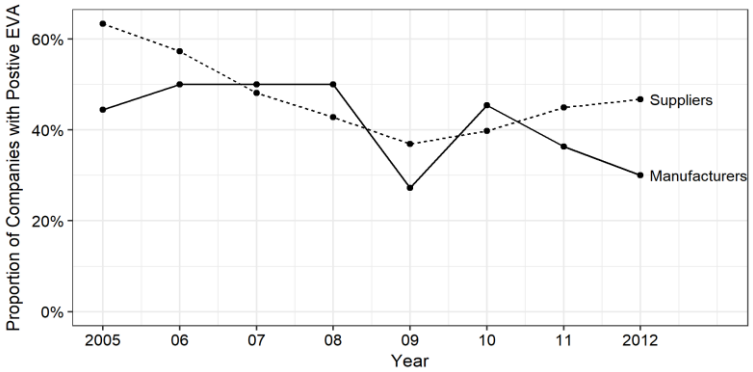

Figure 5. Proportion of the companies with positive EVA distinguished on Manufacturers and Suppliers in the period of 2005-2012
Source: *own processing*

3.2 Identification of Key Performance Indicators using sensitive analysis

The results of the sensitivity analysis are demonstrated in the following tables.

Table 1 shows the results for the sample of the Manufacturers - the change of EVA/Sales if individual indicators influencing EVA (see the pyramidal breakdown on Figure 3) increased by 15 %. As the most contributing factor to the growth of EVA/Sales within the whole reporting period was identified the indicator Value Added/Sales. The most negative impact on EVA/Sales showed Personnel Costs and Depreciation.

Table 1. The change of EVA/Sales using the sensitivity analysis in the period of 2005-2012, Manufacturers

Manufacturers	2005	2006	2007	2008	2009	2010	2011	2012
Tangible Fixed Assets	-0.433%	-0.376%	-0.327%	-0.359%	-0.506%	-0.349%	-0.305%	-0.247%
Intangible Fixed Assets	-0.139%	-0.116%	-0.104%	-0.110%	-0.135%	-0.094%	-0.079%	-0.073%
Long-term Financial Assets	-0.006%	-0.007%	-0.014%	-0.026%	-0.033%	-0.027%	-0.015%	-0.010%
Inventory	-0.090%	-0.079%	-0.064%	-0.071%	-0.086%	-0.067%	-0.055%	-0.043%
Receivables	-0.214%	-0.321%	-0.308%	-0.351%	-0.313%	-0.223%	-0.277%	-0.111%
Short-term Financial Assets	-0.008%	-0.012%	-0.020%	-0.024%	-0.163%	-0.213%	-0.141%	-0.142%
Short-term Payables	0.274%	0.288%	0.238%	0.266%	0.348%	0.279%	0.253%	0.165%
Value Added/Sales	2.593%	2.740%	2.892%	2.763%	2.413%	2.775%	2.728%	2.613%
Personnel Costs/Sales	-0.965%	-0.954%	-0.981%	-1.107%	-1.151%	-1.083%	-1.052%	-1.042%
Depreciation/Sales	-1.007%	-0.962%	-0.814%	-0.814%	-0.974%	-1.020%	-0.766%	-0.679%
Other Costs and Revenues/Sales	0.259%	0.263%	0.285%	0.186%	0.114%	0.147%	0.155%	0.117%
Sales	0.797%	1.028%	1.337%	0.985%	0.354%	0.776%	1.027%	0.974%
Risk-Free Rate	-0.150%	-0.161%	-0.208%	-0.241%	-0.273%	-0.211%	-0.208%	-0.132%
Risk Premiums	-0.432%	-0.421%	-0.368%	-0.412%	-0.586%	-0.463%	-0.397%	-0.315%
Cost of Equity	-0.581%	-0.583%	-0.576%	-0.653%	-0.858%	-0.674%	-0.605%	-0.446%
Cost of Debt	-0.036%	-0.040%	-0.024%	-0.022%	-0.030%	-0.020%	-0.014%	-0.014%
Interest Expenses/Sales	-0.083%	-0.059%	-0.045%	-0.043%	-0.049%	-0.043%	-0.038%	-0.033%

Source: *own processing*

Table 2 shows the results for the sample of the Suppliers - the change of EVA/Sales if individual indicators influencing EVA (see the pyramidal breakdown in Figure 3) increased by 15 %. As the most contributing factor to the growth of EVA/Sales throughout the whole reporting period was identified also the indicator Value Added/Sales, the most negative impact on EVA/Sales showed Personnel Costs and Depreciation, similar results as for the sample of Manufacturers, and also Cost of equity, Tangible Fixed Assets and Receivables.

Table 2. The change of EVA/Sales using the sensitivity analysis in the period of 2005-2012, Suppliers

Suppliers	2005	2006	2007	2008	2009	2010	2011	2012
Tangible Fixed Assets	-0.305%	-0.273%	-0.263%	-0.336%	-0.393%	-0.537%	-0.477%	-0.612%
Intangible Fixed Assets	-0.012%	-0.010%	-0.007%	-0.009%	-0.012%	-0.064%	-0.074%	-0.101%
Long-term Financial Assets	-0.018%	-0.051%	-0.057%	-0.121%	-0.155%	-0.199%	-0.171%	-0.063%
Inventory	-0.123%	-0.143%	-0.132%	-0.173%	-0.136%	-0.135%	-0.142%	-0.126%
Receivables	-0.465%	-0.622%	-0.684%	-0.501%	-0.704%	-0.619%	-0.660%	-0.523%
Short-term Financial Assets	-0.114%	-0.051%	-0.108%	-0.050%	-0.041%	-0.024%	-0.024%	-0.023%
Short-term Payables	0.373%	0.499%	0.602%	0.470%	0.648%	0.867%	0.855%	0.773%
Value Added/Sales	2.304%	2.209%	2.131%	2.107%	2.393%	2.134%	2.166%	2.376%
Personnel Costs/Sales	-0.826%	-0.828%	-0.874%	-1.011%	-1.106%	-1.011%	-0.955%	-0.927%
Depreciation/Sales	-0.427%	-0.382%	-0.381%	-0.427%	-0.575%	-0.563%	-0.532%	-0.710%
Other Costs and Revenues/Sales	-0.326%	-0.193%	-0.004%	-0.009%	-0.111%	-0.046%	0.062%	0.134%
Sales	0.699%	0.754%	0.782%	0.538%	0.546%	0.414%	0.620%	0.761%
Risk-Free Rate	-0.163%	-0.182%	-0.202%	-0.199%	-0.239%	-0.179%	-0.183%	-0.118%
Risk Premiums	-0.483%	-0.472%	-0.444%	-0.514%	-0.591%	-0.542%	-0.517%	-0.561%
Cost of Equity	-0.647%	-0.654%	-0.646%	-0.712%	-0.829%	-0.721%	-0.700%	-0.679%
Cost of Debt	-0.014%	-0.013%	-0.010%	-0.011%	-0.004%	-0.003%	-0.002%	-0.002%
Interest Expenses/Sales	-0.026%	-0.051%	-0.090%	-0.123%	-0.054%	-0.099%	-0.122%	-0.112%

Source: *own processing*

Value Added (VA) impact on EVA/Sales

Figure 6 demonstrates that the small companies benefited due to their higher flexibility in all periods. If Value Added increase, more than their competitors, Large companies gained only half of Medium ones and even a third of Small ones. The Suppliers benefited from increasing Value Added more than Manufacturers. Increasement of Value Added remained almost stable in impact on EVA/Sales in different periods (Pre-Crisis, Crisis and Post-Crisis).

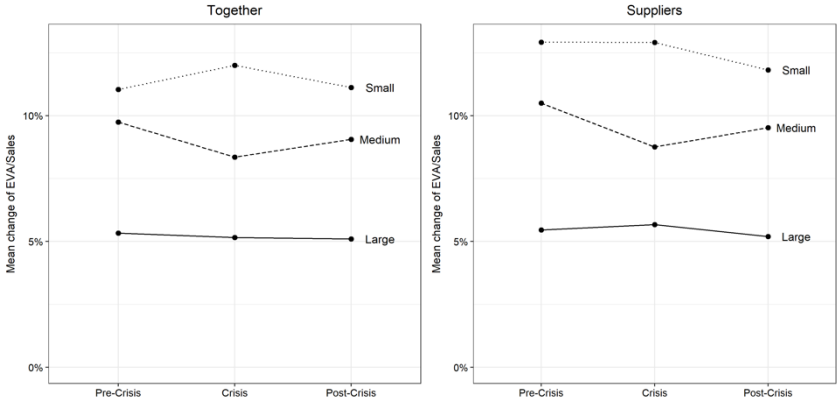

Figure 6. Mean change of EVA/Sales if VA increases, in the Pre-Crisis, Crisis and Post-Crisis periods according to the companies' size.
Source: *own processing*

Personnel costs (PC) impact on EVA/Sales

Figure 7 shows that in all periods Small companies were the most sensitive on increasing Personnel Costs, EVA/Sales for Large companies was on one third of change for Small companies. There was a minimum difference in reaction of the Manufacturers and Suppliers on increasing Personnel Costs. Increasement of Value Added remained almost stable in impact on EVA/Sales in different periods (Pre-Crisis, Crisis and Post-Crisis).

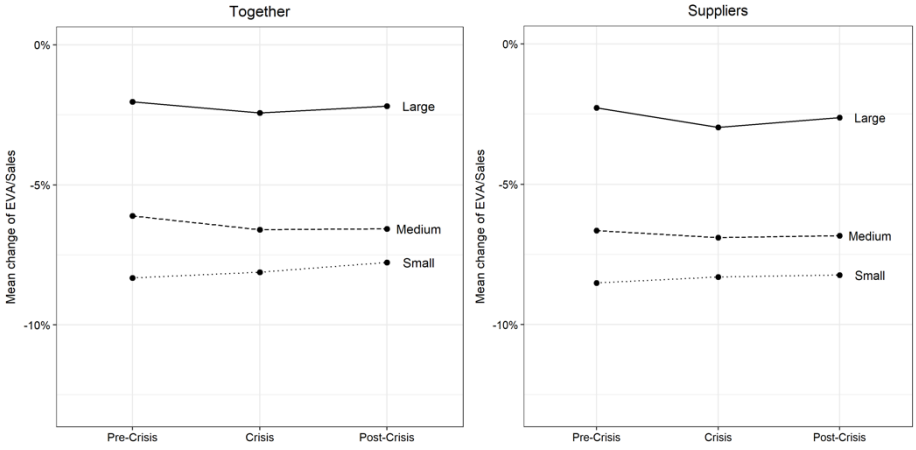

Figure 7. Mean change of EVA/Sales if PC increase, in the Pre-Crisis, Crisis and Post-Crisis periods according to the companies' size.
Source: *own processing*

Depreciation (DEP) impact on EVA/Sales

Figure 8 demonstrates that the change of EVA/Sales on depreciation was almost independent of companies´ size in all investigated periods. According to expectation, Depreciation was stable in time because of long-term life of capital investments.

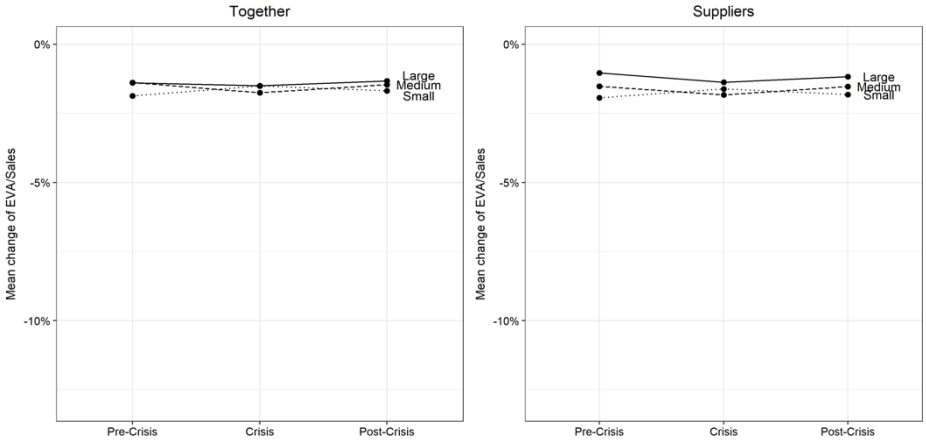

Figure 8. Mean change of EVA/Sales if DEP increases in the Pre-Crisis, Crisis and Post-Crisis periods according to companies' size.
Source: *own processing*

Cost of equity, Long Term Tangible Assets (LTA) and Receivables impacts on EVA/Sales in the sample of Suppliers

Figure 9 shows that there was a very high sensitivity of EVA/Sales on the Cost of equity of Small companies – Suppliers with increasing in the Post-crisis period. The sensitivity of EVA/Sales on change of LTA was quite little and stable during different periods for Large and Medium companies. The highest impact was visible in the sample of Small companies, with a decrease in Crisis period due to the low value of LTA. The highest impact of Receivables was recorded again for Small companies increasing in the Post-Crisis period. A higher sensitivity of Small companies in this set of value drivers is connected with their lower competitiveness and higher riskiness at the market.

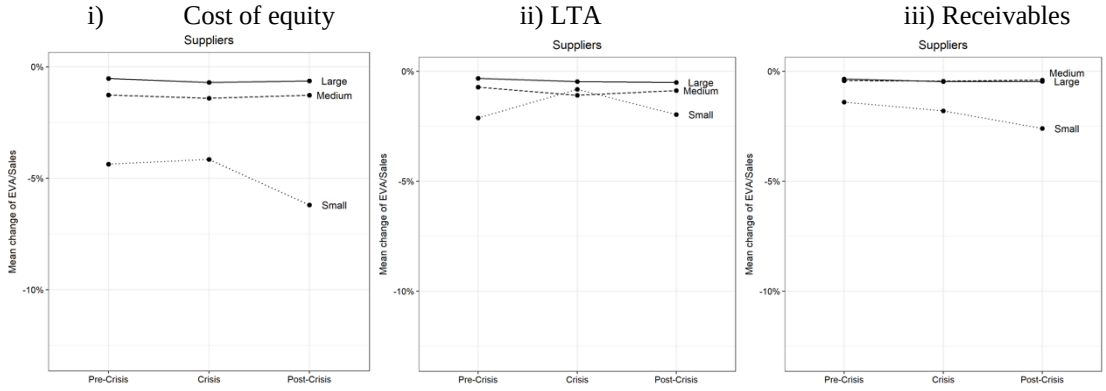

Figure 9. Mean change of EVA/Sales in the sample of the Suppliers if i) Cost of equity, ii) LTA and iii) Receivables increase in the Pre-Crisis, Crisis and Post-Crisis periods according to companies' size.
Source: *own processing*

3.3 The structure of Value Added in the Pre-crisis, Crisis and Post-crisis periods

In the next part, the structure of Value Added and the change of its items are presented in the Pre-crisis, Crisis and Post-crisis periods distinctive in the samples of the Manufacturers and Suppliers (Figure 10) and according to the companies´ size (Figure 11). The last line of the pyramidal breakdown in Figure 2 was used for the analysis.

Figure 10 demonstrates that Personnel costs had the highest share on Value Added (50-80% - Manufacturers, 55-70%- Suppliers. The most stable item in time was, as expected, Depreciation (20%) and was not significantly affected by the Crisis period. The most volatile item was the share of EBIT, which was significantly lower in times of Crisis, on the contrary, the highest values of EBIT were reached in the Pre-crisis period. The volatility of EBIT was significantly higher for Manufacturers.

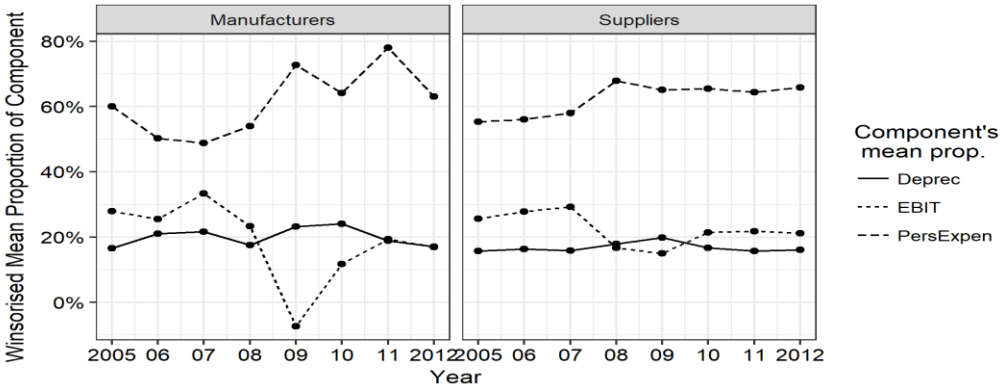

Figure 10. Mean proportion of items of Value Added in the samples of Manufacturers and Suppliers in the period of 2005-2012.
Source: *own processing*

Figure 11 shows that shares of Value Added items depended on the size of companies. For SMEs, the most significant items of Value Added were Personnel costs, which were the highest in the Crisis periods (> 80% share for Small companies). In the group of large companies, the proportion of Personnel costs was the highest, but not as significant as for SMEs. On the other hand, the higher share of Depreciation was demonstrated in the sample of the Large companies, which means greater involvement of technologies in production processes in comparison with Small and Medium sized companies. The share of EBIT (highest for Large companies) was significantly affected by the Crisis period in all samples.

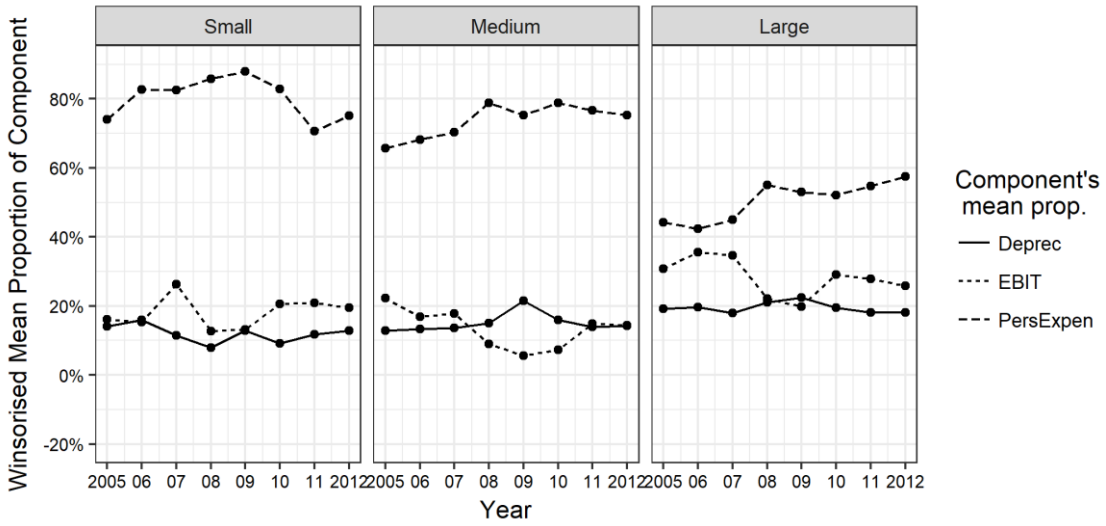

Figure 11. Value's Added component mean values in the samples of Small, Medium and Large companies in the period of 2005-2012
Source: *own processing*

3.4 Identification of Key Performance Indicators using the Stochastic Frontier Analysis

The results of the Stochastic Frontier Analysis for all investigated periods are presented in Table 3.

The Pre-crisis model was based on 132 observations. All variables turned out to be statistically significant on the standard 5% α level. Also, all estimated parameters had expected signs as in the Tables 1 and 2. An increase of Value Added by one per cent raised

EVA by $e^{(\ln(1.01)\times 3.31)} - 1 = 3.35\%$ $e^{(\ln(1.01)\times 3.31)} - 1 = 3.35\%$ $e^{(\ln(1.01)\times 3.98)} - 1 = 4.04\%$. After recalculation for all individual companies, 15% increase of Value Added resulted in 1% to 8% increase of EVA/Sales for the majority of companies.

Crisis period model was based on the 67 observations. This model contained several variables which were statically insignificant. Depreciation was one of the variables. During the Crisis period companies had a very similar level of the TE across all companies´ sizes as well as on the reported EVA values.

Post-Crisis model was estimated from 121 observations. Influence of the Value Added was the weakest of all periods. On the other hand, the importance of Personnel Costs was the highest. An increase of PC by one per cent decreased EVA for the best-performing companies by 1.87 %. The elasticity of EVA on the Working Capital was not proved as in the previous models, as the standard error equalled the size of the estimate.

Lower part *of Table 3 presents* three model's indicators. Indicator *sigmaSq* describes variation of efficiency scores. *Gamma* provides information about the source of errors. Values close to 0 points to the unobserved sources of errors ($V_{it}V_{it}$) while values close to 1 indicate big differences in the technical inefficiencies ($U_{it}U_{it}$). Last parameter *mu* estimates the mean value of the truncated normal distribution.

Table 3. Characteristics of estimated function on the Pre-Crisis, Crisis and Post-Crisis samples

PRE	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-5.67	0.71	-7.96	<0.01
LTA	-0.22	0.10	-2.21	0.03
WC	-0.25	0.11	-2.26	0.02
VA	3.31	0.22	14.97	<0.01
PC	-1.41	0.14	-9.84	<0.01
DEP	-0.27	0.10	-2.68	0.01
RE	-0.24	0.12	-2.05	0.04
sigmaSq	2.52	0.87	2.90	0.00
gamma	0.95	0.02	47.53	<0.01
mu	-3.10	1.14	-2.71	0.01

CRISIS	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-5.94	1.26	-4.73	<0.01
LTA	-0.25	0.14	-1.73	0.08
WC	-0.49	0.20	-2.42	0.02
VA	3.78	0.44	8.66	<0.01
PC	-1.69	0.26	-6.46	<0.01
DEP	-0.12	0.15	-0.84	0.40
RE	-0.01	0.25	-0.06	0.95
sigmaSq	2.60	1.71	1.52	0.13
gamma	0.91	0.07	12.47	<0.01
mu	-3.07	2.95	-1.04	0.30

POST	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-5.26	0.85	-6.19	0.00
LTA	-0.20	0.11	-1.89	0.06
WC	-0.11	0.11	-0.93	0.35
VA	3.57	0.30	11.76	0.00
PC	-1.90	0.23	-8.38	0.00
DEP	-0.29	0.12	-2.34	0.02
RE	-0.39	0.13	-2.91	0.00
sigmaSq	4.19	2.13	1.97	0.05
gamma	0.98	0.01	67.00	0.00
mu	-4.05	2.57	-1.58	0.12

Source: *own processing*

Three panels of *Figure 12* depict relationship between the company size (shape of data point), reached EVA and TE.

Figure 12. Three scatterplots depicting the relationship between EVA and TE in three periods. Values in EVA are in the original values projected to the logarithmic scale.
Source: *own processing*

Detailed descriptive statistics of technical efficiencies are provided in the following tables. *Table 4* presents the results obtained on the Pre-Crisis sample.

Table 4. Summary of the technical efficiencies in the Pre-Crisis sample

Size	Companies	Min	Q25	Mode	Mean	Q75	Max	IQR
S	6	37.2%	43.6%	63.0%	60.4%	75.8%	81.7%	32.3%
M	15	3.5%	50.1%	75.4%	62.9%	81.9%	89.9%	31.8%
L	36	18.1%	56.1%	75.2%	67.5%	82.1%	88.8%	26.0%

Source: *own processing*

Small sized companies had the lowest mode values of TE as summarised in the Pre-Crisis period. There were several companies with small efficiencies despite the relatively high value of EVA. It was caused by the exceptionally high value of one or two inputs compared to its peers' standards. Small companies got closer to other companies in the Crisis period, as seen from the *Table 5*.

Table 5. Summary of the technical efficiencies in the Crisis sample

Size	Companies	Min	Q25	Mode	Mean	Q75	Max	IQR
S	7	24.6%	41.7%	63.7%	56.2%	69.6%	82.3%	27.8%
M	11	13.3%	67.4%	71.3%	65.6%	78.4%	82.4%	11.0%
L	27	27.2%	53.1%	71.4%	64.2%	76.2%	84.9%	23.1%

Source: *own processing*

Small companies reached smaller values of technical efficiency as in the Pre-crisis period. TE values of Medium-sized companies were similar to each other; the interquartile range (IQR) was only 11%. This dispersion was lowest in all three periods. It indicates that companies became more similar to each other in their operations and production with respect to the best-performing companies.

Table 6. Summary of the technical efficiencies in the Post-Crisis sample

Size	Companies	Min	Q25	Mode	Mean	Q75	Max	IQR
S	7	22.7%	27.7%	43.8%	48.6%	66.1%	85.7%	38.4%
M	13	4.1%	37.2%	45.9%	51.4%	75.7%	89.1%	38.5%
L	32	9.0%	49.5%	70.8%	61.1%	80.7%	88.6%	31.2%

Source: *own processing*

In the Post-Crisis period as it is evident in *Table 6*, Large companies remained on the very similar values to Crisis values, but TE of Small and Medium companies dropped. This means that the best companies improved much better than the rest of the companies.

Conclusion

The paper was devoted to deep performance analysis of the automotive sector as the pillar sector in the Czech Republic, using EVA as a complex performance measure with identification of KPIs. The results of research demonstrated the applicability and usefulness

of both suggested methods - the univariate sensitivity analysis and SFA - in KPIs identification. In addition to other indicators, value added was demonstrated as a key driver with the highest positive impact and personnel cost with the highest negative impact on EVA in the automotive sector in all investigated periods, although the magnitude of the effects within investigated Pre-Crisis, Crisis and Post-Crisis periods were changing. The samples of Manufacturers and Suppliers were studied individually for exploration if their performance and the lists of KPIs differ. Also, the samples distinguishing small, medium and large-sized companies were studied for evaluation of performance, and if there could be a firm size effect identified in different periods of the business cycle. The lists of KPIs of Manufacturers and Suppliers slightly differed, although value drivers with the highest impact on performance measured by EVA were identical. Firm size effect as presented in previous research, which demonstrated that small firms tended to reach higher returns than larger firms (e.g. Berk et al., 1999, Gomes et al, 2003, Carlson et al, 2004) was not observed with using EVA considering not only returns, but also costs of capital. Contrary, this effect was in accordance with previous research (Pandey & Sehgal, 2016) with higher sensitivity on the business cycle. Firm size effect was also demonstrated on the structure of value added with an evident difference of proportion of personnel costs, depreciation and EBIT. For SMEs, the most significant items of Value Added were personnel costs, which were the highest in the Crisis periods. This result can be taken account with considering wage compensation allowance or reducing the tax burden on the labor of SMEs as a government measure to protect these companies before bankruptcy in the Crisis period. For large companies, the proportion of personnel costs was the highest in the Crisis period, but not as significant as for SMEs. A higher share of depreciation was demonstrated in the sample of the large companies, which means greater involvement of technologies in production processes in comparison with SMEs. Common trends in automatization and robotization can strengthen the share of this fixed costs and decrease more rapidly the share of EBIT on Value Added in the Crisis period. In line with expectation, the share of EBIT (highest for large companies) was significantly affected by the Crisis period in all samples. The analysis of the technical efficiency scores revealed that companies in the Crisis periods were more similar to each other and closer to the best-performing companies than in other periods. Analysis of the Post-Crisis period showed, that the best companies improved performance much better than the rest of the companies. It can be assumed that very well performing companies show higher sensitivity on the business cycle due to high operating and/or financial leverage.

There were some limitations of this research. SFA failed to prove the existence of effects of some variables identified by the sensitivity analysis. The major drawback of SFA application was its inability to deal with non-positive values. On the other side, the sensitivity analysis did not allow statistical testing of estimated effects as it was possible with the SFA approach. As the shares of the surveyed companies were not publicly traded, it was not possible to use the CAPM model to estimate the cost of equity. The build-up method recommended by the MIT was applied. Using this method led to a higher cost of equity than if the CAPM method was applied, as it included both systematic and non-systematic risks. These results of calculation tightened the view of corporate financial performance.

There are some possibilities for conducting future research. The automotive sector is nowadays rapidly developing innovative sector in terms of digitalization, implementing disruptive technologies and increasing share of automation and robotics. It could change some value drivers, their power and impact on company performance – it should be a challenge for next research.

Acknowledgement

The authors are thankful to the Czech Science Foundation (GA CR), project No. 16-25536S, for financial support to carry out this research.

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