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Implementation of Du Pont Model in Non-Financial Corporations

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ABSTRACT

In this paper, the practical application of the dynamic decomposition of the return on equity is used on the basis of the ratio indicators. These indicators are determined according to the absolute items taken from the Register of Financial Statements of the Slovak Republic and are obtained for individual non-financial corporations according to SK NACE 26 and SK NACE 27 for the period 2013-2016. Du Pont decomposition of the return on equity allowed quantifying the impact of the financial indicators such as return on sales, total assets turnover ratio, financial leverage, and interest and tax profit reduction, which were linked by a multiplicative product interaction. Quantification of the factors impact was applied to a sample of 138 non-financial corporations using the equations valid for the application of the functional method. By applying the exploration data analysis, the impact of the factors is plotted graphically. The box plot shows that the obtained values are very varied and it follows that no clear conclusion can be deduced. There is potential for further exploration of the dynamic model.

INTRODUCTION

Slovakia was, is and will be an industrialized state. According to the statistics of the European Union, the Slovak Republic is even the most industrialized state in the European area. The electrical engineering industry is one of the largest industries in the world. In Slovakia, electrical engineering and engineering sector are the main pillars of industry and are therefore backbone of the Slovak economy. Here, the electrical engineering industry had the fastest growth rate among all manufacturing industries, and it was one of the most attractive sectors for foreign investors. The electrical engineering industry has a long-standing tradition in Slovakia; it is the third strongest manufacturing sector just behind the engineering and automotive industries.

Slovakia is an industrial country, and forecasts showing that the future of the industry is not threatened, but one threat results from the lack of qualified labour. Identification, analyzation, comparation, and evaluation of the electrical engineering industry among the self-governing regions of Slovakia was provided by Midler and Dubcova (2014).

„Financial analysis involves comparing the firm's performance to that of other firms in the same industry field and evaluating trends in the firm's financial position over time" (Vitkova and Semenova, 2015, p. 744). Non-financial corporations from electrical engineering industry were studied in research of Jencova and Litavcova (2013), Jencova, Litavcova and Vasanicova (2016), Litavcova, Jencova and Vasanicova (2017), Jencova et al. (2017). Taking into account the volume of sales, these companies represent the entire manufacturing electrical engineering industry of the Slovak Republic. Jencová and Litavcova (2013), in their monograph, provided financial and economic analysis of the selected company from electrical engineering industry, since 2008, and applied mathematical and statistical methods.

In this paper, we provide the practical application of the dynamic decomposition of the return on equity on the basis of the ratio indicators. On a sample of 138 non-financial corporations from electrical engineering industry, we quantify the impact of the financial indicators such as return on sales, total assets turnover ratio, financial leverage, and interest and tax profit reduction, on the return of equity.

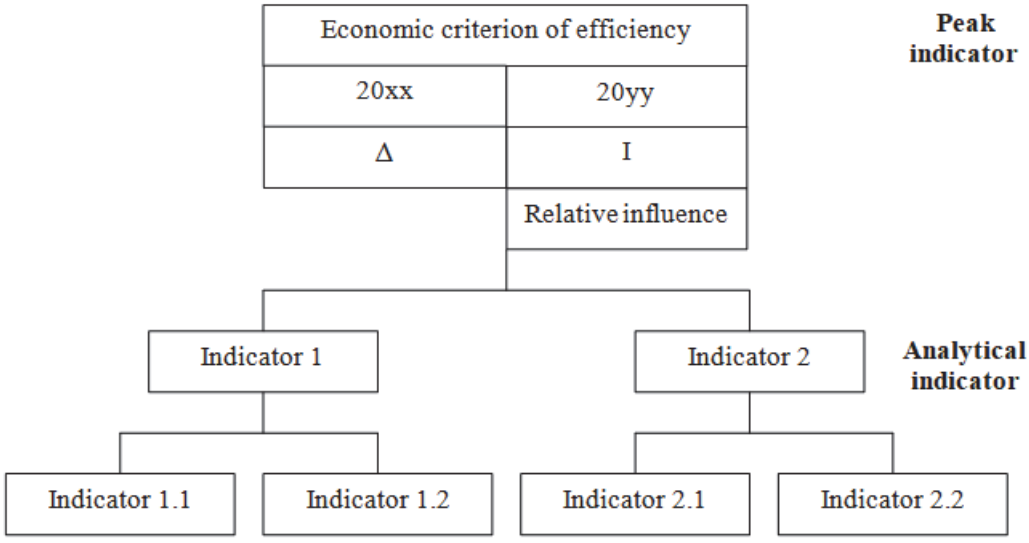
1. DU PONT MODEL

„Financial ratio analysis is a process of determining and interpreting relationships between the items of financial statements to provide a meaningful understanding of the performance and financial position of a company" (Babalola and Abiola, 2013, p. 132; Vitková and Semenova, 2015, p. 744). Financial analysis of the company can be performed by various methods. The methodology should include indicators, among which there are simple and understandable relations and causal connections. One of the appropriate methods is the pyramid system of indicators, which is a logical-deductive indicator system composed by the synthetic indicator that is decomposed to other partial indicators that are in the position of causal factors (Gurcík and Jancíkova, 2002). Pyramidal models form a set of financial metrics that are linked by causal and complementary links, in order to provide the greatest possible value for financial management (Jencova, 2016).

Figure 1 illustrates a simplified pyramidal model. For the field of financial analyzes, the chosen indicator should have the highest reporting value (base period, actual period, index, growth rate, absolute impact, relative impact, comparison of more methods of quantifying the influence of determining factors). Peak indicator, i.e. the synthetic indicator is the indicator of the zero level; the indicators 1, 2 are the indicators of the first level, and they are gradually divided to the further indicators of the lower level. The intent of the pyramidal systems is to explain the behavior of the peak indicator and then quantify the influence of the partial indicators to convert this synthetic indicator.

The degree of decomposition quantifies the weight and aggregate of the indicators. Indicators are linked by vertical links that have a causal character, and by horizontal links that are complementary. Using these linkages, we perform quantification of the individual analytical indicators to change the synthetic indicator. Factor analysis is actually an analysis that allows quantifying causal factors to the peak factor.

Figure 1. Simplified pyramidal model



Source: own processing according to Jenčová (2016)

Boda and Uradnicek (2016, p. 73) defined the static pyramidal decomposition as *"a decomposition of the peak, synthetic indicator into a series of partial factors, between which there are precise mathematical-logical and economic-causal relations. This requirement implies that the change of each partial factor at the higher decomposition stage affects the change of all other analytical factors in the appropriate decomposition branch upwards. Then it also affects the change of the peak synthetic indicator assuming ceteris paribus"*.

Mentioned authors also pointed out that for the purpose of further exploring linkages between factors, it is appropriate to analyze static pyramidal decompositions in a certain chronological sequence. Then the pyramidal decomposition becomes to a certain extent more dynamic. In the valuable papers of Boda (2014) and Uradnicek (2014) is pointed to the inclusion of weights express subjective importance into the dynamic multiplier pyramidal decomposition of the financial metrics.

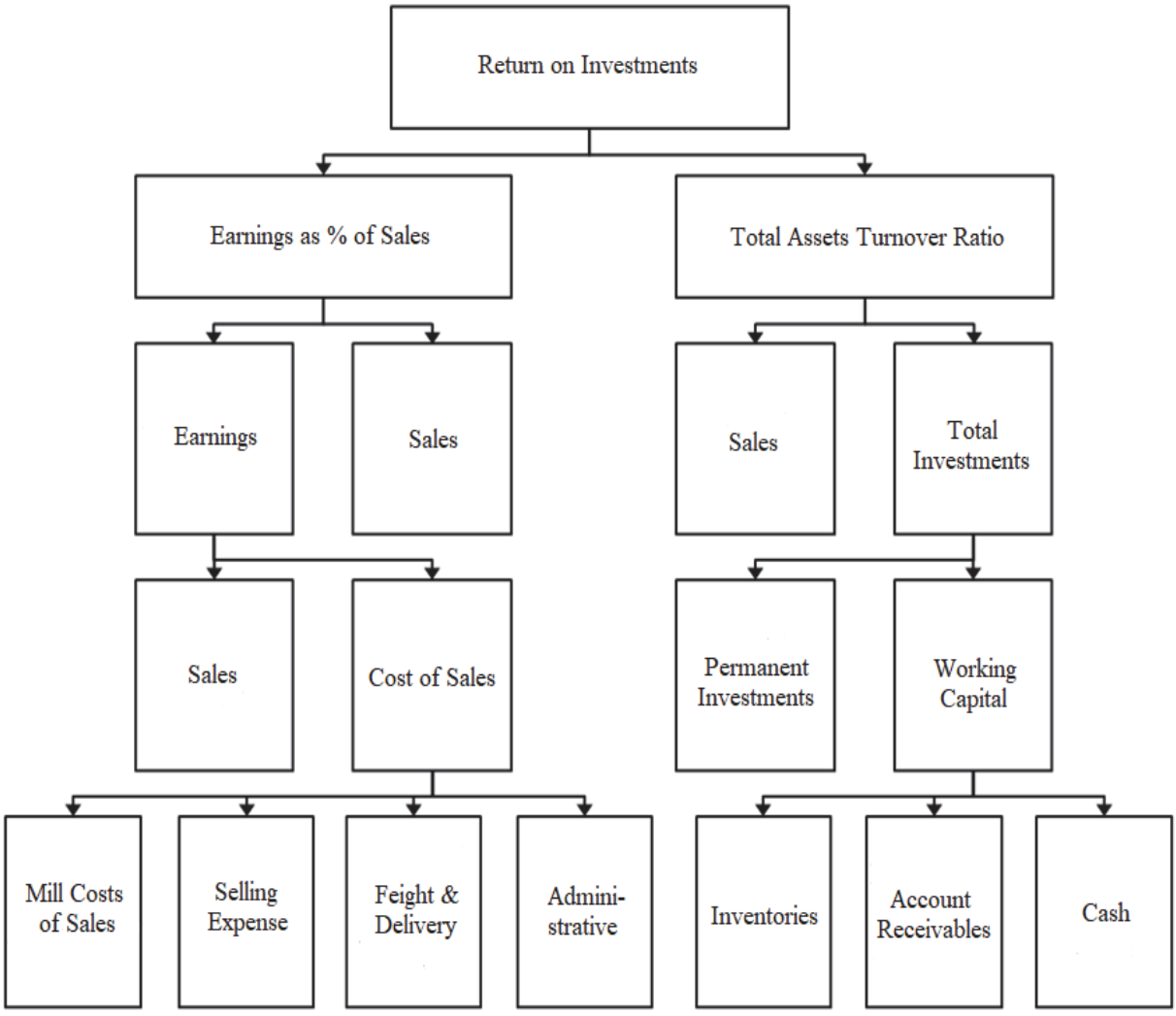
The first pyramidal model, known as the Du Pont decomposition, was applied to the chemical company Du Pont de Nemours. The term Du Pont refers to the company E. I. du Pont de Nemours and Company that was established by Éleuthère Irénée du Pont de Nemours, in 1802. The author of this model was Frank Donaldson Brown (Marek, 2009) who created a model of return on assets (ROA) decomposition in 1912. The ROA indicator is not ideal for investor decision making as it does not distinguish between capital appreciation for shareholders and creditors. This role is better performed by the return on equity (ROE) indicator that Brown created in 1919.

The original Du Pont decomposition of ROA is illustrated in Figure 2. On the first level of decomposition is applied the multiplicative product linkage between the indicators of profitability, activity, indebtedness, and ratio of the various profits. The profitability indicator is represented by the operating profit margin; the activity indicator is represented by the use of assets; indebtedness indicator is represented by the leverage factor. Profit ratio is given by the ratio of net profit for the accounting period and the operating earnings before interest and taxes for the accounting period. Models of Du Pont decomposition are specified in Mitchell, Mitchell and Cai (2013).

For ROE decomposition is appropriate disaggregation by using the eight indicators. The ROE indicator is decomposed into two branches and three rows. The left branch quantifies seven

metrics of ROA as basic earning power, return on sales (ROS), total assets turnover ratio, earnings after taxes (EAT), sales, and assets. The right branch represents the ratio of total assets, or the total invested capital on equity, i.e. the indicator of financial leverage that is the reciprocal value of equity ratio (Jencova, 2016).

Figure 2. Original Du Pont decomposition



Source: own processing according to Marek (2009)

Du Pont model in the manufacturing industries was used in many foreign publications, e.g., Vasiu, Baltes and Ciudin (2012), Lubinski, Fear and Perez (2013), Mihola and Kotesovcova (2015), Vitkova and Semenova (2015), Rudrajeet and Aneja (2017), Carvalho et al. (2017). Pyramidal models of financial corporations were studied by authors Zhang, Han and Zhang (2016). Profitability behavior within manufacturing industry by using data of return of assets that is one of the components of Du Pont decomposition was studied in Pruziak (2017).

2. THE METHODS OF QUANTIFYING THE INFLUENCE OF DETERMINING FACTORS

The profitability indicator of ROE is one of the most widely used financial evaluators the economic situation of the company in terms of profitability (Paulik, Sobekova Majkova, Tykva and Cervinka, 2015). To quantify the impact of analytical factors on the return on equity, in this paper, we apply the logarithmic and functional method within the multiplicative linkage. In the pyramidal system, using appropriate methods it is possible to quantify the intensity of the influence of the individual sub-indicators on the peak indicator and thus explain the development of the financial situation of the company between selected periods.

In addition, it is possible to evaluate differences between the real and planned value of the peak indicator, to compare the company's performance with competitors, to monitor the differences between company's performance and performance of the whole industry or the best companies in the given industry, to predict future development resulting from the causal links between indicators (Sedlacek, 2007; Jencova, 2016). In additive linkages between the indicators, the influence is quantified by the elementary method, using the standard shape, using the ratio of the change and the corresponding overall change multiplied by the impact of the corresponding peak financial indicator.

The implementation of the logarithmic method in the analyzed company is based on the indices of differences of the individual analytical indicators, which are interconnected by multiplicative product and quotient interactions and acquire the values which are valid for applying the logarithmic method (Kucharcikova et al., 2011). As is stated in Zmeskal, Dluhosova and Tichy (2013), and in Dluhosova (2008), the logarithmic method is given by the formulas (1), (2), (3), (4), (5):

$$I_x = \frac{x_1}{x_0} = \frac{a_{1,1}}{a_{1,0}} \cdot \frac{a_{2,1}}{a_{2,0}} \cdot \ldots \cdot \frac{a_{n,1}}{a_{n,0}} = I_{a_1} \cdot I_{a_2} \cdot \ldots \cdot I_{a_n} = \prod_i I_{a_i} \tag{1}$$

$$I_x^{\left(\sum_i \Delta x_{a_i}/\Delta y_x\right)} = \prod_i I_{a_i} \tag{2}$$

$$\left(\sum_i \Delta x_{a_i}/\Delta y_x\right) \cdot \ln I_x - \sum_i \ln I_{a_i} \tag{3}$$

$$\sum_i \Delta x_{a_i} = \frac{\sum_i \ln I_{a_i}}{\ln I_x} \cdot \Delta y_x \tag{4}$$

$$\Delta x_{a_i} = \frac{\ln I_{a_i}}{\ln I_x} \cdot \Delta y_x \tag{5}$$

where x_0 is the basic value of analyzed indicator x, x_1 is the current value of analyzed indicator x, a_i are analytical factors, y is immediately previous synthetic factor, and I denotes index.

Using functional method one can determine discrete revenue (DV, Rx). Taking into account four indicators, calculation is given by equations (8), (9), (10), (11). Functional method, in which are applied two indicators, is given by equations (6), (7), (12), (13):

$$\Delta X_{\to a} = X_0 \cdot \frac{\Delta a}{a_0} \cdot \left(1 + \frac{\frac{\Delta b}{b}}{2}\right) = X_0 \cdot DV_a \cdot \left(1 + \frac{DV_b}{2}\right) \tag{6}$$

$$\Delta X_{\to b} = X_0 \cdot DV_b \cdot \left(1 + \frac{DV_a}{2}\right) \tag{7}$$

$$\Delta X_{\rightarrow a} = X_0 \cdot DV_a \cdot \left(1 + \frac{DV_b + DV_c + DV_d}{2}\right) + \frac{(DV_b \cdot DV_c) + (DV_b \cdot DV_d) + (DV_c \cdot DV_d)}{3} + \frac{DV_b \cdot DV_c \cdot DV_d}{4} \quad (8)$$

$$\Delta X_{\rightarrow b} = X_0 \cdot DV_b \cdot \left(1 + \frac{DV_a + DV_c + DV_d}{2}\right) + \frac{(DV_a \cdot DV_c) + (DV_b \cdot DV_d) + (DV_c \cdot DV_d)}{3} + \frac{DV_a \cdot DV_c \cdot DV_d}{4} \quad (9)$$

$$\Delta X_{\rightarrow c} - X_0 \cdot DV_c \cdot \left(1 + \frac{DV_a + DV_b + DV_c}{2}\right) + \frac{(DV_a \cdot DV_b) + (DV_a \cdot DV_d) + (DV_b \cdot DV_d)}{3} + \frac{DV_a \cdot DV_b \cdot DV_d}{4} \quad (10)$$

$$\Delta X_{\rightarrow d} = X_0 \cdot DV_d \cdot \left(1 + \frac{DV_a + DV_b + DV_c}{2}\right) + \frac{(DV_a \cdot DV_b) + (DV_b \cdot DV_c) + (DV_a \cdot DV_c)}{3} + \frac{DV_a \cdot DV_b \cdot DV_c}{4} \quad (11)$$

where X is the synthetic indicator (in this paper ROE), X_0 is the basic value of analyzed indicator x, DV means discrete revenue, and a, b, c, d are analytical factors.

Functional method, in which are applied two indicators, is given by equations (12), (13), (14). According to Zmeškal, Dluhošová and Tichý (2013), discrete revenue is denoted as Raj $=\Delta a_j/a_{j0}$ a $Rx=\Delta x/x_0$. This method removes the problem of negative indexes of the indicators.

$$\Delta x_{a_1} = \frac{1}{R_x} \cdot R_{a_1} \cdot \left(1 + \frac{1}{2} \cdot R_{a_2}\right) \cdot \Delta y_x \quad (12)$$

$$\Delta x_{a_2} = \frac{1}{R_x} \cdot R_{a_2} \cdot \left(1 + \frac{1}{2} \cdot R_{a_1}\right) \cdot \Delta y_x \quad (13)$$

$$\Delta x_{a_1} = \frac{1}{R_x} \cdot R_{a_i} \cdot \left(1 + \sum_{j \neq i} \frac{1}{2} + \sum_{j \neq i} \sum_{\substack{k \neq i \\ k > j}} \frac{1}{3} \cdot R_{a_j} + \sum_{j \neq i} \sum_{\substack{k \neq i \\ k > j}} \sum_{\substack{m \neq i \\ m > k}} \frac{1}{4} \cdot R_{a_j} \cdot R_{a_k} + \ldots\right) \cdot \Delta y_x \quad (14)$$

3. RESULTS AND DISCUSSION

In the following text, on the basis of a detailed analysis, the impact of analytical indicators on the synthetic indicator of return on equity is quantified. Here are calculated impacts for 138 companies which taking into account the volume of their sales represent almost the entire manufacturing electrical engineering industry.

In the period 2013-2014, the company Visteon Electronics Slovakia, Ltd, Namestovo (established 3rd May 2014) was not included in the analysis; in the period 2014-2016, the company Panasonic AVC Networks Slovakia, Ltd, Krompachy was not included in the analysis due to the zero net turnover; in the period 2013-2016 was not included in the analysis the company Bizlink Technology, Ltd. (established 4th December 2015). In 2016, 98 electrical engineering companies have profit for the accounting period and 40 have loss.

For comparison, in the period 2014-2015, 106 non-financial corporations of electrical engineering industry were in profit; in 2014, 31 companies were in loss, in 2015, 32 non-financial corporations of electrical engineering industry had loss for the accounting period. From the per-

formed analysis resulted that in the period 2013-2014, the decline in return on equity occurred in 71 companies (52.2%); the decline in return of sales occurred in 61 companies (44.85%), and increase occurred in 75 companies (55.14%). The intensity of asset utilization positively determined 77 companies (56.6%). The increase in financial leverage influenced the ROE in 66 companies; the decrease in financial leverage negatively influenced the ROE in 70 companies. The decrease in the tax reduction of profit negatively affected 70 non-financial corporations. In the period 2014-2015, the decline in ROE indicator has occurred in 76 companies (55.74%).

In the period 2014-2015, from the analyzed group of companies, the decrease in ROS occurred in 78 companies (56.93%) and increase in 59 companies. The intensity of asset utilization positively determined 62 companies and negatively influenced 75 companies. The increase in financial leverage increased the ROE indicator in 64 companies (46.71%). Change in the ratio of the profit/loss for the accounting period and operating earnings before interest and taxes had a positive influence on 80 companies.

In the period 2015-2016, negative change in ROE indicator occurred in 84 companies (60.86%), increase in return on sales ROS occurred in 66 companies, decrease was in 70 companies. The intensity of asset utilization positively determined 66 companies (47.82%). The growth of the financial leverage caused the growth of ROE in 59 companies (42.75%). Change in the ratio of the profit/loss for the accounting period and operating earnings before interest and taxes had a positive influence in 69 companies.

Within the analyzed group of companies, in the period 2015-2016, in 44 companies (33.82%), the return on sales ROS mostly contributed to the change in return on equity ROE; in 21 companies (15.44%) ranked second; on the third place ROS influenced 23 companies (16.91%); and on the fourth place was indicated in 48 companies (35.29%). The impact of total asset turnover TAT most determining 25 companies (18.38%), this indicator occurred second place within 45 companies (33.08%), third place within 40 companies (29.41%), and fourth place within 26 companies (19.11%).

The financial leverage FL mostly contributed to the change in ROE in 30 companies (22.05%); in 33 companies (24.26%) was on the second place; as the third mostly determined factor was identified in 41 companies (30.14%) and as the fourth in 32 companies (23.52%). Table 1 lists the order of importance of the individual impacts of the particular analytical indicators on the overall ROE change over three consecutive periods.

Table 1. Ranking of the impact of factors on ROE change in the corporations from the electrical engineering industry

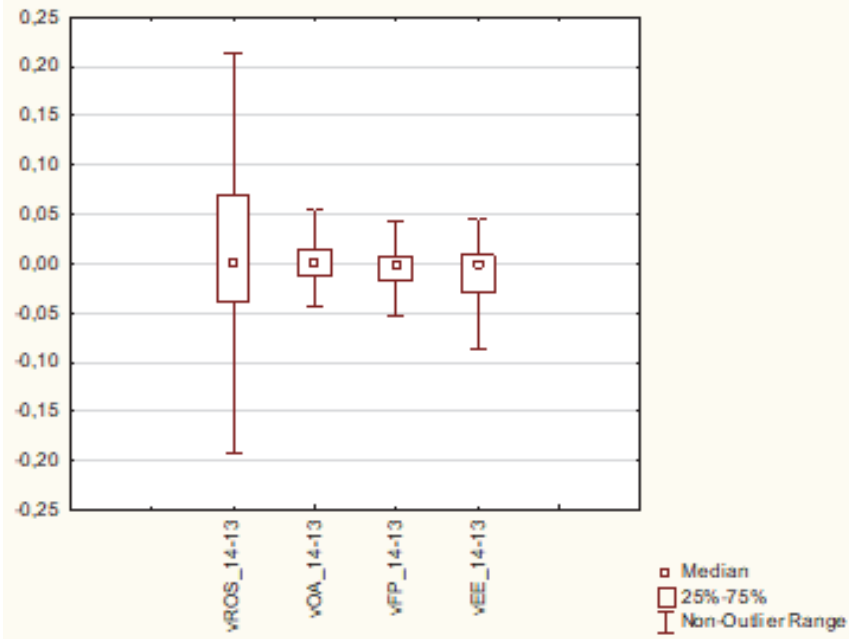
Period / Rank /	2013-2014				2014-2015				2015-2016			
Factor	1	2	3	4	1	2	3	4	1	2	3	4
ROS	47	23	24	42	58	13	13	53	44	21	23	48
TAT	34	37	40	25	25	39	47	26	25	45	40	26
FL	25	40	36	35	23	39	46	29	30	33	41	32
EAT/EBIT	30	36	36	34	31	46	31	29	37	37	32	30

Source: own compilation

If we would assume that the development of change, or the growth rate of return on equity, as well as the partial impacts of analytical indicators, will be similar within the context of dynamic decomposition, the assumption would not be confirmed. The limitation is the length of the time series. There is potential for further exploration of the dynamic model. Using the exploration data

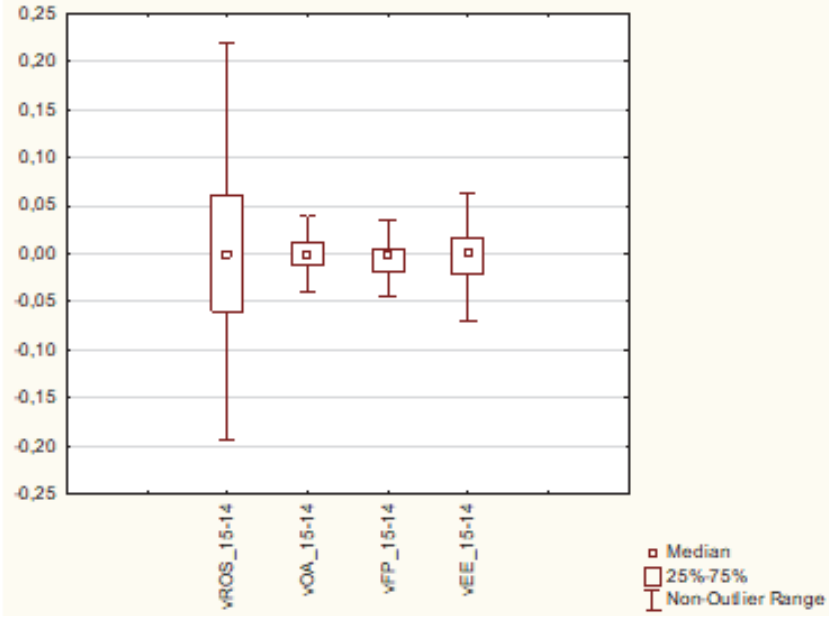
analysis, we graphically visualized the box plots that show the impact of factors (*Figure 1-3*). The box plot shows the minimum value, maximum value, lower quartile, upper quartile, and median. The graph points to outliers or extreme values. The box plot shows that values are very varied, therefore no clear conclusion can be drawn.

Graph 1. Box Plot of the impact of factors on ROE in the period 2013-2014



Source: own processing

Graph 2. Box Plot of the impact of factors on ROE in the period 2014-2015



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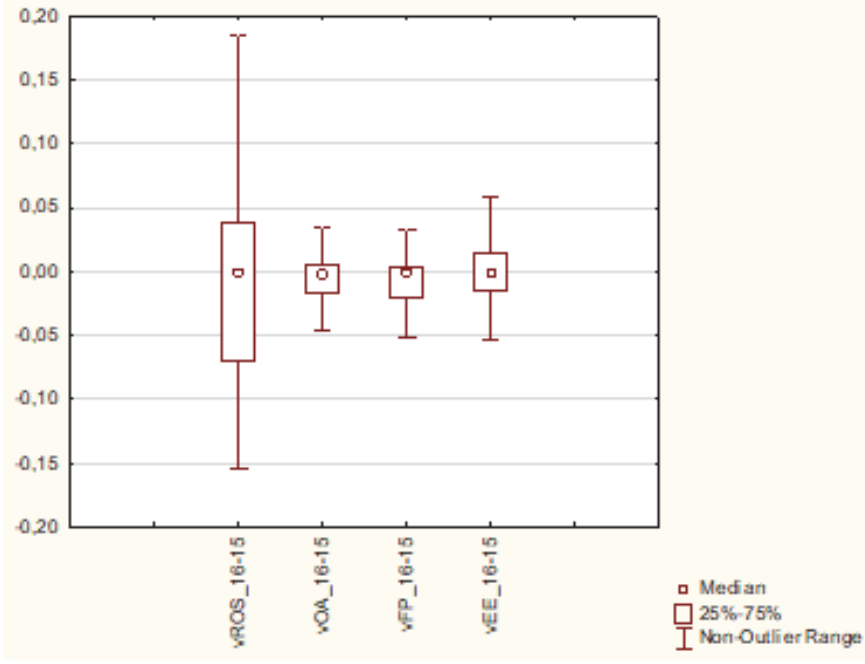
Graph 3. Box Plot of the impact of factors on ROE in the period 2015-2016



Source: own processing

CONCLUSION

In order to quantify the impact of the individual components of the financial equilibrium, we have applied methods for additive, multiplicative and combined linkages between financial indicators. Research suggests that it is still appropriate to implement a functional method that eliminates the disadvantages of other methods; i.e., the logarithmic method may have a problem with negative indexes.

The financial aspects are key factors in a process of company's development (Stefko, Gavurova, Korony, 2016). Managers are still confronted with the decision on how to allocate limited company resources in a challenging and highly competitive environment (Miron, Petrache, 2012). For professionals, accountants, or financial managers, the implementation of the system of indicators is of great importance. Financial metrics systems help financial managers to generate the concept of development, to choose the right strategy, as well as to plan all financial aspects in the short or long term. Therefore, the company's management should emphasize and increasingly implement financial models in its financial and economic analyzes.

Du Pont decomposition of the return on equity allowed quantifying the impact of the four financial indicators such as return on sales, total assets turnover ratio, financial leverage, and interest and tax profit reduction, which were linked by a multiplicative product interaction. Quantification was applied on a sample of 138 non-financial corporations of the Slovak electrical engineering industry using the methods of quantifying the influence of determining factors. It was found that the return on equity is mostly determined by profitability and indebtedness. The box plot shows that the obtained values are very varied and it follows that no clear conclusion can be deduced. There is potential for further exploration of the dynamic model. In future research, the authors will use mentioned model on a sample of non-financial corporations from the tourism sector.

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