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The Possibilities of Difference Analysis Utilisation in Profit Rate Assessment

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Abstract: *The main aim of this article is the application of selected methods of difference analysis to the chosen profit indicator of Return on Equity (ROE). First, the importance of the ROE indicator is described in the paper and then, also, the possible methods of pyramidal decomposition in multiplicative structures – ie. the method of gradual changes, the decomposition method with residue, the logarithmic method and the functional method. The pyramidal decomposition of the ROE top indicator is implemented using the functional method, the only one that can be used in the case of a negative volume index indicator and, at the same time, this method is not sensitive to the order of the factors. In conclusion, the assessment of the impact of partial analytical indicators of pyramidal decomposition on the top analysed indicator of ROE is accomplished. The degree of various influences of sub-indicators on the ROE top indicator, in the analysed periods, was different. The ROE indicator was most affected by the Sales Profitability indicator on the second level of decomposition. In the first and last assessment periods, the Sales Profitability indicator was determined by the Cost Efficiency indicator, in the first, and in the second period, by the cost of sales indicator. The partial factor Financial Leverage affected the ROE the least within the assessment period. The Tax Earnings Reduction indicator following the Interest Earnings Reduction indicator presented the stronger influence on the ROE after the Financial Leverage indicator.*

Key words: Return on Equity ROE · Pyramidal Decomposition · Functional Method

JEL Classification: C02 · G30 · Q12

1 Introduction

The basic criterion for the assessment of the profit rate is the Return on Equity ROE, also known as the Return on Invested Capital. Generally, the ROE indicator can be characterised as a ratio of profit and equity sources, invested capital. The profit, in the profitability indicators, can differ depending on whether it is: used Earnings before Interest and Taxes EBIT, Earnings before Interest EBT, Earnings after Taxes EAT or Earnings after Taxes increased by Interest Expenses. The most widely used form of earnings in the ROE indicator has become Earnings after Taxes, which best describes the transaction outcome and is not affected by the sources from which the activities of a firm are financed. The ROE indicator reflects the overall profitability of a company´s own sources and their evaluation in terms of profit. The level of the ROE indicator depends on the Total Return on Equity and the Interest Rate on Debt. The indisputable advantage of this indicator is the possible identification of substantial relations between analytic indicators and the ability to express these relations using simple mathematical operations. Then, the whole system of the Return on Equity decomposition can be created, as the top indicator, to the partial analytic indicators. This type of decomposition is known as pyramidal decomposition of ROE – ie. Du Pont Pyramidal Decomposition (Dluhošová, 2010).

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2 Literature review

One of the characteristics of the financial analytical tasks is the difference analysis of synthetic indicators and the quantification of the effects that influenced the top indicator. One possibility of how to solve the task is to apply the method of pyramid decomposition of synthetic top indicator to partial analytic indicators. The decomposition allows the identification of partial effects on the top indicator. The links within the pyramid decomposition are recorded as mathematical equations and then the whole pyramid reflects a system of equations. The most important factor for pyramidal system utilisation is the methodologically correct solution of the construction of a system of indicators and the method of quantifying the particular factors´ effects. A causal relation between the top indicator x and sub-indicators a_i is described by Forišková & Richtarová (2010) using the function:

$$x = f(a_1 + a_2 + \cdots + a_n), \tag{1}$$

This represents the effect of sub-indicators on changes observed in the selected top indicator. The top indicator difference is defined as the sum of partial effects (differences) of the analytical indicators, ie.:

$$\Delta y_x = \sum_i \Delta x_{a_i} \tag{2}$$

Where:

x Is the analysed indicator.

Δy_x Is the impact increase in the analysed indicator.

a_i Is the partial explanatory indicator.

Δx_{a_i} Is the sub-indicator effect of a_i on the analysed indicator x.

In the pyramidal decomposition, the function x (l) can be expressed by an additive or multiplicative structure (Dluhošová, 2010). The aim of this paper is the pyramidal decomposition of the ROE indicator that uses, only, a multiplicative structure of sub-indicators and then, later, the methodology of multiplicative structure will be further researched. As Zalai et al. (2000) and Zmeškal, Dluhošová & Tichý (2004) stated, within the process of pyramidal decomposition there can be applied four basic methods for multiplicative structure – the method of gradual changes, the method of decomposition with residue, the logarithmic method and the functional method.

2.1 The method of gradual changes

In this method the total difference is divided into partial effects. Generally, it is possible to quantify the sub-indicators effects for any progression as:

$$\Delta x_{a_i} = \prod_{j<i} a_{j,0} \times \Delta a_i \times \prod_{j>i} a_{j,1} \times \frac{\Delta y_x}{\Delta x} \tag{3}$$

The advantage of this method is the calculation simplicity and the residue decomposition. In contrast, the main disadvantage of this method is that the size of the effects of particular indicators depends on the sequence characteristics. The method of gradual changes is frequently used in practice, but it is always necessary to maintain the methodology and the indicators sequence.

2.2 The method of residue decomposition

Unlike the previous method, the method of residue decomposition is not affected by the indicators sequence - the decomposition is the only one and unique. The problem with this method, however, is the existence of the residual component that cannot be unambiguously interpreted and assigned to particular effects. Although, there are several ways to divide residual component influences, none of

them can be described as being the most suitable. In practice, the method is used only in the presence of the small residual component. Generally, for any number of sub-indicators the factor effect can be expressed as:

$$\Delta x_{a_i} = \Delta a_i . \prod_{j \neq i}^{n} a_{j,0} . \frac{\Delta y_x}{\Delta x} + \frac{R}{n} \quad , \tag{4}$$

where the residue is:

$$R = \Delta y_x - \Delta a \prod_{j \neq i}^{n} a_{j,0} . \frac{\Delta y_x}{\Delta x} . \tag{5}$$

2.3 The logarithmic method

The logarithmic method, at the same time, takes into account all indicators change within the explanation of particular effects, there is no problem with the indicators sequence and residue creation. The only disadvantage of this method is that it is based on logarithms of indices calculating, ie. the logarithms of indices must present a positive value. If the company makes a loss one year and achieves a profit the second year the logarithms of index cannot be calculated. This method results from continual revenue as ln I_{a_i} and ln I_x means the continual revenue of indicators a_i and x.

The effects of particular indicators are expressed as follows:

$$\Delta x_{a_i} = \frac{\ln I_{a_i}}{\ln I_x} . \Delta y_x \, , \tag{6}$$

Where: $I_x = \frac{x_1}{x_0}$ a $I_{a_i} = \frac{a_{i,1}}{a_{i,0}}$ are the indices of analysed and sub-indicators.

2.4 The functional method

The only solution, in which the logarithms of index show the negative value, is the utilisation for a particular part of branch decomposition by the functional method. The functional method takes into account the effect of all sub-indicators within the explanation of particular effects. The top indicator difference is given by the sum of differences (effects) of sub-indicators; the total difference can be expressed as:

$$\Delta y_x = \sum_i \Delta x_{a_i} \, , \tag{7}$$

Where:

x	Is the analysed indicator
Δy_x	Is the increase in the impact in the analysed indicator
a_i	Is the sub-indicator
Δx_{a_i}	Is the sub-indicator effect a_i on the analysed indicator x

The method is based on the discrete revenues R_{a_i} and R_x which are the discrete revenue of indicators a_i and x. Since the aim of this functional method is the quantifying of the sub-indicators effects, there is the question of how to reallocate common effects into particular factors – ie. how to assign the appropriate importance to particular factors. Zalai et al. (2000) mentions a number of possible ways of setting the importance – equally according to the number of sub-indicators or by the expo-

nential function $w_{a_2}^{a_2,a_3,\ldots,a_n} = e^{R_{a_1}} / \sum_i e^{R_{a_1}}$ or according to the modification $w_{a_1}^{a_2,a_3,\ldots,a_n} = e^{|R_{a_1}|} / \sum_i e^{|R_{a_i}|}$ Zalai et al. (2000), also states that there is no clear criterion for the importance option, but that, according to the author, the functional method provides more stable results which are nearest to the results obtained by means of a logarithmic method for the positive indices. Therefore, within the functional method, the best method will be chosen allocating equally according to the number of indicators. The next advantage of the functional method, as Zmeškal, Dluhošová & Tichý (2004) states, is that this method is not sensitive to the factors sequence in the calculation, which is the basic requirement for the method of gradual changes application. The functional method equation is stated by Dluhošová (2004).

$$\Delta x_{a_i} = \frac{1}{R_x} \times R_{a_i} \times (1 + \sum_{j \neq i} \frac{1}{2} * R_{a_j} + \sum_{j \neq i} \sum_{\substack{k \neq i \\ k > j}} \frac{1}{3} \times R_{a_j} \times R_{a_k} + \sum_{j \neq i} \sum_{\substack{k \neq i \\ k > j}} \sum_{\substack{m \neq i \\ m > k}} \frac{1}{4} \times R_{a_j} \times R_{a_k} \times R_{a_m} + \ldots) \times \Delta y_x$$

3 Material and Methodology

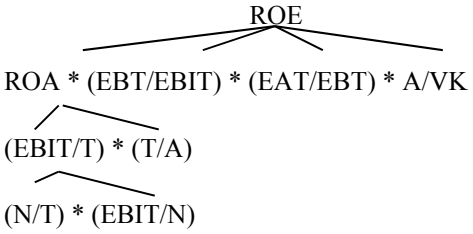
The selected companies sample consists of the 94 domestic agricultural ltd. companies within the period 2004-2007. The main criterion for selecting the domestic agricultural ltd. companies is its combined production (crop production combined with the livestock production), specified ČSÚ, where the specialisation ratio is less than 66% (which means that one single type of activity does not reach more than 66% of the total production). Another comparable criterion of the companies sample is the number of employees and the category of asset turnover, both according to CSÚ. The selected data sample contains the domestic agricultural companies with no more than 499 employees and where the asset turnover does not exceed 299 million CZK within the period 2004-2007. The data required for the pyramidal decomposition are based on the financial statements of the companies; their balance sheets and profit/loss accounts over the period 2004-2007.

The main focus of this paper is to quantify the partial effects of analytical factors (indicators) on the change of the synthetic Return on Equity indicator ROE. The pyramidal decomposition method is applied to quantify the influence of the synthetic ROE index. The pyramidal decomposition is the gradual decomposition of the top indicator into the partial, analytical sub-indicators. The result is the identification of the partial influences on the top indicator. The functional method, which is not yet commonly known and used, was applied to quantify the impact on the ROE indicator. Another reason why this method was selected is the fact that, there were negative indicators appearing during the pyramidal decomposition and, therefore, the logarithmic method could not be used. Moreover, the functional method is not sensitive to the factor order, which is the basic assumption for using the method of gradual changes. The functional method does not contain the residual component, which is created during the decomposition and it is impossible to be assigned to the partial influences. The decomposition of ROE, as presented in Selling & Stickney (1990) was chosen for the application of the functional method. According to the authors, the decomposition of ROE and the transfer to the domestic income category is as follows:

$$\text{ROE} = \text{ROA} * (\text{EBT}/\text{EBIT}) * (\text{EAT}/\text{EBT}) * \text{A}/\text{VK} \qquad (8)$$

Where ROA (Return on Assets) indicates the return of the total capital, (EBT/EBIT) indicates the interest in cases of earnings reduction, (EAT/EBT) represents the tax income reduction, (A/VK) indicates the financial leverage. The ROA indicator is further broken down into the product of sales profitability indicator (EBIT/T) and the asset turnover indicator (T/A): ROA = (EBIT/T) * (T/A).

The Sales profitability index can be further broken down to show a product of Cost of Sales (N/T) and Return on Costs (EBIT/N): EBIT/T = (N/T) * (EBIT/N). The complete pyramidal decomposition of the ROE can be characterised this way:



Quantification of the single factors, for the product of four partial indicators of the method, is possible when the weights are equally distributed according to the number of indicators. The scheme then looks like this.

$$\Delta x_{a_1} = \frac{1}{R_x} \times \left(\begin{array}{l} R_{a_1} + \frac{1}{2} R_{a_1} R_{a_2} + \frac{1}{2} R_{a_1} R_{a_3} + \frac{1}{2} R_{a_1} R_{a_4} + \frac{1}{3} R_{a_1} R_{a_2} R_{a_3} + \frac{1}{3} R_{a_1} R_{a_3} R_{a_4} + \frac{1}{3} R_{a_1} R_{a_4} + \\ + \frac{1}{4} R_{a_1} R_{a_2} R_{a_3} R_{a_4} \end{array} \right) \times \Delta y_x$$

$$\Delta x_{a_2} = \frac{1}{R_x} \times \left(\begin{array}{l} R_{a_2} + \frac{1}{2} R_{a_1} R_{a_2} + \frac{1}{2} R_{a_2} R_{a_3} + \frac{1}{2} R_{a_2} R_{a_4} + \frac{1}{3} R_{a_1} R_{a_2} R_{a_3} + \frac{1}{3} R_{a_2} R_{a_3} R_{a_4} + \frac{1}{3} R_{a_2} R_{a_4} + \\ + \frac{1}{4} R_{a_1} R_{a_2} R_{a_3} R_{a_4} \end{array} \right) \times \Delta y_x$$

$$\Delta x_{a_3} = \frac{1}{R_x} \times \left(\begin{array}{l} R_{a_3} + \frac{1}{2} R_{a_1} R_{a_3} + \frac{1}{2} R_{a_2} R_{a_3} + \frac{1}{2} R_{a_3} R_{a_4} + \frac{1}{3} R_{a_1} R_{a_2} R_{a_3} + \frac{1}{3} R_{a_2} R_{a_3} R_{a_4} + \frac{1}{3} R_{a_3} R_{a_4} + \\ + \frac{1}{4} R_{a_1} R_{a_2} R_{a_3} R_{a_4} \end{array} \right) \times \Delta y_x$$

$$\Delta x_{a_4} = \frac{1}{R_x} \times \left(\begin{array}{l} R_{a_4} + \frac{1}{2} R_{a_1} R_{a_4} + \frac{1}{2} R_{a_2} R_{a_4} + \frac{1}{2} R_{a_3} R_{a_4} + \frac{1}{3} R_{a_1} R_{a_2} R_{a_4} + \frac{1}{3} R_{a_2} R_{a_3} R_{a_4} + \frac{1}{3} R_{a_3} R_{a_4} + \\ + \frac{1}{4} R_{a_1} R_{a_2} R_{a_3} R_{a_4} \end{array} \right) \times \Delta y_x$$

The quantification of the factors, for the product of two partial indicators of the functional method, is possible under the assumption that the weights are equally distributed according to the number of indicators. If the criteria are met the scheme looks like this:

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

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

4 Results and Discussion

The following table displays the input data for the functional method. The values are the annual average of the sample, which are computed as a simple arithmetic mean.

Table 1 Input Data (Thous. CZK)

	2004[9]	2005[9]	2006[9]	2007[9]
Earnings before Taxes (EBT)	5560	4691	5080	11825
Earnings before Interest and Taxes	6928	5918	6546	13434
Earnings after Taxes	4998	4002	4344	10870
Assets	187038	194266	198309	210512
Equity	127705	131684	136480	146955
Sales	117611	115562	118732	132841
Costs	106989	105293	123199	132497

Source: Author´s own research

The three following schemes display the pyramidal decomposition of return on equity and quantify the effects of partial, analytical indicators on the analysed indicator, using the applied functional method during the reporting periods 2005/2004, 2006/2005, 2007/2006.

Picture 1 Pyramidal Decomposition ROE – 2005/2004

Indicator l	
period 0	Period 1
difference	Yield discrete
Absolute influence	

ROE	
0.03914	0.03039
-0.00875	-0.22360
-0.00875	

ROA[9]			EBT/EBIT[10]			EAT/EBT[11]			A/VK[12]	
0.03704	0.03047		0.80253	0.79258		0.89897	0.85311		1.46461	1.47524
-0.00658	-0.17756	*	-0.00995	-0.01240	*	-0.04586	-0.05102	*	0.01063	0.00726
-0.00677			-0.00043			-0.00182			0.00025	

EBIT/T[13]			T/A[14]	
0.05891	0.05121		0.62881	0.59487
-0.00770	-0.13063	*	-0.03394	-0.05398
-0.00485			-0.00192	

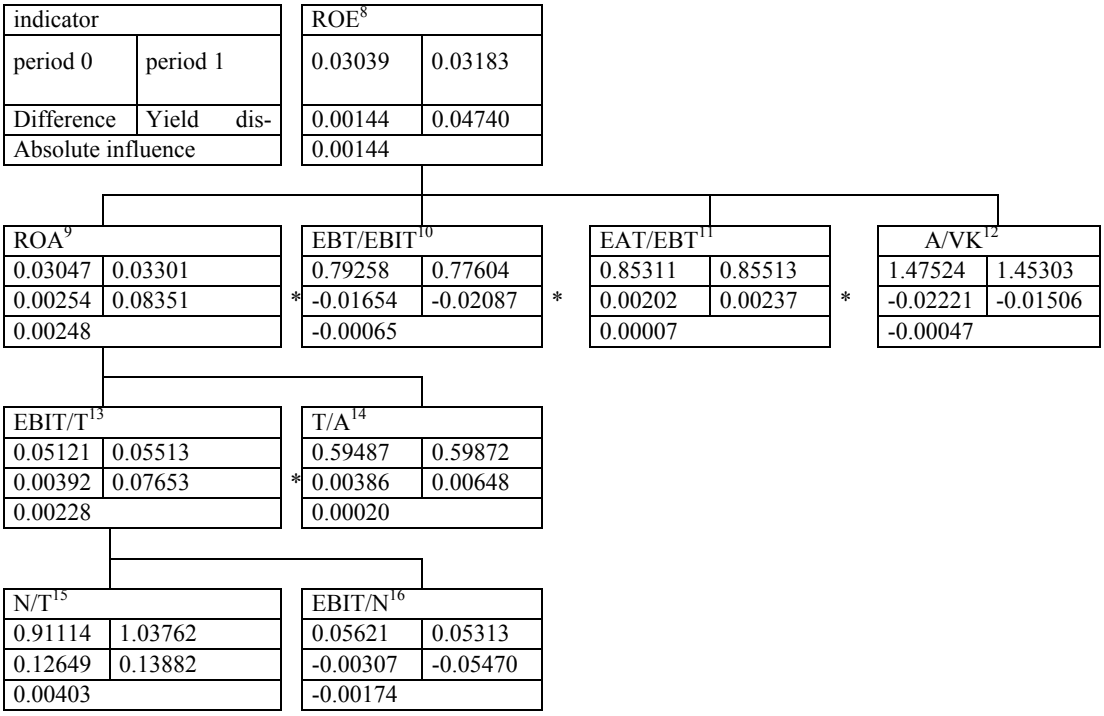
N/T[15]	
0.90969	0.91114
0.00145	0.00160
0.00006	

EBIT/N[16]	
0.06476	0.05621
-0.00855	-0.13202
-0.00490	

Notes: [7]Absolute Influence; [8]Return on Equity; [9]Return on Assets; [10]Interest on Earnings Reduction; [11]Tax Earnings Reduction; [12]Financial Leverage; [13]Sales Profitability; [14]Asset Turnover; [15]Cost of Sales; [16]Return on Costs.

Source: Author´s own research

Picture 2 Pyramidal Decomposition of ROE – 2006/2005



Notes: [8]Return on Equity; [9]Return on Assets; [10]Interest on Earnings Reduction; [11]Tax Earnings Reduction; [12]Financial Leverage; [13]Sales Profitability; [14]Asset Turnover; [15]Cost of Sales; [16]Return on Costs.
Source: Proper research

Table no. 2 summarises the results of the sub-indicators´ influence during the selected period. The sub-indicators are assigned in order based on their degree of influence on the Return on Equity index.

Table 2 The Influence of Analytical Parameters

Indicator	2005/2004		2006/2005		2007/2006	
	Influence	order	Influence	Order	Influence	order
Interest Earnings Reduction	-0.00043	4.	-0.00065	3.	0.00647	2.
Tax Earnings Reduction	-0.00182	3.	0.00007	6.	0.00373	3.
Financial Leverage	0.00025	5.	-0.00047	4.	-0.00074	6.
Asset Turnover	-0.00192	2.	0.00020	5.	0.00267	4.
Cost of Sales	0.00006	6.	0.00403	1.	-0.00202	5.
Return on Costs	-0.00490	1.	-0.00174	2.	0.03190	1.
Total	-0.00876	---	0.00144	---	0.04201	---

Source: Proper research

Picture 3 Pyramidal Decomposition of ROE – 2007/2006

Indicator	
Period 0	Period 1
Difference	Yield discrete
Absolute influence	

ROE[1]	
0.03183	0.07397
0.04214	1.32383
0.04214	

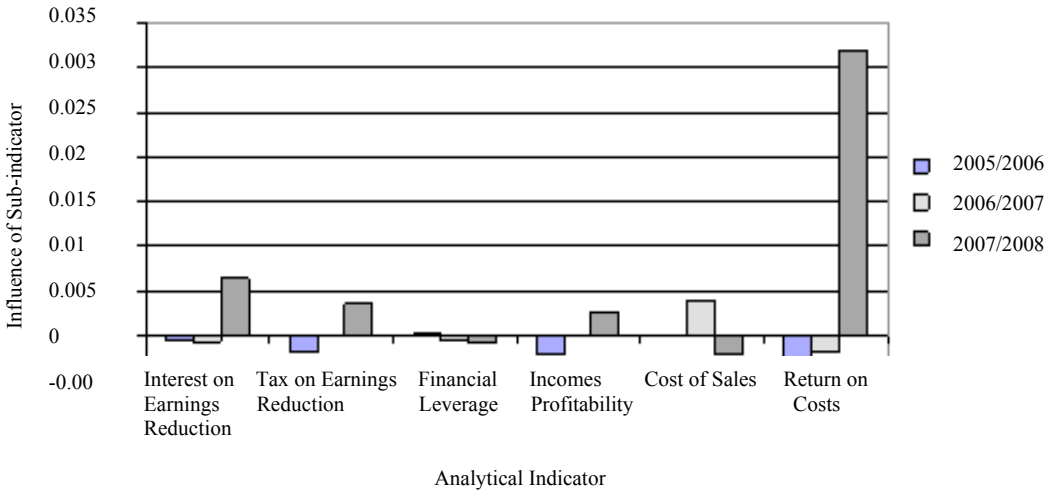
ROA[2]			EBT/EBIT[3]			EAT/EBT[4]			A/VK[5]	
0.03301	0.06382		0.77604	0.88020		0.85513	0.91922		1.45303	1.43249
0.03081	0.93329	*	0.10417	0.13423	*	0.06409	0.07495	*	-0.02054	-0.01413
0.03255			0.00647			0.00373			-0.00074	

EBIT/T[6]			T/A[7]	
0.05513	0.10113		0.59872	0.63104
0.0460	0.8343	*	0.0323	0.0540
0.02988			0.00267	

N/T[8]		EBIT/N[9]	
1.03762	0.99741	0.05313	0.10139
-0.04021	-0.03875	0.04826	0.90824
-0.00202		0.03190	

Notes: [1] Return on Equity; [2]Return on Assets; [3] Interest on Earnings Reduction; [4] Tax on Earnings Reduction; [5] Financial Leverage; [6] Sales Profitability; [7]Asset Turnover; [8] Cost of Sales; [9]Return on Costs.
Source: Proper research

Picture 4 Influence of sub-indicators



Source: Author´s own research

Picture 4 clearly shows that the degree of influence concerning the sub-indicators changed in a given period of time. In 2005/2004, there was a decrease of 22.36% in the ROE (ie. decrease by 0.00875) in the first wave of the equation decomposition. This was, mainly, due to the decrease in the Return on Assets, by 77 % (0.0067), by a 21 % decrease in Tax Earnings Reduction (0.00182), a

5% decrease in Interest Earnings Reduction (0.00043) and by a 3% increase in the Financial Leverage indicator (0.00025).

In 2006/2005, the 4,7% increase in the ROE (0.00144 increase) in the first wave of the equation decomposition, was caused, mainly, by a 173% increase in the Return on Assets index (0.00248), a 45% decrease in the Interest Earnings Reduction index (0.00065), a 33% decrease in Financial Leverage (0.00047) and a 5% increase in the Tax Earnings Reduction (0.00007).

In the last period, 2007/2006 a 132.4% increase in the ROE (0.04214 increase) in the first wave of the equation decomposition, was caused, mainly, by a 77% increase (0.03255) in the Return on Assets, a 15% increase in the Interest Earnings Reduction index (0.00647), a 9% increase in the Tax Earnings Reduction (0.00373) and a 2% decrease in the Financial Leverage index (0.0007).

In the second level of the Pyramidal decomposition of the Return on Equity, the influence was visibly more clear. It can be stated that the Return on Assets was formed, by at least three quarters, by the Sales Profitability indicator.

In the third level of the pyramidal decomposition, the Sales Profitability, in the first and the third period, was influenced, mainly, by the Return on Costs index. The Cost of Sales index influenced the Sales profitability only by 1% in the first period and by 5% in the last period. The opposite situation occurred in the second period. The major sub-indicator influences can be characterised in this way: in 2005/2004 and 2007/2006 the change in Return on Equity was influenced, mainly, by the change in the Return on Costs index. In the 2006/2005 period, the ROE index was influenced, mainly, by the absolute influence of the Cost of Sales indicators.

5. Conclusion

From the decomposition of the top indicator of Return on Equity the following conclusion can be drawn. Return on Equity is influenced by Return on Assets, taxation and by the debt, where the debt influence on ROE is expressed as the Financial Leverage index and Interest Earnings Reduction. The increase in the indebtedness is automatically reflected as an increase in the Financial Leverage index. However, at the same time, an increase in the share of foreign capital brings an increase in the Cost of Interest and causes the decrease of the Interest Earnings Reduction partial index. Thus, it depends on which factor is the dominant one, in deciding if the reduction in the profit decreases the advantage of the Financial Leverage or not. The influence of the analytical indicators on the analysed top indicator of ROE, in the three periods, looked like this. Firstly, it is good to mention that the influence rate of the sub-indicators on the top indicator changed during the periods. Nevertheless, it is still possible to summarise the overall order of influence of the sub-indicators within three periods. Undoubtedly, it is obvious that the ROE was mainly influenced by the Sales Profitability indicator in the second level of the decomposition. Furthermore, the Sales Profitability indicator was, in the first and third periods, set by the Return on Costs indicator, in the first, and in the second period it was set by the Cost of Sales indicator. The Sub-indicator, Financial Leverage, influenced the ROE the least of all the indicators. The Tax Earnings Reduction index had a slightly greater impact on the ROE than the Financial Leverage, followed by the Interest Earning Reduction index.

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