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Causal analysis of determinants influencing the Economic Value Added (EVA) – a case of Polish entity

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Abstract

The aim of the paper is to use a modified method of partial differences with the Taylor series to explain the impact of various factors on the change of EVA. The assumption was that every company is in a different financial condition, so the impact of various factors on the EVA change is different. In case of studied company, in subsequent three years, different influences of various factors are observed, both of individual and combined factors as well. It means that for each company and each year managers should consider the factors that influence the EVA change.

Keywords: economic value added, EVA, determinants, deterministic method, partial differences method.
JEL Classification: G32, G12, M21, C10, C02.

Introduction

In recent years, we have seen more and more pressure on the boards of companies to show a rise in the value of their company in the context of shareholder value. Shareholders are directly interested in the size of generated values. Managers should systematically follow information about value of the company, so that they would be able to make financial, organizational, marketing and allocative decisions through which an increase in company value will be obtained.

The book value of the company illustrates the value of its assets in terms of the balance sheet on a specific day, which is a major drawback of such an assessment because it relates to historical data, and an analysis based upon them is retrospective in nature. The economic value informs about the profitability strength of the company within a given time horizon, which increases the usefulness of this instrument in the process of managerial decisions.

Management aimed at increasing the economic value requires determining and understanding factors, on which the generated value depends. For this purpose, it is necessary to perform analysis with different degrees of detail. Such an analysis can be carried out at the level of the basic equation for the economic value, or this equation can be transformed analogically to the du Pont formula. Also, an analysis can be conducted according to the most basic components that create the ultimate economic value (starting with revenues from sales and incurred variable and fixed costs). It is difficult to say what level of detail is the best. It seems that in each case the decision should be taken by decision makers.

The aim of this article is to use a modified method of partial differences with Taylor series to explain the impact of various factors on the EVA change on the example of one of the largest companies in the mining and metallurgical industry in Poland. Using this method, managers are acquainted with not only factors influenced the EVA change, but also the extent to which these factors explain changes. This will allow them (where possible) to react and control some factors that influence the growth of EVA. In most cases, calculations can be limited to determining the effect of individual factors, although in some cases the effect of combined factors should be identified.

The assumption is that although it can be to some extent determined which factors affect the EVA change, every company is in a different financial condition, so the impact of various factors on the EVA change is different. Majority of methods is based on a regression analysis made for a smaller or larger group of companies. Usually the analyses concern specific sector of publicly listed companies, e.g. China's Security Market [Chen & Qiao 2008], Telecom Operators in China [Li & Tang 2011], Consumer Product Sector (Indian Market) [Deene & Balappa 2007], JSE Securities Exchange (South Africa) [Hall 2002], Indonesia Stock Exchange [Khadafi & Heikal 2014], Bucharest Stock Exchange Market [Tabara & Vasiliu 2013]. However, the results presented in these studies differ (sometimes) significantly. One can therefore conclude that the factors influencing EVA vary in different countries and different sectors. According to the author, these factors are also different for each company. Therefore, it seems that it is pointless to use regression analysis for a set of companies. These factors should be identified for each company individually. For this purpose, the deterministic methods of cause and effect analysis can be used, however, their limitation should be taken into account. Among these methods, perhaps only consecutive substitution method is used to determine the factors of EVA change [Bluszcz & Kijewska 2016; Trandafir 2015; Petrescu & Apostol 2009; Burja & Burja 2009]. While this method is relatively simple, the influence of substitutions order on the results is its disadvantage. Therefore, in this study the modified method of partial differences with Taylor series is proposed to explain the impact of various factors on the EVA change.

The next part of the paper is composed of three sections. Sections 1 presents different approaches to analyses of EVA in other works as well as the methods used to identification determinants of EVA. The description of method that is used in analysis is presented in Section 1. The results and key findings of the research and discussed in Section 3. The paper is closed with concluding remarks and comments to the assumptions.

1. Literature review

The concept of economic value added has found widespread acceptance relatively recently, however, as Peter F. Drucker [1995] writes, this concept is based on something that has long been known: "what we generally call profits, the money left to service equity, is usually not profit at all. Until a business returns a profit that is greater than its cost of capital, it operates at a loss".

1.1. Approaches to analyses of EVA

Economic Value Added (EVA)[1] has gained in popularity after the publication of Stewart's book [1991], "The Quest for Value". This gave rise to many scientific studies as well as discussions relating to many aspects of economic value. The most popular aspects concern the relationship of EVA and share prices or stock returns [Farsio et al. 2004; Garvey & Milbourn 2000; Visaltanachoti et al. 2008], others concern the relationship of EVA and MVA (Market Value Added) [Stewart 1991; Kramer & Pushner 1997; Lehn & Makhija 1997], or value-based management and EVA [Athanassakos 2007; Weissenrieder 1997]. There are plenty of publications on the very concept of EVA, methods of calculation and comparisons with other measures [Pal & Sura 2007; Young 1997; Shil 2009]. It is worth noting at least two papers, in which the authors make extensive review of literature on these subjects [Worthington & West 2001; Sharma & Kumar 2010]. There are some publications which analyze different factors affecting the EVA.

[1] EVA® is a registered trademark of Stern Stewart & Co.

The method of regression analysis and factor analysis are most often used in the analysis of the factors influencing the EVA. For example, a multiple regression analysis was used to investigate the factors influencing EVA for a set of more than 100 companies and for the period of 10 years in [Hall 2002] and for companies listed in China's security market [Chen & Qiao 2008]. Also, regression analysis was performed for 65 Romanian companies listed on the Bucharest Stock Exchange Market [Tabara & Vasiliu 2013]. In some publications one of the deterministic methods - the method of consecutive substitutions was used [Bluszcz & Kijewska 2016; Trandafir 2015; Petrescu & Apostol 2009; Burja & Burja 2009].

Deterministic methods of casual analysis are quite often used for economic phenomena. Causal analysis lies in determining the factors influencing the studied economic indicator, and then evaluating the size of impact of these factors on the other deviations. Among deterministic methods of causal analysis most frequently mentioned are consecutive substitutions, differentiation, residues, partial differences, indicator method, the proportional distribution of deviations, cross-functional substitutions and logarithmic method [Bednarski et al. 1996, pp. 42-58; Żwirbla 2007, pp. 21-78; Jerzemowska (ed.) 2013, pp. 29-33; Żwirbla 2014]. These methods are of different labor-intensity, mathematical correctness and practical usefulness. Some of the deterministic methods that can be used to evaluate the various factors affecting the economic phenomena (but not EVA) are described in [Miculeac & Cechin-Crista 2014; Filatov & Nechaev 2014; Filatov & Ryabchenkova 2014].

Among the deterministic methods mentioned earlier, consecutive substitutions and residues methods are relatively simple. However, their main disadvantage is the impact of the order of substitutions on the results. In addition, conventional way of connecting combined with individual deviations distorts the results [Waśniewski & Skoczylas 2002, pp. 48-49]. Similarly, the functional method has, albeit to a lesser extent, also disadvantages. Logarithmic method gives quite good results, but in case of handling with negative financial indicators, it cannot be applied. The method of partial differences in their traditional form although has many advantages, it raises a few objections, which are broadly covered Żwirbla [2014]. Hence, a modified method of partial differences with the Taylor series is proposed.

1.2. Decomposition of Economic Value Added

Economic Value Added (EVA) is based directly on the assumption that value creation for owners occurs only when the profits generated by resources involved exceed the cost of capital employed. In its simplest form, EVA can be defined as the difference between operating profit after tax (NOPAT) and the weighted average cost of capital invested, expressed in monetary units. This definition can be expressed by formulas [Hawawini & Viallet 2007, p. 545]:

$$EVA = NOPAT - WACC \cdot IC \tag{1}$$

or

$$EVA = \left(ROIC - WACC\right) \cdot IC \tag{2}$$

where:
NOPAT – Net Operating Profit After Taxes,
IC – Invested Capital at the beginning of the period (year),
ROIC – Return on Invested Capital,
WACC – Weighted Average Cost of Capital.

In practice, Stern Stewart & Co. makes a large series of adjustments. In this paper this aspect is omitted.

With so written formula for EVA we can conclude that there are four main actions that maximize the economic value. They are as follows [Karame 2009; Scott 2001]:

1) To improve the operations and efficiency through an increase in *NOPAT* margin (return on *NOPAT*). This can be achieved by, i.a., reducing production costs, improving processes, producing according to the principle of Just-in-Time. Such techniques as Lean Manufacturing, Six Sigma, Kanban, TQM, etc., would be helpful.
2) To reduce the amount of capital invested. This means selling assets, reducing management costs, or maintaining the current level of sales while reducing working capital and fixed assets turnover.
3) To optimize the capital structure; for example, to increase the debt in relation to equity, as far as it will decrease the *WACC* and does not put at risk the flexibility and security of the company.
4) To invest capital profitably by allocating it in such a way that the value will be created. Possible activities include the acquisitions that generate value, investing in projects that generate a positive *NPV* or investment in marketing or research and development.

The *WACC* in formulas (1) or (2) is calculated as [Hawawini & Viallet 2007, p. 338]:

$$WACC = r_E \cdot \frac{E}{V} + r_D \cdot (1 - T) \cdot \frac{D}{V} \tag{3}$$

where:
r_E – cost of equity,
r_D – cost of debt (interest-bearing),
E – equity,
D – interest-bearing debt,
T – tax rate,
V – enterprise value equal to the sum of invested equity and interest-bearing debt.

The product of the weighted average cost of capital (*WACC*) and invested capital (*IC*) in the formula (1) means a charge of equity expressed in monetary units.

A condition for performing the causal analysis is to identify factors that we take into consideration in that analysis. Hence the need for the decomposition of the formula for EVA according to the assumed level of the detail.

Going back to the formula (2) return on invested capital (*ROIC*) can be expressed as the product of two indicators:

$$ROIC = \frac{NOPAT}{IC} = \frac{NOPAT}{S} \cdot \frac{S}{IC} \tag{4}$$

where:
S – sales (sales revenue)
$\frac{NOPAT}{S}$ – profit margin,
$\frac{S}{IC}$ – capital invested turnover.

Consequently, the EVA can be written in the form:

$$EVA = \left(\frac{NOPAT}{S} \cdot \frac{S}{IC} - WACC \right) \cdot IC \tag{5}$$

According to Rappaport [1999, p. 65], there are seven value drivers: increase in sales growth, increase in operating profit margin, reduction in tax payments, reduction in fixed capital investment, investment reduction in working capital, value growth duration and reduction in cost of capital. In this study four factors from formula (5) are taken into consideration. Looking at this formula *NOPAT*, *S*, and *IC* are obtained from financial statements of the analyzed company. But the calculation of the *WACC* is a more difficult problem. In the literature, we can find some approaches for calculating the *WACC* components, i.e. cost of equity and cost of debt. The approach based on Capital Assets Pricing

Model (*CAPM*) and procedure of calculating *WACC* for the same company is presented in [Bluszcz et al. 2015].

Cost of equity k_E can be calculated as [Damodaran 2015]:

$$k_E = R_f + ERP \times \beta \tag{6}$$

where:
R_f – risk-free rate of return,
ERP – equity risk premium,
β – coefficient measuring the market risk.

In practice, estimating cost of debt r_D is based on a knowledge of the conditions for granting the loan on the market in a given period. Analysts (in Poland) usually take *3M WIBOR* plus a risk premium, which lenders require. Generally accepted level of the risk premium is 0.5%.

In the analysis presented in the following sections for clarity and to simplify calculations, the weighted average cost of capital (WACC) is treated as a single factor, without breaking it according to the formula (3).

2. Research methodology

Causal analysis is used in situations of a detailed analytical study, which seeks to determine the impact of certain factors on the basis of deviations found during the comparative analysis. It involves mainly [Jerzemowska 2013, p. 29]:
- identification of factors affecting the investigated economic indicator,
- calculation of the size of impact of various factors on the deviation resulted from the previous comparisons.

As noted earlier in a causal analysis of economic phenomena, different deterministic methods can be used. However, as noted in the Literature review, there is no perfect method, each has some drawbacks. In this study, after considering the advantages and disadvantages of these methods [Wędzki 2009, pp. 444-445; Żwirbla 2007, pp. 21-78; Dobija 1988] the method of partial differences was chosen to analyze the factors influencing the EVA, but introducing some modifications.

Partial differences method in its traditional form involves the simultaneous isolation of the partial individual deviation and partial deviations that express combined influence of factors and then treating them as separate elements of analytical study.

In its basic version, in case of two factors the procedure should be as follows:
- to calculate the effect of the change of the first factor, on the assumption that the second factor has the value taken as a reference base,

– to determine the effect of the change of the second factor, assuming that the first factor has the value taken as the reference base,
– to calculate the impact of both factors together.

In case of a larger number of factors (e.g. three), the task becomes even more complex; the above steps must be performed for a change of each factor, as well as the combined deviation of each of all factors.

Hence, in this study, the modified method of partial differences by using Taylor series was utilized, which was proposed by Wójtowicz [2014]. Such a modified method has the advantage that it frees us from the problems associated with the character of the studied analytical function and allows for the resignation of the total deviation analysis. What's more, in some cases, one can resign from the analysis of the cumulative impact of factors.

The starting point is to assume that the aim is to analyze the difference R:

$$R = f\left(x_1^1, \ldots, x_n^1\right) - f\left(x_1^0, \ldots, x_n^0\right) \tag{7}$$

where:
$f(x_1, \ldots, x_n)$ – studied function of n arguments,
$x_1, \ldots, x_n$ – arguments representing the alleged factors shaping the tested function.

Index (^{1}) indicates the current value of the function f (at point P_1) and index (^{0}) is the base of comparisons (at point P_0).

The difference (7) can be represented as the sum of the partial differences caused by the influence of changes of individual factors. Using methods of mathematical analysis, one can conclude that if the partial derivatives of the function $f(x_1, x_2)$ are in a certain neighborhood of the point and are continuous as functions of x_1, x_2, then (for two variables):

$$R = f\left(x_1^0 + \Delta x_1, x_2^0 + \Delta x_2\right) - f\left(x_1^0, x_2^0\right) = f'_{x1}\left(x_1^0, x_2^0\right)\Delta x_1 + f'_{x2}\left(x_1^0, x_2^0\right)\Delta x_2 + r\left(\Delta x_1, \Delta x_2\right) \tag{8}$$

wherein:

$$\lim_{(\Delta x1, \Delta x2) \to (0,0)} \frac{r\left(\Delta x_1, \Delta x_2\right)}{\left|\left(\Delta x_1, \Delta x_2\right)\right|} = 0 \tag{9}$$

Conditions (8) and (9) mean that a finite increment of differentiable function may well be approximated by using a linear function of increments of independent variables $\Delta x1$, $\Delta x2$ with error $r(\Delta x1, \Delta x2)$, which tends to zero if $\Delta x1 \to 0$, $\Delta x2 \to 0$. Using the theorem of Lagrange, the increments of any economic size can be analyzed [Wójtowicz 2014].

From the point of view of financial analysis, there is no need to make assumptions about the general form of the function *f*, also, the order of calculating increments (as is in the case e.g. in the method of consecutive substitutions) does not matter.

Taking into account the relevant assumptions and having the value of the function *f* at the point P_0, its value can be presented at any point *P,* which belongs to a certain interval as:

$$f(P) = f(P_0) + \frac{df(P_0)(\Delta x_1, \Delta x_2)}{1!} + \frac{d^2 f(P_0)(\Delta x_1, \Delta x_2)}{2!} + \cdots + \frac{d^n f(P_0)(\Delta x_1, \Delta x_2)}{n!} \quad (10)$$

This series can be a useful tool for studying the impact of various factors on the value of the EVA. The value of the function *f* at the point P_0 is known (i.e. EVA for the first year included in the analysis, and thus being the base of the comparison), and at the point P_1, (i.e. EVA for the following year covered by the analysis). This impact can be estimated by approximation of the function by Taylor series. Due to the series properties obtained results are independent of the order of substitution. Also, the form of the function *f* is not a limitation. The difficulty occurs when the number of factors is large, then it might be necessary to designate several higher order derivatives.

3. Research findings and results

To examine the real impact of factors on the achieved EVA the analysis was carried out on the example of one of the companies from mining and metallurgy industry – KGHM Polska Miedź S.A. (KGHM). This company is a global producer of copper and silver with over 50 years of experience and is a company listed on the Warsaw Stock Exchange. The analysis was conducted for the years 2011-2014. The basic financial numbers were obtained from officially published financial statements and then appropriately processed.

Table 1 presents some financial data from financial statements or calculated according to the previous formulas. Further calculations were based upon them.

Table 1. Some financial values and ratios for KGHM

Specification	2011	2012	2013	2014	Change 2012/2011	Change 2013/2012	Change 2014/2013
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Equity (mn €)	5.296	5.360	5.561	5.990	64	201	429
Debt (mn €)	640	1.780	1.619	2.180	1.140	-162	561
Invested Capital (IC)* (mn €)	4.504	5.936	7.140	7.180	1.204	39	990
Equity share	0.89	0.75	0.77	0.73	-0.142	0.024	-0.041

Table 1 cont.

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Debt share	0.11	0.25	0.23	0.27	0.142	-0.024	0.041
Sale (mn €)	6.452	6.807	5.927	5.112	355	-881	-815
NOPAT (mn €)	2.646	1.165	744	694	-1.481	-422	-49
Cost of Equity (%)	16.18	14.24	12.78	12.37	-1.94	-1.46	-0.41
Cost of Debt (%)	4.17	4.07	2.52	2.39	-0.10	-1.54	-0.14
WACC (%)	14.88	11.70	10.47	9.71	-3.18	-1.24	-0.76
ROIC (%)	58.75	19.63	10.41	9.67	-39.12	-9.21	
NOPAT/S	0.41	0.17	0.13	0.14	-0.24	-0.05	
S/IC	1.43	1.15	0.83	0.71	-0.28	-0.32	
Net profit (mn €)	2.673	1.139	720	585	-1.535	-419	
EVA (mn €)	1.976	470	−3.82	−2.6	-1.506	-474	

To expand function (5) in the Taylor series, the partial derivatives of the first order at the point P_0 should be determined:

$$\frac{\partial EVA}{\partial F1} = F2 \times IC; \ \frac{\partial EVA}{\partial F2} = F1 \times IC; \ \frac{\partial EVA}{\partial WACC} = -IC; \\ \frac{\partial EVA}{\partial IC} = F1 \times F2 - WACC \tag{11}$$

where:

$F1 = \frac{NOPAT}{S}$, $F2 = \frac{S}{IC}$.

According to formulas (11), appropriate calculations for each year were conducted and presented in Tables 2, 3, and 4. The first component of the Taylor series multiplied by changes of a given factor allowed us to calculate the alleged impact of changes in the factors on the real value of EVA. Also, their relative impact on EVA was calculated.

Table 2 shows that the first component of Taylor series explains 86% (-1,298.29 mn €) of change in the value of EVA in 2012. The greatest negative impact had a decrease of the operating margin (–119%).

Table 2. The impact on EVA in 2012 as compared to 2011 (for the first-order derivatives)

Factor affecting the EVA	Derivative of EVA_0 (mn €)	Change of factor	The impact of changes on EVA (mn €)	Relative impact (%)
NOPAT/S	6,452	-0.239	-1,542	-119
S/IC	1,847	-0.286	-528	-41
WACC	-4,504	-0.0318	143	11
IC	0.44	1,432	628	48
Total			-1,298.29	-100

Table 3. The impact on EVA in 2013 as compared to 2012 (for the first-order derivatives)

Factor affecting EVA	Derivative of EVA0 (mn €)	Change of factor	The impact of changes on EVA (mn €)	Relative impact (%)
NOPAT/S	6,807	-0.05	-311.03	-67
S/IC	1,016	-0.32	-321.83	-69
WACC	-5,936	-0.0124	73.48	16
IC	0.08	1,204	95.42	21
Total			-463.96	100

Table 3 shows that the first component of Taylor series explains 98% (-463,96 mn €) of change in the value of EVA in 2013. The greatest negative impact had a decline in both operating margin (-67%), and the turnover ratio of capital invested (–69%).

In 2014 compared to 2013 there was a slight increase in the value of EVA (1.26 mn €). Table 4 shows that the negative impact of *S/IC* was compensated by a positive impact of two other factors: *WACC* and *NOPAT/S*. But the first term of Taylor series explains as much as 819% of change of EVA. Therefore, in this case one should seek the combined influence of examined factors.

Table 4. The impact on EVA in 2014 as compared to 2013 (for the first-order derivatives)

Factor affecting EVA	Derivative of EVA_0 (mn €)	Change of factor	The impact of changes on EVA (mn €)	Relative impact (%)
NOPAT/S	5,927	0.010	61.34	618
S/IC	896	-0.118	-105.78	-1,065
WACC	-7,140	-0.0076	54.39	548
IC	-0.00053	39	-0.02	0.00
Total			9.93	100

Table 5 shows the cumulative impact of analyzed factors on the actual EVA after the first order differentiation.

Table 5. Identified deviations for the first-order derivatives

Specification	2012	2013	2014
Change in actual EVA (mn €)	-1,505.48	-474.11	1.21
Total identified deviation of EVA (mn €)	-1,298.29	-463.96	9.93
Total identified the relative deviation of EVA (%)	86	98	819

In case of searching for information to what extent there is a combined impact of the analyzed factors, the second term of Taylor series should be calculated, i.e. the second partial derivatives.

$$
\begin{aligned}
&\frac{\partial^2 EVA}{\partial F1^2} = 0; \qquad \frac{\partial^2 EVA}{\partial F1\,\partial F2} = IC; \qquad \frac{\partial^2 EVA}{\partial F1\,\partial WACC} = 0;\\
&\frac{\partial^2 EVA}{\partial F1\,\partial IC} = F2 = \frac{S}{IC}; \quad \frac{\partial^2 EVA}{\partial F2^2} = 0; \qquad \frac{\partial^2 EVA}{\partial F2\,\partial WACC} = 0;\\
&\frac{\partial^2 EVA}{\partial WACC^2} = 0; \qquad \frac{\partial^2 EVA}{\partial F2\,\partial IC} = F1 = \frac{NOPAT}{S};\\
&\frac{\partial^2 EVA}{\partial IC^2} = 0; \qquad \frac{\partial^2 EVA}{\partial WACC\,\partial IC} = -1.
\end{aligned}
\tag{12}
$$

Second order derivatives with respect to each analyzed factor have the value of zero, which is in line with expectations conditioned on their merits, because individual effect of each of these factors has already been identified. The formulas for symmetric derivatives (which have the same value) were omitted, and in fact we have four pairs of non-zero partial derivatives.

Tables 6-8 show the non-zero second-order derivatives and the combined values of the second component of Taylor series respectively for the following years.

In 2012, the second term of the Taylor series explains 20.3% (-304.98 mn €) of the EVA change. Table 6 shows the combined negative impact of ratios (*NOPAT/S)&(IC)* and *(S/IC)&(IC)*, and the positive impact of the other two combined groups of indicators. Together the two terms of the series explain 106.5% change of EVA.

Table 6. The combined impact on EVA in 2012 as compared to 2011 (for the second-order derivatives)

Factors affecting EVA	The second derivative of EVA_0 (mn €)	Change of factors	The impact of changes on EVA (mn €)	Relative impact (%)
(NOPAT/S)&(S/IC)	4,504.00	0.07	307.55	101
(NOPAT/S)&(IC)	1.43	-342.23	-490.25	-161
(S/IC)&(IC)	0.41	-409.19	-167.82	-55
(WACC)& (IC)	-1.00	-45.54	45.54	15
Total			-304.98	-100

The second term of the Taylor series explains 5.8% (–27,58 mn €) of the EVA change in 2013. Table 7 shows, like the year before, the cumulative negative impact of ratios (*NOPAT/S)&(IC)* and *(S/IC)&(IC)*, and the positive impact of the other two combined group of indicators. Together the two terms of the series explain 103.7% change of EVA.

Table 7. The combined impact on EVA in 2013 as compared to 2012 (for the second-order derivatives)

Factors affecting EVA	Derivative of EVA_0 (mn €)	Change of factors	The impact of changes on EVA (mn €)	Relative impact (%)
(NOPAT/S)&(S/IC)	5,936	0.01	85.91	311
(NOPAT/S)&(IC)	1.15	-55.03	-63.11	-229
(S/IC)&(IC)	0.17	-381.53	-65.30	-237
(WACC)& (IC)	-1.00	-14.91	14.91	54
Total			-27.58	-100

As previously mentioned, in 2014 there was a slight increase in EVA and the share of each factor in this change is different. While the first term of the Taylor series explained in excess change of EVA (819%), the second term compensates it to a large degree (–715%, –8,67 mn €). Together, the two terms explain 104% of the EVA change. As shown in Table 8, the biggest impact on the EVA change have combined factors (*NOPAT/S)&(IC)*.

Table 9 shows the cumulative impact of analyzed factors on the actual EVA after the second-order differentiation.

The more terms of Taylor series are counted, the more they explain the real changes of EVA. In practice, it appears that in this case it does not make much sense to examine the combined impact of three or more factors. Calculation of the third partial derivatives are here purely to show that we can explain nearly 100% of the EVA change. When calculating the partial derivatives for the third-order degree we receive six (symmetrical) non-zero values for three factors: *F1=NOPAT/S*, *F2=S/IC*, and *IC*.

$$\frac{\partial^3 EVA}{\partial F1 \partial F2 \partial IC} = 1 \tag{13}$$

Table 8. The combined impact on EVA in 2014 as compared to 2013 (for the second-order derivatives)

Factors affecting EVA	Derivative of EVA_0 (mn €)	Change of factors	The impact of changes on EVA (mn €)	Relative impact (%)
(NOPAT/S)&(S/IC)	7,140	-0.0012	-8.73	-101
(NOPAT/S)&(IC)	0.83	0.41	0.34	4
(S/IC)&(IC)	0.13	-4.66	-0.58	-7
(WACC)& (IC)	-1.00	-0.30	0.30	3
Total			-8.67	-100

Table 9. Identified deviations for the second-order derivatives

Specification	2012 (mn €)	2013 (mn €)	2014 (mn €)
1	*2*	*3*	*4*
$\dfrac{2 \times \dfrac{\partial^2 EVA \times \Delta F1 \times \Delta F2}{\partial F1 \partial F2}}{2!}$	307,55	85.91	-8.73

Table 9 cont.

1	*2*	*3*	*4*
$\frac{2\times\frac{\partial^2 EVA\times\Delta F1\times\Delta IC}{\partial F1\,\partial IC}}{2!}$	-490.25	-63.11	0.34
$\frac{2\times\frac{\partial^2 EVA\times\Delta F2\times\Delta IC}{\partial F2\,\partial IC}}{2!}$	-167.82	-65.30	-0.58
$\frac{2\times\frac{\partial^2 EVA\times\Delta IC\times\Delta WACC}{\partial IC\,\partial WACC}}{2!}$	45.54	14.91	0.30
Total	-304.98	-27.58	-8.67

Table 10 presents the combined impact of three factors on the change of EVA for subsequent years. They explain respectively –6.5%, –3.7% and –4.0% changes of EVA.

Table 11 summarizes all calculations. As can be seen from the last line the total identified deviations explain 100% of the EVA changes each year.

Table 10. Identified deviations for the third-order derivatives

Specification	2012 (mn €)	2013 (mn €)	2014 (mn €)
$\frac{6\times\frac{\partial^2 EVA\times\Delta F1\times\Delta F2\times\Delta IC}{\partial F1\,\partial F2\partial IC}}{3!}$	98	17	-8.67

Table 11. Summary of deviations

Specification	2012	2013	2014
Change in actual EVA (mn €)	-1,505.48	-474.11	1.21
Identified deviation of EVA (first-order derivate) (mn €)	-1,298.2	-463.96	9.93
Identified deviation of EVA (second-order derivate) (mn €)	-304.98	-27.58	-8.67
Identified deviation of EVA (third-order derivate) (mn €)	98.00	17.00	-0.05
Total identified deviation (mn €)	-1,505.48	-474.11	1.21
Total identified the relative deviation of EVA (%)	100	100	100

Although in 2012 and 2013 we will see some similarities when it comes to single factors influencing the EVA change, but in 2014 we should look for the impact of the combined factors. This confirms the initial assumption that every company and every year is a different situation. Each year managers should analyze the financial situation of the company and react accordingly to it. In many studies, it is assumed that the EVA determinants are universal, what is difficult to accept.

Conclusions

In recent years, the growth in the value of the company is a strategic objective of management. One of the measures of that value is the economic value added (EVA). However, it is not enough to calculate it. It is necessary in each case to analyze the factors that influenced the increase or decrease of EVA. The first step is to decide at what level of detail we want to operate. In the paper the equation for EVA was transformed in a way like du Pont formula, getting four factors. These are the operating profit margin before taxes (*NOPAT/S*), the rotation of capital invested (*IC/S*), weighted average cost of capital (*WACC*) and invested capital (*IC*). But *WACC* can be broken into such factors as cost of equity, cost of debt and share of equity in assets.

Out of the deterministic methods that can be used to causal analysis the method of partial differences was chosen, in which properties of the Taylor series were used. Its advantage is that even functions with very complex form can be used, and also the fact that the order of the calculation of increments does not matter.

The analysis was conducted basing on financial data from the 2011-2014 years. The effect of various factors on the changes in EVA was identified for years 2012-2014. As assumed, because in each year there was a different financial situation of the company, so the impact of each factors on the change in EVA was different. In the years 2012 and 2013 a negative impact on the decline in EVA had the same two factors: (NOPAT/S) and (S/IC) although to different degrees. The first component Taylor series explains 86% and 98% of change in EVA respectively in 2012 and 2013. One could stop there, though for illustration, further calculations were performed, i.e. the influence of factors combined. In these years, there was identified the influence of the same combined effect: negative impact of combined (NOPAT/S) & (IC) and (S/IC) & (IC), and the positive impact of the combined (NOPAT/S) & (S/IC). For 2014 the results were different. The relative impact of factors in the first order derivatives was extremely high: (S/IC) had negative impact, (NOPAT/S) and WACC positive, and IC none. Hence, especially in this case the calculation of the second-order derivatives had to be calculated. There was an identified impact of combined factors, i.e. positive of (NOPAT/S) & (S/IC), while others combined factors had minimal impact.

Just for illustration, and verification the correctness of calculations deviations for the for the third-order derivatives were determined.

In most cases, the analysis can be reduced to the first-order derivatives. But also, to calculate the combined impact of two or more factors is not a problem.

Presented method can be used by practitioners i.e. managers. In every company and in every year, they are dealing with different economic and financial situation of their company. Diversified results in subsequent years indicate that we cannot generalize the impact of individual factors. It means that a universal set of EVA determinants cannot be specified. Each year managers should analyze the EVA change, using e.g. presented method, and then should make decisions having regard to the positive or negative impact of obtained factors on EVA.

In Poland, according to the author's knowledge, there are no studies, in which such a thesis is assumed. There are also no studies using the deterministic methods, except for the method of consecutive substitutions. But this method is sensitive to the order of substitutions. Modified method of partial differences has no such limits. It should be noted, however, that deterministic methods, including this one presented here do not allow to consider factors that are not included in the formula for EVA, e.g. macroeconomic factors that also affect the EVA change.

Proposed method can be applied to any company, in any country and any industry. It is expected that in each case, the results will be different. It should be noted that presented method can be used to analyze any other economic indicators.

In further research the equity cost, debt cost and capital structure will be considered instead of weighed average cost of capital (WACC), hence more factors would be taken into account in the model.

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