IMPACT OF THE VALUE-ADDED INTELLECTUAL COEFFICIENT AND ITS COMPONENTS ON OVERALL PERFORMANCE OF SELECTED EUROPEAN COMPANIES

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Abstract: This paper discusses intellectual capital as one of the key determinants of companies' competitiveness and its future development. The purpose of this research is to identify the performance of intellectual capital measured by Value Added Intellectual Coefficient (VAIC^{TM}) in selected European companies, to empirically estimate the relationship between intellectual capital performance and overall performance of these companies, and examine the role of various intellectual capital components. Intellectual capital shows to have significant influence on ROE and employees' productivity but the analysis casts doubt on the VAIC as a proper measure of intellectual capital, at least from the value perspective view.

Key words: knowledge economy, intellectual capital, VAIC^{TM}, company performance, software company

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Introduction

During the industrial age, value of products was created by quantity of raw materials and physical work, companies considered natural resources and physical assets as their source of wealth. In current economy, popularly known as knowledge economy, the situation is different. Material assets are no more the only significant factor responsible for value creation. Dominant activity of economy is production of knowledge, which creates goods and services (Pulic, 2008; Pastor et al., 2015). Knowledge is the main factor influencing current growth and competitiveness (Šoltés and Gavurová, 2014; Gavurová, 2012). Unfortunately, financial statements are becoming limited and insufficient in explaining market value of the companies, and the difference between market value and book value is consistently increasing (e.g. Chen et al., 2005). It is possible to state that we have entered the epoch of intellectual value.
Knowledge itself is significant for the companies only in that case, if they are able to transform it into value creating action identifiable on the market. Only such knowledge becomes intellectual capital (IC) (Pulic, 2008). There are several similar quoted definitions of IC. For example, Stewart (1997) defined IC as intellectual material (knowledge, experience, information, and intellectual

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property) that can be used to create wealth. Other view of IC has been presented by Pulic (2008), who states that IC includes employees, who have ability of transforming knowledge into products and services creating value on the market. In spite of importance of IC in the knowledge-based economy, the identification and measurement of IC and its items in financial statements is not easy (Nimtrakoon, 2015). IC is something that cannot be touched, therefore its measure and valuation is becoming the biggest challenge. The last two decades, IC literature has shown to be of increasing attention from both, academics and practitioners (Serenko and Bontis, 2013). Moreover, many studies on relationship between IC and financial performance of different companies from different countries have been published (e.g. Bassi and van Buren, 1999; Pulic, 2004, 2008; Riahi-Belkaoui, 2003; Wang, 2008; Zeghal and Maaloul, 2010; Rahman, 2012; Chen et al., 2005; and others).

The paper discusses IC as one of the key determinants of company's competitiveness and its future development. The purpose of this paper is to investigate the relationship between IC measured by Value Added Intellectual Coefficient (VAIC^{TM}) and four indicators of market valuation and financial performance of software companies from member states of European Union. Software companies are known as ascribing special significance to intangible assets. They can have very low amount of tangible assets, but nevertheless, they are able to have outstanding sales (Brooking, 1996). Therefore it is emphasized as a sector with a need for IC.

The research paper is organized as follows. First section introduces the literature review on previous studies applying VAIC^{TM} model. Second section describes sample selection, measurement of variables and research technique. Descriptive statistics and empirical results of our regression models are mentioned in the fourth section. The conclusion of research as well as its limitations and potentials for future research are then discussed.

Literature Review

There have been developed varieties of approaches for measuring IC. The pioneer in measuring and reporting IC is Skandia Navigator™ developed by Edvinsson and Malone (1997). The method represented fundamentally new way of looking at company's value. An example of 'second generation methods' is the IC-Index^{TM}, which tries to combine all the different individual indicators into a single index, and attempts to correlate the changes in IC with changes in the market (Roos et al., 1997). Intangible Asset Monitor Approach identifies three measurement indicators: growth and renewal, efficiency, and stability for each of the three intangible assets (Sveiby, 1997). Other examples of frequently used approaches are Tobin's Q, The Value Explorer™, Calculated Intangible Value, Economic Value Added (EVA™), Market Value Added (MVA^{TM}) or Value Added Intellectual Coefficient (VAIC^{TM}) model (Pulic, 2004, 2008). This various approaches for measuring IC can be grouped into four main methods (see Sveiby, 2010).

Over the past two decades, VAIC^{TM} model attracted much attention. VAIC^{TM} is a quantifiable and relatively easily obtainable measurement of IC based on available information from financial statements. Pulic (2004) has argued that the basic indicators of industrial economy have brought an innovation in the company's performance measurement and shareholder's maximization approach, but in knowledge-based economy, they do not really show whether and how much value has been created. In 1998, Pulic came with the idea of VAIC^{TM} as a useful measurement tool of value added creating company's intellectual ability. Instead of directly measuring IC of company, the VAIC^{TM} is offered as a measure of efficiency, with which company uses its physical, structural and human capital (Pulic, 2004). For the first time, Pulic tested the model VAIC^{TM} in 2000 using data of 30 randomly selected companies from UK during the years 1992-1998. His objective was to identify the relationship between company's performance and IC. He threated employees not as a cost, but as an important asset – human capital, as the source of further development.

Many researchers have adopted the VAIC^{TM} model as a proxy of IC in analysing relationship between performance of IC and company's performance. In general, the most of the studies found positive relationship between IC or some of its components and company's performance. For example, one of the early researches by Bassi and Van Buren (1999) revealed a positive relationship between IC investment and financial performance using data of 500 American companies. Similarly Riahi-Belkaoui (2003) found a positive association between IC and financial performance using data of US multinational companies. The UK studies also have shown positive association between IC and market value (Wang, 2008) and stock market performance (Zeghal and Maaloul, 2010). Research of Rahman (2012) showed that companies with greater IC efficiency tended to have a better financial performance. Chen et al. (2005) investigated relationship between company's IC and market value. Using the sample of Taiwanese listed companies, they found a positive impact of IC measured by VAIC^{TM} on market value and financial performance. They have also emphasised the importance of IC for future financial performance.

However, not all studies support these results. Firer and Williams (2003) found a significant negative association between human resources and company's performance. Additionally, Appuhami (2007) reported non-significant association between human capital efficiency and capital gains made by investors. Further investigation on this relationship by Ting and Lean (2009) also pointed out non-significant negative relationship between component of IC - structural capital efficiency and performance of companies based on ROA. Shiu (2006) found only weak relationships between VAIC^{TM} and performance. Moreover, there is number of papers, which addressed VAIC^{TM}'s weaknesses and its limitations (e.g. Stahle et al., 2011; Chu et al., 2011; Andriessen, 2004). Analysis of Stahle et al. (2011) pointed to the validity problem related to confusion in the computation of IC' components, especially structural capital and a misapplication of IC concept. Some of the limitations have been indicated by Chu et al. (2011). They have argued that this model does not produce results for the companies having negative values of 'Value Added' and reverse link between human capital and structural capital is problematic. Andriessen (2004) has offered a critical view of this model, in which he emphasises his concerns over some of the assumptions of the model, and proved an interaction effect between the components of IC.

Research Methodology

Our dataset consisted of data of 289 software companies from member states of European Union during the period of three years. Software industry is a suitable example for understanding features of knowledge-based economy, as it faces rapid obsolescence of products more than other companies. The necessity for a high degree of product innovations is one of the mail features of this sector. Data has been downloaded from Datastream and Worldscope databases. All companies were listed on stock exchange. Companies with incomplete data have been excluded, and as a result, we have analysed 95 companies from 2013 to 2015. VAIC^{TM} and its components have been used as a measure of IC and represent our independent variables. Additionally, we have added one categorical variable – time. Company's performance is defined by four main indicators representing our dependent variables – market to book value ratio, return on assets, return on equity and employees' productivity (Chen et al., 2005).

Dependent variables

Company's performance can be measured in many different ways. For our analysis, we have chosen the following dependent variables:
First variable, Market to book value ratio (MB) measures the market value of the company relative to its book value. Edvinsson and Malone (1997) conclude that the difference between these two values is the value of IC. As concluded by several other authors (e.g. Riahi-Belkaoui, 2003; Chen et al., 2005), we suppose significant relationship between MB ratio and VAIC^{TM}, respectively its components. This indicator is calculated according to following formula $MB = MCap / SE$, where MCap represents market capitalization and SE stands for shareholder's equity.
It is expected that higher value of VAIC^{TM} eventually its components indicates higher value of financial performance indicators. We have examined relationship between three indicators, which was calculated according to following formulas:

(1) Return on Total Assets (ROA) expresses how efficiently company uses its total assets, i.e. $ROA = EBIT / TA$, where EBIT represents earnings before interest and tax and TA stands for total assets of company.
(2) Return of Equity (ROE) expresses the profitability of money invested by shareholders, i.e. $ROE = EBIT / SE$, where EBIT represents earnings before interest and tax and SE stands for shareholder's equity.

(3) Employees' productivity (EP) expresses average output of one employee within the specific period of time, i.e. $EP = EBIT / EMP$, where EBIT represents earnings before interest and tax and EMP stands for number of employees.

Independent variables

Following Pulic (2004), to measure the level of IC in companies, we applied VAIC™ model and its three components, which represent the independent variables. The VAIC™ composite coefficient consists of the sum of human capital efficiency (HCE), structural capital efficiency (SCE) and capital employed efficiency (CEE). HCE and SCE together constitute intellectual coefficient efficiency (ICE). Following equation formalize the VAIC™ algebraically:

$$VAIC^{TM} = HCE + SCE + CEE \tag{1}$$

When using VAIC™, company's ability to create 'Value Added' (VA) by the human capital must first be calculated. It has been used as a benchmark of success of a business entity. The simplest calculation of VA is calculating it as the difference between total output and total input (VA = OUT – IN), where total output represents the overall sales of company, all the products and services sold on the market. Total input contains all expenses, everything that came into the company. This indicator also has been estimated as sum of operating profit, employee cost, depreciation and amortization. The value of intellectual capital efficiency (ICE) has two components, human and structural capital. All the expenditures for employees are embraced in human capital. Therefore the model has changed and salaries and wages are no more part of input. Today, this is accepted by the most of the authorities in this field (Pulic, 2008).
One of the VAIC™ components is an indicator of human capital efficiency (HCE). It shows how much value added is created by the human capital. Human capital representing investments in knowledge workers is expressed by total labour cost. For HCE calculation, we have used the formula HCE = VA/HC. Higher value of HCE pointed to effective utilisation of human capital.
Structural capital efficiency (SCE) measures the share of structural capital in creation of value added. Structural capital is expressed as a difference between value added and human capital (SC =VA-HC). Human capital and structural capital are inversely proportional. As a result, decrease of structural capital will be accompanied by an increase of human capital. The calculation of SCE looks as follows: SCE=SC/VA. The sum of human capital efficiency and structural capital efficiency represents coefficient of an efficiency of intellectual capital (ICE).
Capital Employed Efficiency represents the value added created by one unit of physical and financial capital of company (CE). Capital employed (CE) can be defined as the book value of firm's net assets (CE = total assets – total liabilities). Formula for calculating CEE is as follows: CEE = VA / CE.

Linear Regression Analysis

We identify and estimate relationship between performance of intellectual capital measured by VAIC™ in selected companies and overall performance of these companies based on linear regression models applied by Aminiandehkordi et al. (2014); Chen et al. (2005); Clarke et al. (2011), and Gan and Saleh (2008). We used model with these dependent variables, i.e. MB, ROA, ROE or EP, and gave them in relationship with these independent variables, i.e. VAIC™, HCE, SCE, CEE and time. Table 1 presents eight regression models to determine the impact of VAIC™ and its components on chosen market valuation and financial indicators. Our analysis has been performed using statistical software R.

Table 1. Linear regression models

Model	Equation
MB1	$MB_i = \beta_0 + \beta_1 + VAIC_i + \varepsilon_i$
MB2	$MB_i = \beta_0 + \beta_1 HCE_i + \beta_2 SCE_i + \beta_3 CEE_i + time + \varepsilon_i$
ROA1	$ROA_i = \beta_0 + \beta_1 + VAIC_i + \varepsilon_i$
ROA2	$ROA_i = \beta_0 + \beta_1 HCE_i + \beta_2 SCE_i + \beta_3 CEE_i + time + \varepsilon_i$
ROE1	$ROE_i = \beta_0 + \beta_1 + VAIC_i + \varepsilon_i$
ROE2	$ROE_i = \beta_0 + \beta_1 HCE_i + \beta_2 SCE_i + \beta_3 CEE_i + time + \varepsilon_i$
EP1	$EP_i = \beta_0 + \beta_1 + VAIC_i + \varepsilon_i$
EP2	$EP_i = \beta_0 + \beta_1 HCE_i + \beta_2 SCE_i + \beta_3 CEE_i + time + \varepsilon_i$

Regression models include four models investigating relationship between aggregated VAIC™ and dependent variables, and four models expressing the relationship between components of VAIC™ (HCE, SCE, and CEE) and dependent variables. Categorical variable time is included in each model in order to define an intercept for each analysed year.

Empirical Results and Findings

Following tables (Table 2, Table 3, and Table 4) present the results of applied regression models. Empirical results from Table 2 show positive effect of VAIC™ on market to book ratio, return on equity and employees' performance. However, models MB1 and ROA1 suffered for heteroscedasticity; therefore adjustments had to be applied. Model ROE1 is able to predict 14.87 percent of profitability measured by ROE. Explanatory power of model EP1 is very low (3.514 percent).

Table 2. Regression analysis of relationship between VAIC™ and dependent variables

	Model MB1	Model ROA1	Model ROE1	Model EP1
	Estimate	Estimate	Estimate	Estimate
Intercept 2013	-0.1304	1.00272 ***	5.1119 *	6.3097*
Intercept 2014	2.52372 ***	-0.0183 ***	-4.3013 **	6.3097
Intercept 2015	-0.1304	1.00272	5.1119	6.3097
VAIC™	0.07485***	0.02311	1.5456 ***	1.0185 **
R^2	0.4787	0.1139	0.1487	0.03514

***, **,*, Indicates significant at α = 0.001, 0.01, 0.05, 0.1 level respectively

Table 3 shows estimates of regression coefficients for VAICTM components. From the reason that models MB2 and ROA2 seemingly suffer from heteroscedasticity, further interpretation in this part will focus only on models ROE2 and EP2. After testing individual effects of VAICTM components, R-Squared increased in both cases. Significant increase was observed in model EP2. Placing different values on all three components has significant effect on company's performance expressed by employees' productivity. All components of VAICTM – HCE, SCE and CEE – have statistically significant effect on 1 percent significance level. Models ROE1 and ROE2 prove importance of intellectual capital for decisions of investors.

Table 3. Regression analysis of relationship between VAIC™ *components* and dependent variables

	Model MB2	Model ROA2	Model ROE2	Model EP2
	Estimate	Estimate	Estimate	Estimate
Intercept 2013	-0.40781*	1.00207***	6.5915*	12.9911***
Intercept 2014	2.64084***	-0.05831***	-1.342**	12.9911
Intercept 2015	-0.40781	1.00207	12.9447*	12.9911
HCE	-0.06623	0.12052*	1.9210**	4.6534***
SCE	-0.16610***	0.07921	1.9903**	5.3467***
CEE	0.16798***	-0.04979	-0.5215	-3.8637***
R^2	0.4849	0.1328	0.1766	0.1996

***, **,*, Indicates significant at α = 0.001, 0.01, 0.05, 0.1 level respectively

Profitability of shareholder's equity is higher in case of companies with higher intellectual capital. Increase of VAIC™ by 1 unit will cause increase of ROE by 1.5456 percent. HCE and SCE have shown to be statistically significant on 5 percent significance level. However, increase of CEE by 1 percent will cause decrease of ROE by 0.5215 percent. Models explaining MB and ROA suffer from heteroscedasticity. As a consequence, OLS estimators and regression predictions are no longer efficient, and tests of hypotheses are no more valid. We have used heteroscedasticity and autocorrelation consistent (HAC) or "robust" covariance matrix in order to calculate more accurate values of estimated parameters (den Haan and Levin, 1997). Table 4 shows the estimates, associated standard errors, test statistics and p-values drawn after application of "coeftest".

Table 4. Regression analysis estimates after performed adjustments

	Model MB1	Model MB2	Model ROA1	Model ROA2
	Estimate	Estimate	Estimate	Estimate
Intercept 2013	-0.130395	-0.407806	1.002719***	1.002075***
Intercept 2014	2.52372***	2.640843***	-0.0183***	-0.058302***
Intercept 2015	-0.130395	-0.407806	1.002719	1.002075
VAIC^{TM}	0.074851	-	0.023114	-
HCE	-	-0.066235	-	0.120518.
SCE	-	-0.166105	-	0.079213.
CEE	-	0.167976	-	-0.049785

***, **,*, Indicates significant at $\alpha = 0.001, 0.01, 0.05, 0.1$ level respectively

After performed adjustments, Models MB1 and MB2 show no statistically significant effect of VAIC^{TM} and its components on MB ratio. The hypothesis that difference between market value and book value is caused by intellectual capital was rejected. This is the same result as those of Ståhle et al. (2011), Chu et al. (2011) or Gan and Saleh (2008). According to model ROA1, we are not able to explain productivity measured by ROA by changes in aggregated VAIC^{TM}. However, the positive effect of HCE and SCE on ROA is significant on 10% significant level (Model ROA2).

Research Implications

Being aware of value of intellectual capital is important feature of corporate management. It is important to remember that intangible assets only create value in connection with tangible assets. However, their effect can be multiplied in case, that intangible assets are managed properly. Our paper investigates contribution of intangible assets to the value of a selected group of indicators and provides information to managers on what they need to focus on when trying to meet desired financial and productivity objectives. On the selected sample of EU companies, significant relationship between the VAIC components and the efficiency of the capital investment represented by ROE, ROA as well as the efficiency of the company’s labour represented by employees’ productivity indicators has been observed and indicated. Unfortunately the results do not support the hypothesis that VAIC is in clear connection with a company’s stock market value, what can cast doubt on the VAIC as a proper measure of intellectual capital, at least from the value perspective view. The result is very important because the method is widely used in micro as well as macro analyses and this is one of the first rigorous scientific analyses in which this kind of method has been implemented.

Summary

As the result of our findings, we can generally conclude that VAIC^{TM} components are able to explain profitability measured by ROE and ROA as well as they have statistically significant effect on productivity of employees. However both, aggregated VAIC™ and its components fail to explain market to book value ratio. Output of an analysis also implies that structure of intellectual capital efficiency (HCE and SCE) has significantly positive effect on company's profitability and employees' productivity. Our study is applied on limited number of companies from only one industrial sector with data within last three years. Moreover, this study has limitations resulting from limitations of VAIC™ model mentioned above. However, VAIC™ model is still developing method and it can be considered as relatively easily obtainable measurement of intellectual capital based on available information from financial statements.

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WPŁYW WSPÓŁCZYNNIKA INTELEKTUALNEJ WARTOŚCI DODANEJ I JEGO SKŁADNIKÓW NA OGÓLNĄ PRODUKTYWNOŚĆ WYBRANYCH EUROPEJSKICH PRZEDSIĘBIORSTW

Streszczenie: Niniejszy artykuł omawia kapitał intelektualny jako jedną z kluczowych determinant konkurencyjności przedsiębiorstw i ich przyszłego rozwój. Celem niniejszego badania jest określenie wpływu kapitału intelektualnego mierzonego poprzez współczynnik intelektualnej wartości dodanej (VAIC^{TM}) w wybranych europejskich przedsiębiorstwach,

w celu empirycznego oszacowania zależności między wydajnością kapitału intelektualnego a ogólną produktywnością przedsiębiorstw oraz zbadania roli różnych składników kapitału intelektualnego. Kapitał intelektualny ma istotny wpływ na ROE oraz produktywność pracowników, ale przeprowadzona analiza rzuca cień wątpliwości na matodę VAIC jako właściwą miarę kapitału intelektualnego, przynajmniej z punktu widzenia wartości.
Słowa kluczowe: gospodarka opartej na wiedzy, kapitał intelektualny, VAIC^{TM}, produktywność przedsiębiorstwa, producent oprogramowania

價值增加的知識系統及其組成部分對所選歐洲公司整體業績的影響

摘要：本文討論了知識資本作為企業競爭力和未來發展的關鍵決定因素之一。
這項研究的目的是確定在增值智力係數（VAIC^{TM}）在選定的歐洲公司
衡量的知識資本的表現，以實證估計智力資本表現與這些公司的整體績效之間的關係，並檢查各種智力資本組成部分。智力資本顯示對ROE和員工生產力有重大影響，但分析引起了對VAIC作為智力資本的適當衡量的懷疑，至少從價值觀的角度來看
關鍵詞：知識經濟，智力資本，VAIC^{TM}，公司績效，軟件公司